

IBPS Question Bank

Chapter 5 — Computer Aptitude / Knowledge

630 questions | 30 subtopics

Easy / Moderate / Difficult | with worked solutions

How this was produced, and how far it has been checked. These questions were machine-generated against the IBPS syllabus breakdown. Every question was then re-solved by a second, independent pass that did not see the proposed answer, and anything it flagged was re-worked by a third pass. In this chapter 29 of 30 subtopics (97%) completed that check; any marked [unchecked] below did not, and should be treated as a draft.

Across the whole bank the checker flagged **285 of 3,948 questions (7.2%)**, and 149 subtopics were revised as a result. The largest categories were near-duplicate questions within a subtopic (34%) and a faulty explanation attached to an otherwise correct answer (22%); genuinely wrong answer keys were 9%. The counts in each subtopic heading show what was flagged there *before* repair.

This is a strong check, not a proof. Both passes are the same kind of system and can share a blind spot, so a surviving error is likelier in the places machines agree wrongly — fine detail in Computer Knowledge, and judgement calls in English usage. Re-solve any answer you dispute rather than trusting the key, and please report anything that still looks wrong.

Section 5.1

5.1.1 History and generations of computers

[checked, 3 flagged]

1. Rohan Mehta, a newly recruited clerk, is attending an induction class at his bank. The trainer asks the batch to name the scientist who is universally known as the “Father of the Computer” for designing the Analytical Engine. The correct name is: [Easy]

- | | |
|---------------------|----------------------|
| (A) Blaise Pascal | (D) John von Neumann |
| (B) Charles Babbage | (E) Herman Hollerith |
| (C) Alan Turing | |

2. The main electronic component used in the first generation of computers was: [Easy]

- | | |
|-----------------------------|--------------------|
| (A) Transistor | (D) Microprocessor |
| (B) Integrated Circuit (IC) | (E) None of these |
| (C) Vacuum tube | |

3. Integrated Circuits (ICs) were used for the first time as the basic building block in computers of the: [Easy]

- | | |
|-----------------------|-----------------------|
| (A) First generation | (D) Fourth generation |
| (B) Second generation | (E) Fifth generation |
| (C) Third generation | |

4. The Intel 4004, released in 1971, is regarded as the world’s first microprocessor. Computers built around a microprocessor belong to which generation? [Easy]

- (A) Second generation
- (B) Third generation
- (C) Fourth generation
- (D) Fifth generation
- (E) None of these

5. Fifth generation computers are chiefly associated with the development of: [Easy]

- (A) Vacuum tube circuits
- (B) Artificial Intelligence
- (C) Punched card input
- (D) Magnetic drum memory
- (E) Discrete transistors

6. The abacus, regarded as the earliest known calculating device, was first developed in: [Easy]

- (A) India
- (B) China
- (C) Greece
- (D) Egypt
- (E) Japan

7. The person credited with being the world's first computer programmer, for writing the algorithm intended for Babbage's Analytical Engine, is: [Easy]

- (A) Grace Hopper
- (B) Ada Lovelace
- (C) Dennis Ritchie
- (D) Charles Babbage
- (E) None of these

8. A bank's IT trainer writes four switching technologies on the board: (i) Integrated Circuit, (ii) Microprocessor, (iii) Transistor, (iv) Vacuum tube. Arranged in the chronological order in which they first became the basis of computers (earliest first), the correct sequence is: [Moderate]

- (A) (iv), (iii), (i), (ii)
- (B) (iv), (i), (iii), (ii)
- (C) (iii), (iv), (ii), (i)
- (D) (i), (iv), (iii), (ii)
- (E) (iv), (iii), (ii), (i)

9. Which of the following pairs of "generation – main memory technology" is correctly matched? [Moderate]

- (A) First generation – Magnetic core memory
- (B) Second generation – Magnetic drum
- (C) Third generation – Punched cards only
- (D) First generation – Magnetic drum
- (E) Fourth generation – Vacuum tube memory

10. The transistor, which replaced the bulky vacuum tube and gave rise to the second generation of computers, was invented in 1947 at Bell Laboratories by: [Moderate]

- (A) Jack Kilby and Robert Noyce
- (B) John Bardeen, Walter Brattain and William Shockley
- (C) J. Presper Eckert and John Mauchly
- (D) Howard Aiken and Grace Hopper
- (E) None of these

11. Which one of the following is NOT a characteristic of second generation computers? [Moderate]

- (A) Use of transistors in place of vacuum tubes
- (B) Use of assembly language and early high-level languages such as FORTRAN and COBOL
- (C) Lower power consumption and smaller size than first generation machines
- (D) Use of integrated circuits as the basic switching element
- (E) Use of magnetic core memory as the main memory

12. Which of the following is regarded as the first computer designed and built indigenously in India, developed at the Tata Institute of Fundamental Research and commissioned in 1960? [Moderate]

- (A) PARAM 8000
- (B) HEC-2M
- (C) TIFRAC
- (D) IBM 1401
- (E) None of these

13. Built at the University of Cambridge in 1949, which machine is regarded as the first full-scale, practical electronic computer to operate on the stored-program principle? [Moderate]

- (A) ENIAC
- (B) EDSAC
- (C) UNIVAC-I
- (D) Harvard Mark I
- (E) Atanasoff-Berry Computer

14. Herman Hollerith's punched-card tabulating machine is an important landmark in computing history. Which of the following statements about it is correct? [Moderate]

- (A) It was an electronic stored-program computer used in the 1890 US census
- (B) It processed the 1890 US census data using punched cards, and Hollerith's company later grew into IBM
- (C) It was designed by Charles Babbage and completed by Ada Lovelace
- (D) It was the first machine to use integrated circuits for data processing
- (E) It was built at Bell Laboratories after the invention of the transistor

15. Match List-I with List-II and choose the correct combination.

List-I: (a) First generation, (b) Second generation, (c) Third generation, (d) Fourth generation.

List-II: (i) Assembly language with magnetic core memory, (ii) Machine (binary) language with magnetic drum memory, (iii) VLSI chips with graphical user interface software, (iv) Integrated circuits with time-sharing and multiprogramming operating systems. [Difficult]

- (A) a-ii, b-i, c-iv, d-iii
- (B) a-i, b-ii, c-iii, d-iv
- (C) a-ii, b-i, c-iii, d-iv
- (D) a-iii, b-iv, c-i, d-ii
- (E) a-i, b-ii, c-iv, d-iii

16. Five milestones of computing are listed: (i) ENIAC becomes operational, (ii) Pascal builds the Pascaline adding machine, (iii) Intel releases the 4004 microprocessor, (iv) Babbage designs the Analytical Engine, (v) Hollerith's tabulating machine processes the US census. If these are arranged in chronological order (earliest first), which milestone occupies the THIRD position? [Difficult]

- (A) (i)
- (B) (ii)
- (C) (iii)
- (D) (iv)
- (E) (v)

17. Consider the following statements.

I. ENIAC used vacuum tubes and was programmed by rewiring and setting switches rather than by a

stored program.

II. The transistor replaced the vacuum tube as the basic switching element in third generation computers.

III. ULSI (Ultra Large Scale Integration) technology is associated with fifth generation computers.

Which of the statements is/are correct?

[Difficult]

- (A) Only I
- (B) Only I and II
- (C) Only I and III
- (D) Only II and III
- (E) All of I, II and III

18. Which one of the following “computer – generation” pairs is INCORRECTLY matched? [Difficult]

- (A) IBM 1401 – Second generation
- (B) IBM System/360 – Third generation
- (C) Apple Macintosh – Fourth generation
- (D) ENIAC – First generation
- (E) PDP-8 – Fourth generation

19. Which of the following statements correctly brings out the difference between Babbage’s Difference Engine and his Analytical Engine? [Difficult]

- (A) The Difference Engine was electronic while the Analytical Engine was mechanical
- (B) The Difference Engine could be programmed with punched cards while the Analytical Engine could not
- (C) The Analytical Engine had a separate “store” and “mill” and could be programmed with punched cards, making it the first design of a general-purpose programmable computer
- (D) Both machines were completed and sold commercially in Babbage’s lifetime
- (E) The Analytical Engine used vacuum tubes for arithmetic while the Difference Engine used gears

20. Consider the following features: I. ULSI technology, II. Parallel processing, III. Programming mainly in binary machine language, IV. Natural language understanding and expert systems. Which of these are correctly attributed to fifth generation computers? [Difficult]

- (A) Only I and II
- (B) Only II and IV
- (C) Only I, II and IV
- (D) Only I, III and IV
- (E) All of I, II, III and IV

21. In a bank’s computer awareness quiz, Priya Nair is asked: “ENIAC, the first general-purpose electronic computer, was publicly unveiled in 1946, and the first microprocessor, the Intel 4004, was released in 1971. If the third generation of computers is taken to have begun in 1964, then by how many years did the gap between ENIAC and the Intel 4004 exceed the gap between ENIAC and the start of the third generation?” [Difficult]

- (A) 5 years
- (B) 7 years
- (C) 9 years
- (D) 11 years
- (E) None of these

5.1.2 Classification and types of computers

[checked, 2 flagged]

22. The PARAM series of supercomputers, widely used in Indian research institutions, was developed by which organisation? [Easy]

- (A) C-DAC (Centre for Development of Advanced Computing)

- (B) ISRO (Indian Space Research Organisation)
- (C) NAL (National Aerospace Laboratories)
- (D) BARC (Bhabha Atomic Research Centre)
- (E) None of these

23. Computers may be classified on the basis of the principle of operation, i.e. the manner in which data is handled. Which of the following is NOT a type under this classification? [Easy]

- (A) Analog computer
- (B) Digital computer
- (C) Hybrid computer
- (D) Mainframe computer
- (E) None of these

24. A device that works by measuring a continuously varying physical quantity, such as a speedometer or a mercury thermometer, is an example of which type of computing device? [Easy]

- (A) Digital computer
- (B) Analog computer
- (C) Hybrid computer
- (D) Mainframe computer
- (E) Supercomputer

25. Shri Ramesh Iyer, a clerk at a bank branch in Nagpur, works on an ordinary desktop PC at his counter. Under classification by size and capability, this desktop PC is a [Easy]

- (A) Minicomputer
- (B) Mainframe computer
- (C) Microcomputer
- (D) Supercomputer
- (E) None of these

26. The single, very large, highly reliable central machine at a nationalised bank's data centre that keeps every customer account and simultaneously serves thousands of branch terminals and ATMs is best classified as a [Easy]

- (A) Microcomputer
- (B) Mainframe computer
- (C) Analog computer
- (D) Workstation
- (E) None of these

27. In the ICU of a hospital, an instrument continuously senses a patient's blood pressure as a varying electrical signal, converts it into numeric form and then processes and displays it on a screen. Such an instrument is an example of a [Easy]

- (A) Purely analog computer
- (B) Purely digital computer
- (C) Hybrid computer
- (D) Supercomputer
- (E) None of these

28. The processing speed of a supercomputer is normally expressed in [Easy]

- (A) BPS (bits per second)
- (B) DPI (dots per inch)
- (C) FLOPS (floating point operations per second)
- (D) Hertz only
- (E) None of these

29. Arrange the following four categories of computers in INCREASING order of processing capability: (i) Mainframe computer, (ii) Microcomputer, (iii) Supercomputer, (iv) Minicomputer. [Moderate]

- (A) (ii), (iv), (i), (iii)
- (B) (ii), (i), (iv), (iii)
- (C) (iv), (ii), (i), (iii)
- (D) (iii), (i), (iv), (ii)
- (E) None of these

30. A supercomputer installed at a research centre is rated at 3 petaflops. Expressed in floating point operations per second, this is [Moderate]

- (A) 3×10^9
- (B) 3×10^{12}
- (C) 3×10^{15}
- (D) 3×10^{18}
- (E) None of these

31. Which one of the following statements about a hybrid computer is correct? [Moderate]

- (A) It is a digital computer that has been fitted with an extra hard disk
- (B) It combines an analog section that measures continuous physical quantities with a digital section that processes the converted data
- (C) It is any computer that can run two different operating systems
- (D) It is a mainframe that also serves as a supercomputer at night
- (E) None of these

32. A single-user computer with a very powerful processor, large RAM and a high-end graphics sub-system, used by one architect for 3D building design, is best described as a [Moderate]

- (A) Workstation
- (B) Mainframe computer
- (C) Analog computer
- (D) Minicomputer
- (E) None of these

33. The controller inside a modern washing machine, which runs one fixed program written permanently into its memory and cannot be used for any other task, is best described as a [Moderate]

- (A) General purpose analog computer
- (B) General purpose digital microcomputer
- (C) Special purpose embedded digital computer
- (D) Minicomputer
- (E) None of these

34. In the client-server arrangement used in a bank branch, which of the following statements about the server is correct? [Moderate]

- (A) A server must always be a supercomputer
- (B) A server is a computer that provides shared resources and services to other computers called clients on the network
- (C) A server is always an analog computer because it handles continuous traffic
- (D) A server can never be accessed by more than one client at a time
- (E) None of these

35. Which of the following is NOT a recognised basis for classifying computers? [Moderate]

- (A) Size and processing capability
- (B) Purpose (general purpose or special purpose)
- (C) Principle of operation (analog, digital or hybrid)
- (D) Brand name of the manufacturer

(E) None of these

36. Which one of the following statements regarding the classification of computers is FALSE?[Difficult]

- (A) Every supercomputer in use today is a digital computer
- (B) A microcomputer is one whose entire central processing unit is contained in a single microprocessor chip
- (C) A hybrid computer contains both analog and digital components
- (D) Mainframes and supercomputers are both classified by size and processing capability
- (E) A mainframe is classified as a supercomputer merely because both are physically large machines

37. Consider the following statements about the classification of computers by PURPOSE. (I) A general purpose computer can be programmed to carry out many different kinds of task, whereas a special purpose computer is designed and built to carry out one predetermined task. (II) A special purpose computer must always be analog in its principle of operation. (III) The purpose-based classification is independent of the size-based classification, so special purpose machines range from a tiny appliance controller up to a very large machine dedicated to a single application. Which of the statements is/are correct? [Difficult]

- (A) Only (II)
- (B) Only (I) and (II)
- (C) Only (I) and (III)
- (D) All of (I), (II) and (III)
- (E) None of these

38. The mainframe at a bank's data centre can process 12,000 transactions per second. Assuming it works at full load through an 8-hour banking day, the total number of transactions processed in that day is [Difficult]

- (A) 3.456×10^6
- (B) 3.456×10^7
- (C) 3.456×10^8
- (D) 3.456×10^9
- (E) None of these

39. A supercomputer sustains 2 petaflops. The time it will take to complete a simulation requiring 10^{17} floating point operations is approximately [Difficult]

- (A) 5 seconds
- (B) 20 seconds
- (C) 50 seconds
- (D) 200 seconds
- (E) None of these

40. Match List I with List II and select the correct answer using the codes given below. List I: (i) Supercomputer (ii) Mainframe (iii) Minicomputer (iv) Microcomputer. List II: (P) Numerical weather prediction at a national meteorological centre (Q) Centralised core banking server of a nationalised bank (R) Departmental production-control system of a mid-sized manufacturing unit (S) Desktop used by a single clerk at a branch counter. [Difficult]

- (A) (i)-P, (ii)-Q, (iii)-R, (iv)-S
- (B) (i)-Q, (ii)-P, (iii)-S, (iv)-R
- (C) (i)-P, (ii)-R, (iii)-Q, (iv)-S
- (D) (i)-S, (ii)-R, (iii)-Q, (iv)-P
- (E) None of these

41. Consider the following statements. (I) Analog computers operate on continuously varying physical quantities. (II) Analog computers generally give greater numerical precision than digital computers. (III) In a hybrid computer, analog input is converted into digital form before being processed. Which of the statements is/are correct? [Difficult]

- (A) Only (I)
- (B) Only (I) and (III)
- (C) Only (II) and (III)
- (D) All of (I), (II) and (III)
- (E) None of these

42. An ATM deployed by a bank runs only the fixed set of banking functions written into it and is built around a processor embedded inside the machine. In terms of classification of computers, an ATM is best described as a [Difficult]

- (A) General purpose digital mainframe computer
- (B) Special purpose analog computer
- (C) Special purpose digital computer built around an embedded microprocessor
- (D) Hybrid computer, because currency notes are a continuously varying quantity
- (E) None of these

5.1.3 Number systems: binary, octal, decimal, hexadecimal; conversions [checked, 2 flagged]

43. During a computer awareness session at the Coimbatore branch, the trainer writes the binary number $(101101)_2$ on the board and asks Priya Nair to state its decimal equivalent. The correct value is: [Easy]

- (A) 43
- (B) 45
- (C) 47
- (D) 49
- (E) None of these

44. A bank's ATM logs a transaction counter value of 58 in decimal. The system stores it in binary. The binary equivalent of $(58)_{10}$ is: [Easy]

- (A) $(110110)_2$
- (B) $(101110)_2$
- (C) $(111010)_2$
- (D) $(111100)_2$
- (E) None of these

45. The hexadecimal number $(2F)_{16}$ appears in a colour code used on a bank's website. Its decimal equivalent is: [Easy]

- (A) 45
- (B) 31
- (C) 51
- (D) 47
- (E) None of these

46. Anil Kumar, a probationary officer, is asked to convert the octal number $(347)_8$ into decimal. The value he should obtain is: [Easy]

- (A) 231
- (B) 213
- (C) 229
- (D) 247
- (E) None of these

47. A trainee at the IT desk has written down five numbers, each claimed to be an octal number. Exactly one of them cannot be a valid octal number. Which one is it? [Easy]

- (A) $(345)_8$
- (B) $(706)_8$
- (C) $(218)_8$

- (D) $(177)_8$
- (E) $(640)_8$

48. A cheque batch of 200 instruments is numbered internally in hexadecimal. The hexadecimal equivalent of $(200)_{10}$ is: [Easy]

- (A) $(B8)_{16}$
- (B) $(D8)_{16}$
- (C) $(C6)_{16}$

- (D) $(C8)_{16}$
- (E) None of these

49. The binary string $(110101)_2$ read from a status register has to be reported in octal. The octal equivalent is: [Easy]

- (A) $(65)_8$
- (B) $(56)_8$
- (C) $(55)_8$

- (D) $(63)_8$
- (E) None of these

50. Two binary counters in a bank's server hold the values $(1011)_2$ and $(1101)_2$. When the two values are added, the sum expressed in binary is: [Moderate]

- (A) $(10110)_2$
- (B) $(11010)_2$
- (C) $(11000)_2$

- (D) $(10100)_2$
- (E) None of these

51. A memory address byte is recorded as $(3A)_{16}$. Sunita Rao is asked to express the same quantity in octal. The correct octal form is: [Moderate]

- (A) $(62)_8$
- (B) $(72)_8$
- (C) $(58)_8$

- (D) $(65)_8$
- (E) None of these

52. Four values recorded in different number systems are shown below. Which of them represents the largest quantity? [Moderate]

- (A) $(10110)_2$
- (B) $(26)_8$
- (C) $(23)_{10}$

- (D) $(1A)_{16}$
- (E) None of these

53. In a diagnostic exercise a clerk is asked to evaluate $(11010)_2 - (1011)_2$ and report the result in binary. The correct answer is: [Moderate]

- (A) $(10001)_2$
- (B) $(1101)_2$
- (C) $(1111)_2$

- (D) $(11110)_2$
- (E) None of these

54. A two-digit number is written as 24 in some base b , and its value in decimal is 20. The base b is: [Moderate]

- (A) 9
(B) 8
(C) 7
- (D) 6
(E) None of these

55. An interest factor stored by a system is 0.625 in decimal. Its exact binary representation is:
[Moderate]

- (A) $(0.110)_2$
(B) $(0.011)_2$
(C) $(0.111)_2$
- (D) $(0.1001)_2$
(E) None of these

56. The product $(101)_2 \times (110)_2$, expressed in binary, is: [Moderate]

- (A) $(11110)_2$
(B) $(11100)_2$
(C) $(10110)_2$
- (D) $(11010)_2$
(E) None of these

57. A processor in a bank's cheque-sorting machine stores signed integers in 8-bit two's complement form. The representation stored for the value -45 is: [Difficult]

- (A) $(10101101)_2$
(B) $(11010010)_2$
(C) $(11010011)_2$
- (D) $(11011011)_2$
(E) None of these

58. While debugging a memory dump, an officer must compute $(A7)_{16} + (5B)_{16}$ and record the sum in hexadecimal. The sum is: [Difficult]

- (A) $(102)_{16}$
(B) $(1F2)_{16}$
(C) $(FE)_{16}$
- (D) $(112)_{16}$
(E) None of these

59. A numeral is written as 144 in an unknown base b , and the same quantity equals 49 in decimal. The value of b is: [Difficult]

- (A) 7
(B) 6
(C) 5
- (D) 8
(E) None of these

60. The octal number $(57.4)_8$ has to be converted into hexadecimal for a technical report. The correct hexadecimal form is: [Difficult]

- (A) $(2F.4)_{16}$
(B) $(2F.8)_{16}$
(C) $(3F.8)_{16}$
- (D) $(2E.8)_{16}$
(E) None of these

61. A branch processes exactly 1000 vouchers in a day and the figure is stored in binary. The number of 1s appearing in the binary representation of $(1000)_{10}$ is: [Difficult]

- (A) 4
- (B) 5
- (C) 7
- (D) 8
- (E) None of these

62. A 16-bit register in a bank's core banking server holds the pattern $(1011011000101111)_2$. The same content written in hexadecimal is: [Difficult]

- (A) $(B26F)_{16}$
- (B) $(A62F)_{16}$
- (C) $(B63F)_{16}$
- (D) $(B62F)_{16}$
- (E) None of these

63. An audit tool prints ledger totals in an unfamiliar base b , and on one page the addition $(23)_b + (14)_b = (42)_b$ is shown as a correct calculation. The base b being used is: [Difficult]

- (A) 5
- (B) 6
- (C) 7
- (D) 8
- (E) None of these

5.1.4 Logic gates

[checked, 1 flagged]

64. During a training session at the IT cell of Punjab National Bank, Anjali Deshmukh is shown a gate whose output is 1 (HIGH) only when every one of its inputs is 1, and 0 in all other cases. The gate being demonstrated is: [Easy]

- (A) OR gate
- (B) NOR gate
- (C) XOR gate
- (D) AND gate
- (E) NAND gate

65. A 2-input XOR (Exclusive-OR) gate produces an output of 1 when: [Easy]

- (A) both the inputs are 0
- (B) both the inputs are 1
- (C) the two inputs are different from each other
- (D) the two inputs are the same as each other
- (E) None of these

66. Which one of the following logic gates has only ONE input terminal and one output terminal, and is therefore also called an inverter? [Easy]

- (A) AND gate
- (B) OR gate
- (C) NOT gate
- (D) NAND gate
- (E) XOR gate

67. In a 2-input NAND gate, the output is LOW (that is, 0) only when: [Easy]

- (A) both the inputs are LOW
- (B) both the inputs are HIGH
- (C) exactly one input is HIGH
- (D) the two inputs are different
- (E) None of these

68. In digital electronics, the two gates that are called UNIVERSAL gates, because any other logic gate can be built using only copies of either one of them, are: [Easy]

- (A) AND and OR
(B) NAND and NOR
(C) NOT and AND
- (D) XOR and XNOR
(E) OR and NOT

69. A logic gate used in a bank's cheque-sorting machine has 3 input lines. The number of rows in the complete truth table of this gate is: [Easy]

- (A) 3
(B) 6
(C) 8
- (D) 9
(E) 16

70. According to the complement law of Boolean algebra, the value of $A + \overline{A}$ is: [Easy]

- (A) 0
(B) 1
(C) A
- (D) $\overline{A}$
(E) None of these

71. Karthik Iyer, a systems officer, connects a 2-input NAND gate in a locker-monitoring panel. Out of the four possible input combinations of the two lines, the number of combinations for which the NAND output is 1 is: [Moderate]

- (A) 0
(B) 1
(C) 2
- (D) 3
(E) 4

72. A 3-input XOR gate is fed by three sensor lines in an ATM tamper circuit. Out of the eight possible input combinations, the number of combinations for which the output is 1 is: [Moderate]

- (A) 2
(B) 3
(C) 4
- (D) 5
(E) None of these

73. By De Morgan's first theorem, the expression $\overline{A + B}$ is equivalent to: [Moderate]

- (A) $\overline{A} + \overline{B}$
(B) $\overline{A} \cdot \overline{B}$
(C) $A \cdot B$
- (D) $A + B$
(E) None of these

74. In a circuit board, the two input terminals of a single NAND gate are shorted together and the same signal A is applied to both. The gate now behaves exactly like a: [Moderate]

- (A) AND gate
(B) OR gate
(C) NOT gate
- (D) XOR gate
(E) NOR gate

75. The outputs of a 2-input XOR gate and the input line A are fed to a 2-input AND gate, so that $Z = (A \oplus B) \cdot A$. The simplified expression for Z is: [Moderate]

- (A) A (D) $\overline{A}B$
 (B) B (E) $A + B$
 (C) $A\overline{B}$

76. Using the absorption law of Boolean algebra, the expression $A + AB$ simplifies to: [Moderate]

- (A) A (D) $A + B$
 (B) B (E) None of these
 (C) AB

77. A currency-verification machine at a Bank of Baroda branch compares two counters and lights a “MATCH” lamp only when the two counter bits are identical, that is, the lamp glows for the input pairs (0, 0) and (1, 1) and stays off for (0, 1) and (1, 0). The gate used is: [Moderate]

- (A) NOR gate (D) XNOR gate
 (B) XOR gate (E) None of these
 (C) NAND gate

78. The minimum number of 2-input NAND gates required to implement the Exclusive-OR (XOR) function is: [Difficult]

- (A) 3 (D) 6
 (B) 4 (E) None of these
 (C) 5

79. A logic network built by an IT officer realises the function $F = \overline{\overline{A} \cdot \overline{B}} + \overline{A + B}$. The simplified value of F is: [Difficult]

- (A) 0 (D) $A \oplus B$
 (B) 1 (E) $\overline{A} \cdot \overline{B}$
 (C) $A + B$

80. A three-variable control network in a core-banking server realises the function $F = (A+B) \cdot (\overline{A}+C)$. The fully simplified expression for F is: [Difficult]

- (A) $AC + \overline{A}B$ (D) ABC
 (B) $AB + \overline{A}C$ (E) None of these
 (C) $A + B + C$

81. The Boolean function $F = AB + A\overline{B} + \overline{A}B$ implemented on a branch server’s access circuit is equivalent to a single: [Difficult]

- (A) A only (D) $A + B$
 (B) B only (E) $A \oplus B$
 (C) AB

82. A bank’s automated loan-screening logic clears a file when either (i) the CIBIL flag C and the income flag I are both 1, or (ii) the collateral flag L is 1 while the past-default flag D is 0. Thus $F = C \cdot I + L \cdot \overline{D}$. Out of the 16 possible combinations of the four flags, the number for which the file is cleared is: [Difficult]

- (A) 6
- (B) 7
- (C) 8
- (D) 9
- (E) None of these

83. While designing a board using a single type of chip, an engineer needs to realise a 2-input OR function using 2-input NAND gates only. The minimum number of NAND gates required is: [Difficult]

- (A) 1
- (B) 2
- (C) 4
- (D) 5
- (E) None of these

84. In a test circuit the outputs of a 2-input NAND gate and a 2-input NOR gate, both driven by the same inputs A and B , are fed into a third gate which is a 2-input NOR gate. The overall circuit $Y = \overline{(AB)} + \overline{(A + B)}$ is equivalent to a single: [Difficult]

- (A) AND gate
- (B) OR gate
- (C) XOR gate
- (D) NAND gate
- (E) NOR gate

Section 5.2

5.2.1 Input devices

[checked, 3 flagged]

85. At a branch of Punjab National Bank, cheques deposited at the counter are passed through a machine that reads the string of numbers printed along the bottom edge of each cheque in special magnetic ink. The input technology used by this machine is: [Easy]

- (A) OMR (Optical Mark Reader)
- (B) OCR (Optical Character Reader)
- (C) MICR (Magnetic Ink Character Recognition)
- (D) Bar code reader
- (E) None of these

86. During a computer awareness class for IBPS Clerk aspirants, the faculty asks the students to identify the odd one out. Which of the following is NOT an input device? [Easy]

- (A) Joystick
- (B) Light pen
- (C) Plotter
- (D) Trackball
- (E) Bar code reader

87. On a standard QWERTY computer keyboard, the keys labelled $F1$ to $F12$ placed in a row at the top are called function keys. Their total number is: [Easy]

- (A) 8
- (B) 10
- (C) 12
- (D) 14
- (E) 16

88. A regional office purchases a flat-bed scanner to digitise old loan files. The scanning quality, or resolution, of such a scanner is measured in: [Easy]

- (A) Hertz (Hz)
- (B) DPI (dots per inch)
- (C) BPS (bits per second)
- (D) PPM (pages per minute)
- (E) None of these

89. In a recruitment test conducted by a bank, candidates darken circles with an HB pencil on a printed answer sheet. These sheets are later fed into a machine that senses which circles have been darkened and awards marks. This machine is a: [Easy]

- (A) Magnetic ink character reader
- (B) Optical mark reader
- (C) Digitiser
- (D) Web camera
- (E) None of these

90. A trackball fitted on the customer-service terminal of a bank branch is best described as: [Easy]

- (A) A mouse turned upside down, in which the user rotates the exposed ball with the fingers while the body stays stationary
- (B) A pen-shaped device that is touched to the screen to select an item
- (C) A pressure-sensitive rectangular pad on which the user slides a fingertip
- (D) A device that reads the magnetic strip of an ATM card
- (E) A device that converts printed text into editable text

91. Which of the following devices is used to enter voice or sound into a computer, for example while recording a customer's telephonic consent? [Easy]

- (A) Speaker
- (B) Microphone
- (C) Woofer
- (D) Headphone
- (E) Monitor

92. The characters of the MICR band printed at the bottom of Indian bank cheques are drawn in a special typeface whose thick and thin strokes produce a distinctive magnetic waveform for each character. The font standard adopted in India is: [Moderate]

- (A) OCR-A
- (B) CMC-7
- (C) E-13B
- (D) Courier New
- (E) None of these

93. A bank has 40,000 old loan application forms that were filled in on a typewriter. The management wants them not merely photographed but converted into text files that a clerk can later edit and search in a word processor. The most suitable input technology is: [Moderate]

- (A) A scanner used alone, saving each page as an image
- (B) A scanner together with OCR software
- (C) An OMR reader
- (D) An MICR reader-sorter
- (E) A digital camera

94. Small shopkeepers in Coimbatore display a square black-and-white pattern at the counter which customers scan with a mobile phone camera to make a UPI payment. Compared with an ordinary one-dimensional bar code, this pattern: [Moderate]

- (A) Stores data only along its horizontal axis and hence holds less information

- (B) Stores data along both the horizontal and the vertical axes and hence holds much more information
- (C) Can be read only by a laser scanner and never by a camera
- (D) Contains no error-correction information at all
- (E) None of these

95. A Bank Mitra operating a micro-ATM in a village under the Aadhaar Enabled Payment System (AEPS) allows a customer to withdraw Rs. 2,000 after the customer places a thumb on a small device and the identity is verified online. That device is an example of: [Moderate]

- (A) An output device, because it displays the verification result
- (B) A biometric input device
- (C) A storage device, because it stores the customer's thumb impression permanently
- (D) A magnetic stripe reader
- (E) None of these

96. A public information kiosk installed outside a bank branch has a touch screen that responds correctly even when a customer operates it wearing woollen gloves or using the blunt end of a plastic pen. The technology of this touch screen is most likely: [Moderate]

- (A) Capacitive, because it senses the electrical charge of the human body
- (B) Resistive, because it senses the physical pressure that presses two conductive layers together
- (C) Infrared, because it requires the finger to be warm
- (D) Optical character recognition
- (E) None of these

97. A toggle key is one which switches a setting alternately on and off each time it is pressed. Which of the following keys on a standard keyboard is NOT a toggle key? [Moderate]

- (A) Caps Lock
- (B) Num Lock
- (C) Scroll Lock
- (D) Insert
- (E) Shift

98. A currency-chest register measuring 8 inches by 10 inches is scanned at a resolution of 300 dots per inch. The total number of pixels in the resulting image is: [Moderate]

- (A) 24,000
- (B) 7,20,000
- (C) 24,00,000
- (D) 72,00,000
- (E) None of these

99. The web camera fitted at a bank's video-KYC desk captures frames of 640 pixels by 480 pixels in 24-bit colour at 15 frames per second, and the raw feed is held for one second before compression. The amount of data captured in that one second is: [Difficult]

- (A) 3,07,200 bytes
- (B) 9,21,600 bytes
- (C) 46,08,000 bytes
- (D) 1,38,24,000 bytes
- (E) None of these

100. An EAN-13 bar code has 12 data digits followed by one check digit. The check digit is found by adding the digits in the odd positions (1st, 3rd, ..., 11th), adding three times the sum of the digits in the even positions (2nd, 4th, ..., 12th), and choosing the digit that makes the grand total a multiple of 10. For a carton whose first twelve digits are 890123456789, the check digit is: [Difficult]

- (A) 0 (D) 6
(B) 2 (E) 8
(C) 4

101. A bank's examination cell has to evaluate 7,200 OMR answer sheets. It runs 3 identical OMR scanners simultaneously, each of which processes 40 sheets per minute. Assuming the machines run without any break, the total time taken to finish all the sheets is: [Difficult]

- (A) 30 minutes (D) 90 minutes
(B) 45 minutes (E) 180 minutes
(C) 60 minutes

102. A data-entry operator at a service branch keys in account-opening forms at a steady rate of 12,000 keystrokes per hour. Each form requires 250 keystrokes. In a shift of 7 hours that includes a single break of 30 minutes, the number of complete forms the operator can key in is: [Difficult]

- (A) 288 (D) 324
(B) 300 (E) 336
(C) 312

103. Consider the following statements about direct data-entry devices.

- (i) MICR is highly reliable and fast but can recognise only a small fixed set of characters.
(ii) OMR detects the presence or absence of a mark at a predetermined position rather than the shape of a character.
(iii) A bar code reader is an output device because it displays the price of the article.

Which of the statements is/are correct?

[Difficult]

- (A) Only (i) (D) All of (i), (ii) and (iii)
(B) Only (i) and (ii) (E) None of these
(C) Only (ii) and (iii)

104. Among the peripherals listed below, exactly one performs the roles of input device and output device in the same unit. That peripheral is: [Difficult]

- (A) Light pen (D) Joystick
(B) Flat-bed scanner (E) Plotter
(C) Touch screen

105. While designing the data-capture chain for opening a savings account, a bank must (i) photograph the applicant at the counter, (ii) capture the applicant's signature directly as a digital image at the moment of signing, and (iii) convert the 12-digit Aadhaar number printed on a submitted photocopy into a figure that can be edited in the form. The correct set of input devices, taken in that order, is: [Difficult]

- (A) Web camera, plotter, MICR reader-sorter
(B) Web camera, signature pad (digitiser), flat-bed scanner with OCR software
(C) Flat-bed scanner, web camera, OMR reader
(D) Signature pad (digitiser), web camera, bar code reader
(E) None of these

5.2.2 Output devices

[checked, 1 flagged]

106. During the induction programme at a Bank of Baroda branch, the trainer asks Priya Nair to identify the output device from the list of peripherals lying on the table. Which of the following is an output device? [Easy]

- (A) Keyboard
- (B) Monitor
- (C) Mouse
- (D) Scanner
- (E) Joystick

107. A soft copy is output that is shown temporarily and disappears when the machine is switched off, whereas a hard copy is a permanent printed copy. Which of the following devices produces ONLY a soft copy of the output? [Easy]

- (A) Laser printer
- (B) Plotter
- (C) Monitor
- (D) Dot-matrix printer
- (E) Inkjet printer

108. In computer terminology the abbreviation VDU, commonly used for the screen unit of a bank terminal, stands for: [Easy]

- (A) Visual Display Unit
- (B) Video Data Unit
- (C) Visual Data Utility
- (D) Virtual Display Unit
- (E) None of these

109. The engineering department of a housing finance company has to print large-size building layouts, site maps and architectural blueprints on sheets much wider than A4. The most suitable output device for this work is a: [Easy]

- (A) Laser printer
- (B) Thermal printer
- (C) Line printer
- (D) Plotter
- (E) Inkjet printer

110. Which of the following is an audio output device of a computer system? [Easy]

- (A) Microphone
- (B) Webcam
- (C) Light pen
- (D) Speaker
- (E) MICR reader

111. The smallest addressable dot on a computer monitor, a large number of which together form the complete displayed image, is called a: [Easy]

- (A) Byte
- (B) Font
- (C) Pixel
- (D) Sector
- (E) Bit

112. At the counter of a Punjab National Bank branch, the clerk inserts the customer's passbook into a machine which prints the fresh entries directly onto the multi-page passbook. This machine belongs to which category of printers? [Easy]

- (A) Inkjet printer
- (B) Impact (dot-matrix) printer
- (C) Laser printer
- (D) Thermal printer
- (E) Plotter

113. The Andheri branch of a bank has to print quarterly statements running to 1,250 pages. The branch laser printer prints at a steady rate of 25 pages per minute and no time is lost in loading paper. The time taken to complete the entire print job is: [Moderate]

- (A) 40 minutes
- (B) 45 minutes
- (C) 50 minutes
- (D) 60 minutes
- (E) None of these

114. Four of the five devices listed below share a common property, while one of them does not belong to that group. Which one is NOT an output device? [Moderate]

- (A) Plotter
- (B) OMR reader
- (C) Speaker
- (D) Projector
- (E) Monitor

115. Some peripherals can accept data from the user as well as present processed results, and are therefore classified as both input and output devices. Which of the following belongs to that class? [Moderate]

- (A) Light pen
- (B) Barcode reader
- (C) Joystick
- (D) Touch-screen monitor
- (E) Flatbed scanner

116. A bank has purchased Full HD monitors for its currency chest office. The resolution of each monitor is 1920×1080 . The total number of pixels on one such screen is: [Moderate]

- (A) 1,036,800
- (B) 2,073,600
- (C) 2,160,000
- (D) 3,110,400
- (E) None of these

117. The printing speed of a dot-matrix printer, which prints one character at a time, is normally expressed in: [Moderate]

- (A) PPM
- (B) LPM
- (C) CPS
- (D) DPI
- (E) BPS

118. In one widely used non-impact printer, the image of the page is first drawn by a laser beam on a photosensitive rotating drum, then developed with a very fine dry powder which sticks to the charged areas, and finally fixed permanently on the paper by heat and pressure in the fuser unit. The fine dry powder used in this process is called: [Moderate]

- (A) Toner
- (B) Liquid ink
- (C) Ribbon ink
- (D) Thermal dye
- (E) None of these

119. The monitor at a bank's help-desk terminal has a refresh rate of 75 Hz, that is, the screen image is redrawn 75 times every second. If the terminal is kept switched on and idle for exactly 4 minutes, the number of times the screen is redrawn during this period is: [Moderate]

- (A) 4,500
- (B) 9,000
- (C) 18,000
- (D) 30,000
- (E) None of these

120. The publicity section of a bank prints a promotional photograph of size 8 inches $\times$ 10 inches on a printer set to a resolution of 300 dots per inch (dpi) in both directions. The total number of dots printed in this photograph is: [Difficult]

- (A) 2,400,000
- (B) 5,400,000
- (C) 7,200,000
- (D) 9,000,000
- (E) None of these

121. A back-office dot-matrix printer prints at a uniform speed of 120 characters per second. It has to print a report of 750 lines, each line containing exactly 96 characters. In addition, the printer pauses for 0.2 second at the end of every line to feed the paper forward. The total time taken to print the complete report is: [Difficult]

- (A) 10 minutes
- (B) 12 minutes
- (C) 12.5 minutes
- (D) 15 minutes
- (E) None of these

122. A monitor is operated in "True Colour" mode, in which the colour of every pixel is stored using 24 bits. The maximum number of distinct colours that such a monitor can display is: [Difficult]

- (A) 256
- (B) 65,536
- (C) 1,048,576
- (D) 16,777,216
- (E) None of these

123. A display adapter must hold one full screen image in its video memory. If the monitor is run at a resolution of 1024×768 with a colour depth of 16 bits per pixel, the video memory required for one screen is (take 1 KB = 1024 bytes and 1 MB = 1024 KB): [Difficult]

- (A) 0.75 MB
- (B) 1 MB
- (C) 1.5 MB
- (D) 3 MB
- (E) None of these

124. A regional office must print 4,000 pages of loan documents. Printer A, which prints 30 pages per minute, starts the job alone. After 20 minutes Printer B, which prints 20 pages per minute, is switched on and both printers then work together on the remaining pages. The total time taken from the start until the job is finished is: [Difficult]

- (A) 88 minutes
- (B) 90 minutes
- (C) 92 minutes
- (D) 96 minutes
- (E) None of these

125. Consider the following three statements about printers.

(i) An impact printer presses the print head against an inked ribbon and the paper, and can therefore

print on multi-part carbon stationery.

(ii) A laser printer is an impact printer.

(iii) The print quality or sharpness of a printer is measured in dots per inch (dpi).

Which of the statements given above are correct?

[Difficult]

(A) Only (i)

(D) Only (ii) and (iii)

(B) Only (i) and (ii)

(E) All of (i), (ii) and (iii)

(C) Only (i) and (iii)

126. A processing centre must print 18,000 statement pages and the entire job has to be completed within 150 minutes. Each available laser printer prints at 24 pages per minute, all printers run simultaneously at full speed, and no printer can be shared or paused. The minimum number of such printers required is:

[Difficult]

(A) 4

(D) 8

(B) 5

(E) None of these

(C) 6

5.2.3 CPU: ALU, CU, registers

[checked, 1 flagged]

127. Priya Sharma is attending an induction class after joining a bank as a clerk. The trainer displays a block diagram of the CPU and points to the unit that actually carries out additions, subtractions and comparisons, such as checking whether a customer's balance is less than Rs. 5,000. The unit being pointed to is the:

[Easy]

(A) Control Unit

(D) Input Unit

(B) Arithmetic Logic Unit

(E) None of these

(C) Main Memory Unit

128. Which component of the CPU fetches instructions from memory, decodes them and generates the timing and control signals for the rest of the computer, but does not itself perform any calculation?

[Easy]

(A) Arithmetic Logic Unit

(D) Control Unit

(B) Accumulator

(E) None of these

(C) Cache memory

129. In a computer awareness class the teacher asks the students what the registers of a CPU actually are. The correct description of a register is:

[Easy]

(A) A small, very high speed storage location inside the CPU that holds data, addresses or instructions temporarily while an instruction is being processed

(B) A permanent storage area on the hard disk reserved for the operating system

(C) A printed list of all the programs installed on the computer

(D) A slow, non-volatile memory chip used to store the BIOS

(E) None of these

130. The special purpose register that is closely associated with the ALU and that holds one of the operands before an operation and the result immediately after the operation is the:

[Easy]

- (A) Program Counter
- (B) Memory Address Register
- (C) Instruction Register
- (D) Accumulator
- (E) Stack Pointer

131. The Program Counter (PC) of a CPU always holds: [Easy]

- (A) The instruction that is currently being executed
- (B) The address of the next instruction to be executed
- (C) The result of the last arithmetic operation
- (D) The number of programs currently running
- (E) None of these

132. The Central Processing Unit of a computer is made up of: [Easy]

- (A) The monitor, the keyboard and the mouse
- (B) The Control Unit, the Arithmetic Logic Unit and a set of registers
- (C) RAM and ROM only
- (D) The hard disk and the optical drive
- (E) None of these

133. Which one of the following is NOT a part of the Central Processing Unit? [Easy]

- (A) Arithmetic Logic Unit
- (B) Control Unit
- (C) Instruction Register
- (D) Hard disk drive
- (E) None of these

134. During a memory read operation the CPU first places the address of the required memory location in one register, and the data that arrives back from memory is deposited in a second register. These two registers are, respectively: [Moderate]

- (A) The Memory Data Register and the Memory Address Register
- (B) The Memory Address Register and the Memory Data Register
- (C) The Program Counter and the Instruction Register
- (D) The Instruction Register and the Accumulator
- (E) None of these

135. The CPU of a bank's server has just fetched an instruction from main memory. Before the Control Unit can work out what operation is required, the instruction bit pattern itself must be held in the: [Moderate]

- (A) Program Counter
- (B) Memory Address Register
- (C) Instruction Register
- (D) Accumulator
- (E) Stack Pointer

136. The correct sequence of the phases of a machine cycle, as carried out by the Control Unit for every instruction, is: [Moderate]

- (A) Decode, Fetch, Execute, Store
- (B) Fetch, Execute, Decode, Store
- (C) Fetch, Decode, Execute, Store
- (D) Execute, Fetch, Decode, Store
- (E) None of these

137. A bank purchases servers whose processors are advertised as "64-bit" processors. In terms of CPU architecture, this description most directly means that: [Moderate]

- (A) The processor can be connected to at most 64 peripheral devices
- (B) The processor runs at a clock speed of 64 MHz
- (C) The processor contains exactly 64 registers in all
- (D) The general purpose registers are 64 bits wide, so the processor handles 64 bits of data in a single operation
- (E) The computer can have a maximum of 64 MB of main memory

138. In a loan processing program the ALU subtracts one amount from another and the difference turns out to be exactly zero. The fact that the result was zero is recorded in a particular register so that the Control Unit can use it to decide a conditional branch. That register is the: [Moderate]

- (A) Accumulator
- (B) Program Counter
- (C) Memory Data Register
- (D) Flag register (status register)
- (E) Stack Pointer

139. A Control Unit in which the control signals for each instruction are produced by executing a sequence of micro-instructions held in a special control memory inside the CPU is known as a: [Moderate]

- (A) Hardwired control unit
- (B) Associative control unit
- (C) Cascaded control unit
- (D) Micro-programmed control unit
- (E) None of these

140. Which one of the following is NOT a function of the Control Unit of a CPU? [Moderate]

- (A) Fetching instructions from main memory
- (B) Decoding the opcode of an instruction
- (C) Performing the addition and subtraction of two operands
- (D) Generating timing and control signals for the other units
- (E) Directing the movement of data between the CPU, memory and I/O devices

141. In the CPU of a bank's mainframe the Memory Address Register (MAR) is 20 bits wide and the Memory Data Register (MDR) is 16 bits wide, and memory is organised as words of the MDR width. The maximum size of main memory that this CPU can address is: [Difficult]

- (A) 1 MB
- (B) 2 MB
- (C) 16 MB
- (D) 20 MB
- (E) None of these

142. An 8-bit ALU adds the two signed two's complement numbers 01100100 and 00101101 and places the sum in an 8-bit accumulator. Which of the following statements about the outcome is correct? [Difficult]

- (A) The accumulator holds 145 and no flag is disturbed
- (B) The accumulator holds 10010001, the carry-out flag is 1 and the overflow flag is 0
- (C) The accumulator holds 10010001, the overflow flag is set to 1 and the sign flag indicates a negative result, because 145 is beyond the +127 limit of an 8-bit signed register
- (D) The accumulator holds -145 and the overflow flag is 0
- (E) None of these

143. The processor of a bank's transaction server uses a 5-stage instruction pipeline in which every stage takes exactly one clock cycle of 1 nanosecond. Assuming the pipeline is filled without any stall, hazard or branch penalty, the total time taken to complete 100 instructions is: [Difficult]

- (A) 100 nanoseconds
- (B) 105 nanoseconds
- (C) 104 nanoseconds
- (D) 500 nanoseconds
- (E) None of these

144. A general purpose register in a processor is 16 bits wide and is used to hold unsigned whole numbers only. The largest interest amount, in whole rupees, that this register can hold is: [Difficult]

- (A) Rs. 32,767
- (B) Rs. 65,536
- (C) Rs. 65,535
- (D) Rs. 32,768
- (E) None of these

145. During the fetch phase of an instruction cycle the following three register transfer micro-operations take place: (i) $IR \leftarrow MDR$ (ii) $MAR \leftarrow PC$ (iii) $MDR \leftarrow \text{Memory}[MAR]$. The correct chronological order in which the Control Unit causes them to occur is: [Difficult]

- (A) (i), (ii), (iii)
- (B) (iii), (ii), (i)
- (C) (ii), (i), (iii)
- (D) (ii), (iii), (i)
- (E) None of these

146. Considering registers, cache memory, main memory and magnetic disk together, which of the following statements about the memory hierarchy of a computer is correct? [Difficult]

- (A) Registers have the shortest access time and the highest cost per bit, while the magnetic disk has the longest access time and the lowest cost per bit
- (B) Registers have the shortest access time but the lowest cost per bit, since they are very few in number
- (C) Cache memory is faster than a register because it lies closer to the ALU
- (D) Main memory has a lower cost per bit than a magnetic disk but a longer access time
- (E) None of these

147. A processor has 16 general purpose registers. Its instruction format consists of an opcode field of 6 bits, two fields each naming one of the general purpose registers, and one field holding a direct memory address. If the main memory has 2^{16} addressable locations, the total length of one instruction is: [Difficult]

- (A) 26 bits
- (B) 28 bits
- (C) 30 bits
- (D) 32 bits
- (E) None of these

5.2.4 Memory: primary, secondary, cache, virtual

[checked, 3 flagged]

148. Anjali Deshmukh, a clerk at a branch of a public sector bank, was typing a long customer letter when a sudden power cut switched off her desktop computer. When the machine restarted, the unsaved letter was completely lost. The memory whose contents were lost in this way is: [Easy]

- (A) ROM
- (B) RAM
- (C) Hard disk drive
- (D) DVD-ROM
- (E) Pen drive

149. During an IT awareness session at a bank, the trainer draws the memory hierarchy on the board and asks which of the following listed memories the CPU can access in the shortest time. The correct answer is: [Easy]

- (A) Cache memory
- (B) Main memory (RAM)
- (C) Hard disk drive
- (D) Magnetic tape
- (E) Optical disk (CD/DVD)

150. A bank's IT department orders external hard disks for branch backups. If the capacity of one disk is 1 GB, then 1 GB is equal to: [Easy]

- (A) 1000 KB
- (B) 1024 KB
- (C) 1024 MB
- (D) 1024 TB
- (E) None of these

151. Which one of the following is an example of secondary (auxiliary) storage rather than primary memory? [Easy]

- (A) RAM
- (B) Cache memory
- (C) CPU registers
- (D) Hard disk drive
- (E) None of these

152. When a computer at a bank counter is switched on, a small program permanently stored inside the machine starts the system and loads the operating system. The memory in which this start-up (BIOS/bootstrap) program is permanently stored is: [Easy]

- (A) RAM
- (B) Cache memory
- (C) Virtual memory
- (D) ROM
- (E) Magnetic tape

153. A bank's core banking terminal has only 8 GB of RAM, yet the operating system reports that a much larger amount of memory is available to programs. This extra memory space, created by using a reserved area of the hard disk as though it were RAM, is called: [Easy]

- (A) Cache memory
- (B) Virtual memory
- (C) Flash memory
- (D) Register memory
- (E) None of these

154. Which type of semiconductor memory stores each bit in a capacitor and therefore must be refreshed hundreds of times per second to retain its contents? [Easy]

- (A) SRAM
- (B) ROM
- (C) PROM
- (D) EEPROM
- (E) DRAM

155. Mr. Suresh Iyer, a branch manager, wants to copy scanned account-opening files onto a new 16 GB pen drive. Each file is exactly 250 MB in size and the whole capacity of the pen drive is available. Taking $1\text{ GB} = 1024\text{ MB}$, the maximum number of such complete files that can be stored on the pen drive is: [Moderate]

- (A) 64
- (B) 65
- (C) 66
- (D) 67
- (E) None of these

156. In a bank server, the cache memory serves a word in 10 ns when the word is found in the cache. When the word is not found, the total time taken to supply it to the CPU from main memory is 100 ns. If the hit ratio of the cache is 90%, the average access time per memory reference is: [Moderate]

- (A) 10 ns
- (B) 19 ns
- (C) 55 ns
- (D) 91 ns
- (E) None of these

157. Arrange the following memories in the correct order of decreasing speed of access (fastest first):
(i) Main memory (ii) CPU register (iii) Magnetic tape (iv) Cache memory (v) Magnetic disk [Moderate]

- (A) (ii), (iv), (i), (v), (iii)
- (B) (iv), (ii), (i), (iii), (v)
- (C) (ii), (i), (iv), (v), (iii)
- (D) (i), (ii), (iv), (iii), (v)
- (E) None of these

158. Which one of the following statements correctly distinguishes SRAM from DRAM? [Moderate]

- (A) SRAM is slower than DRAM and is therefore used as main memory
- (B) SRAM stores a bit in a capacitor, whereas DRAM stores a bit in a flip-flop
- (C) SRAM does not need refreshing, is faster and costlier per bit, and is used for cache memory
- (D) Both SRAM and DRAM are non-volatile memories
- (E) None of these

159. On a bank workstation running many applications at once, the operating system spends most of its time swapping pages between RAM and the hard disk instead of executing user instructions, and the machine slows down drastically. This undesirable condition in a virtual memory system is known as: [Moderate]

- (A) Fragmentation
- (B) Spooling
- (C) Caching
- (D) Defragmentation
- (E) Thrashing

160. A memory chip used in a bank's ATM controller has 16 address lines and 8 data lines. The total storage capacity of this chip is: [Moderate]

- (A) 16 KB
- (B) 32 KB
- (C) 64 KB
- (D) 128 KB
- (E) None of these

161. Which type of read-only memory has a transparent quartz window on its package so that its stored contents can be erased by exposing the chip to strong ultraviolet light before it is reprogrammed? [Moderate]

- (A) PROM
- (B) EEPROM
- (C) Mask ROM
- (D) EPROM
- (E) Flash memory

162. A bank's transaction server has a two-level cache. Every reference first searches the L1 cache, which takes 1 ns and has a hit ratio of 0.90. On an L1 miss, the L2 cache is searched, which takes a further 10 ns and has a hit ratio of 0.80 for the references that reach it. On an L2 miss, the word is fetched from main memory in a further 100 ns. The average memory access time is: [Difficult]

- (A) 2.0 ns
(B) 3.0 ns
(C) 4.0 ns
(D) 12.0 ns
(E) None of these

163. A computer at a bank's data centre uses a virtual address space of 4 GB with a page size of 4 KB. The number of pages in the virtual address space is: [Difficult]

- (A) 1024
(B) 65 536
(C) 1 048 576
(D) 4 194 304
(E) None of these

164. A memory module fitted in a bank's server is organised as 4 M locations, and each location stores one word of 16 bits. The total capacity of this module expressed in bytes is: [Difficult]

- (A) 4 MB
(B) 8 MB
(C) 16 MB
(D) 64 MB
(E) None of these

165. A bank branch takes a full backup of its daily transaction data on magnetic tape cartridges. The data generated per working day is 4.5 GB and the backup is retained for 30 working days. Each cartridge can store 25 GB and costs Rs. 850. Assuming a cartridge cannot be shared between the leftover of one lot and another purchase, the minimum amount the branch must spend on cartridges is: [Difficult]

- (A) Rs. 4,250
(B) Rs. 4,590
(C) Rs. 5,100
(D) Rs. 5,950
(E) None of these

166. A bank's document server has 60 GB of free secondary storage. Each scanned cheque image occupies exactly 240 KB. Taking $1 \text{ GB} = 1024 \text{ MB}$ and $1 \text{ MB} = 1024 \text{ KB}$, the number of cheque images that can be stored in the free space is: [Difficult]

- (A) 256
(B) 131 072
(C) 262 144
(D) 524 288
(E) None of these

167. In a system using demand paging, one memory access takes 100 ns. If a page fault occurs, servicing it (fetching the page from disk) takes 8 ms. The page fault rate is 0.001, that is, one access in every thousand causes a fault. The effective memory access time is nearest to: [Difficult]

- (A) 100.1 ns
(B) 800.1 ns
(C) 8 000 ns
(D) 8 099.9 ns
(E) None of these

168. Which one of the following statements about computer memory is FALSE? [Difficult]

- (A) Cache memory is faster but costlier per bit than main memory
(B) Virtual memory allows a program larger than the available physical RAM to be executed
(C) Data stored on a hard disk is processed directly by the ALU without first being brought into main memory
(D) DRAM requires periodic refreshing, whereas SRAM does not
(E) ROM retains its contents even when the power supply is switched off

5.2.5 Ports and connectors

[checked, 4 flagged]

169. During a hardware demonstration at the Erode branch of a public sector bank, the IT officer points to the blue trapezoidal socket on the back of the CPU cabinet into which the older monitor cable is plugged. He asks Ramesh Iyer how many pins this VGA connector carries. The correct answer is:

[Easy]

- (A) 9 pins
- (B) 15 pins
- (C) 19 pins
- (D) 25 pins
- (E) None of these

170. In an IBPS Clerk computer awareness paper, a candidate is asked to expand the abbreviation USB, which appears on almost every port of a modern branch terminal. The correct expansion is:

[Easy]

- (A) Uniform System Bus
- (B) Universal Storage Bus
- (C) Universal Serial Bus
- (D) Unified Serial Buffer
- (E) None of these

171. A new counter terminal at a bank branch in Salem has to be connected to the branch Local Area Network using a Cat-6 cable. The connector at the end of that cable, which plugs into the network port of the terminal, is called:

[Easy]

- (A) RJ-11
- (B) RJ-45
- (C) DB-9
- (D) PS/2
- (E) None of these

172. An older desktop machine in the record room of a co-operative bank still has two round 6-pin mini-DIN sockets, one purple and one green. According to the standard PC colour code, the green socket is meant for the:

[Easy]

- (A) Keyboard
- (B) Mouse
- (C) Printer
- (D) Speaker
- (E) None of these

173. A projector in the training hall of a bank's staff college is connected to a laptop using a cable marked HDMI. The abbreviation HDMI stands for:

[Easy]

- (A) High Density Media Interconnect
- (B) High-Definition Multimedia Interface
- (C) Hybrid Digital Monitor Input
- (D) High Definition Modular Interconnect
- (E) None of these

174. The rural branch of a bank at Pollachi still uses a dial-up backup line. The technician says the telephone line must be plugged into the RJ-11 socket. In normal computing practice, an RJ-11 connector is used for:

[Easy]

- (A) Connecting a printer to the CPU
- (B) Connecting a telephone or dial-up modem line
- (C) Connecting a monitor to the graphics card
- (D) Connecting an external hard disk

(E) None of these

175. A bank's audio-visual room is being upgraded. The officer wants a single cable that will carry both the picture and the sound from the media player to the display panel. Among the following ports, the one that carries digital video and digital audio together is: [Easy]

(A) VGA

(D) RJ-45

(B) PS/2

(E) None of these

(C) HDMI

176. While disposing of obsolete equipment, the IT section of a bank finds an old desktop with a long 25-pin D-shaped female socket that was originally used with a dot-matrix printer. Identify this port and the manner in which it transmitted data: [Moderate]

(A) Serial port; one bit at a time

(B) Parallel port; several bits simultaneously

(C) Game port; one bit at a time

(D) Parallel port; one bit at a time

(E) None of these

177. A vendor supplying scanners to a bank states that the new devices support the SuperSpeed USB 3.0 standard. The maximum theoretical data transfer rate of USB 3.0 is: [Moderate]

(A) 12 Mbps

(D) 10 Gbps

(B) 480 Mbps

(E) None of these

(C) 5 Gbps

178. A clerk at a branch counter needs to attach a device while the terminal is running, without shutting the machine down. Among the following, the port that is NOT hot-swappable, that is, the one whose device should be connected only when the system is switched off, is: [Moderate]

(A) USB port

(D) SD card slot

(B) PS/2 port

(E) None of these

(C) eSATA port

179. A new ultrabook issued to a bank's regional manager has a small oval reversible port labelled Thunderbolt 3. Regarding the physical connector used by Thunderbolt 3, which statement is correct? [Moderate]

(A) It uses the same connector shape as USB Type-C

(B) It uses the same connector shape as USB Type-A

(C) It uses a 15-pin D-sub connector

(D) It uses an RJ-45 modular connector

(E) None of these

180. An officer compares two display cables available in the branch store: one marked VGA and one marked DVI-I. Which of the following statements correctly distinguishes them? [Moderate]

(A) VGA carries only a digital signal, DVI-I carries only an analogue signal

(B) VGA carries only an analogue signal, DVI-I can carry both digital and analogue signals

(C) Both carry only digital signals

(D) Both carry only analogue signals

(E) None of these

181. During a training session on peripherals, the faculty explains that a single USB host controller can address a limited number of devices through hubs. The maximum number of devices that can be connected to one USB host controller is: [Moderate]

- (A) 63
- (B) 64
- (C) 127
- (D) 128
- (E) None of these

182. An old console cable in a bank's server room ends in a 9-pin D-shaped male connector that follows the RS-232 standard. Which of the following describes this port correctly? [Moderate]

- (A) It is a serial port that transmits one bit at a time
- (B) It is a parallel port that transmits eight bits at a time
- (C) It is a network port that transmits at 1 Gbps
- (D) It is a display port carrying digital video
- (E) None of these

183. A branch officer copies a customer database backup of size 1.5 GB from a bank terminal to an external drive over a USB 2.0 Hi-Speed port. Assuming the port sustains its full theoretical rate of 480 Mbps, that 1 byte = 8 bits and 1 GB = 1024 MB, the time taken for the transfer is closest to: [Difficult]

- (A) 12.8 seconds
- (B) 25.6 seconds
- (C) 51.2 seconds
- (D) 102.4 seconds
- (E) None of these

184. A bank's IT policy note states that a standard USB 2.0 port supplies up to 500 mA at 5 V, whereas a USB 3.0 port supplies up to 900 mA at 5 V. Using $P = V \times I$, by how much does the maximum power available from a USB 3.0 port exceed that from a USB 2.0 port? [Difficult]

- (A) 1.5 W
- (B) 2.0 W
- (C) 2.5 W
- (D) 4.5 W
- (E) None of these

185. A branch server pushes a daily transaction archive of size 750 MB to the zonal office over a Gigabit Ethernet link terminated in RJ-45 connectors. Taking the link rate as 1000 Mbps, 1 byte = 8 bits, and assuming the link runs at full rate with no overhead, the transfer time is: [Difficult]

- (A) 4 seconds
- (B) 6 seconds
- (C) 7.5 seconds
- (D) 8 seconds
- (E) None of these

186. Consider the following statements made during a computer awareness class for IBPS PO aspirants:

- I. A VGA port transmits an analogue video signal and carries no audio.
- II. An HDMI cable can carry digital video and digital audio together.
- III. An RJ-11 connector has more conductor positions than an RJ-45 connector.

Which of the statements is or are correct?

[Difficult]

- (A) I and II only
- (B) II and III only
- (C) I and III only
- (D) All of I, II and III
- (E) None of these

187. The network engineer at a bank's data centre terminates a Cat-5e cable with an RJ-45 plug, using all four twisted pairs. The link is then configured to run 100BASE-TX Fast Ethernet, which uses only two of those pairs. How many individual wires in that cable remain unused by the Fast Ethernet link? [Difficult]

- (A) 2
- (B) 4
- (C) 6
- (D) 8
- (E) None of these

188. A bank is preparing a technical note ranking connection standards by maximum theoretical data rate. Arrange the following in ascending order of maximum data rate: (i) USB 2.0, (ii) USB 3.0, (iii) Gigabit Ethernet over RJ-45, (iv) Thunderbolt 3. [Difficult]

- (A) (i), (ii), (iii), (iv)
- (B) (i), (iii), (ii), (iv)
- (C) (iii), (i), (ii), (iv)
- (D) (ii), (i), (iii), (iv)
- (E) None of these

189. While preparing a scrap inventory, a technician at a bank's regional office counts the pins on three legacy connectors found on an old desktop: one VGA (DE-15) socket, one RS-232 serial (DB-9) socket and one parallel printer (DB-25) socket. What is the total number of pins across these three connectors? [Difficult]

- (A) 34
- (B) 40
- (C) 45
- (D) 49
- (E) None of these

Section 5.3

5.3.1 System vs application software

[checked, 2 flagged]

190. During an induction class at a bank, the trainer asks the new clerks to identify the system software from the list given below. The correct choice is: [Easy]

- (A) MS Word
- (B) Tally ERP 9
- (C) Microsoft Windows 11
- (D) Adobe Photoshop
- (E) Google Chrome

191. Priya Nair, a clerk at a branch in Kochi, prepares the monthly cash-flow statement of Rs. 48,50,000 using MS Excel. MS Excel is correctly classified as: [Easy]

- (A) Operating system
- (B) Application software
- (C) Language translator
- (D) Device driver
- (E) Firmware

192. The software that acts as an interface between the user and the computer hardware, and manages memory, files, processes and input-output devices, is called: [Easy]

- (A) Word processor
- (B) Presentation package
- (C) Spreadsheet package
- (D) Operating system
- (E) None of these

193. A small program supplied along with a new laser printer, which enables the operating system to communicate correctly with that printer, is known as a: [Easy]

- (A) Word processor
- (B) Device driver
- (C) Database report
- (D) Application package
- (E) None of these

194. Which one of the following is an example of application software? [Easy]

- (A) Assembler
- (B) Linker
- (C) BIOS
- (D) Device driver
- (E) Tally ERP 9

195. A compiler, which converts a program written in a high-level language into machine code, is best classified as: [Easy]

- (A) Application software
- (B) System software
- (C) Hardware
- (D) An output device
- (E) None of these

196. A media player is manufactured once and sold in an identical, ready-made form to lakhs of buyers, every one of whom installs and uses exactly the same product without any change. Such a package is an example of: [Easy]

- (A) System software
- (B) General purpose application software
- (C) A language translator
- (D) A device driver
- (E) Firmware

197. Consider the following seven items: Linux, MS PowerPoint, Assembler, Google Chrome, Network device driver, Tally ERP 9, Interpreter. How many of these are system software? [Moderate]

- (A) Three
- (B) Five
- (C) Two
- (D) Four
- (E) None of these

198. Which one of the following statements about system software and application software is NOT true? [Moderate]

- (A) System software is normally installed and loaded into memory before application software can be used.
- (B) An application program usually reaches the hardware only by making requests to the operating system.
- (C) Application software can be loaded and run on a computer even when no operating system is present.
- (D) A compiler is counted as system software even though a programmer uses it directly.

- (E) System software is written to be general and hardware-oriented, while application software is written for a specific user task.

199. Arrange the following four layers of a computer system in the correct order, starting from the innermost layer and moving outwards to the person operating the machine: Hardware, Operating system, Application software, User. [Moderate]

- (A) Hardware, Application software, Operating system, User
- (B) User, Operating system, Application software, Hardware
- (C) Hardware, Operating system, Application software, User
- (D) Operating system, Hardware, Application software, User
- (E) None of these

200. The start-up program permanently written into a ROM chip on the motherboard, which tests the hardware and then loads the operating system, is best described as: [Moderate]

- (A) Firmware, which is a form of system software
- (B) General purpose application software
- (C) Customised application software
- (D) A language translator
- (E) None of these

201. Four of the five items given below belong to one class when software is divided into system software and application software. Which one is the odd item out? [Moderate]

- (A) Assembler
- (B) Interpreter
- (C) Compiler
- (D) Spreadsheet package
- (E) Loader

202. Two trainees make the following statements. Statement I: Utility programs such as an antivirus package and a disk defragmenter are grouped under system software. Statement II: MS PowerPoint is an example of general purpose application software. Which of the statements is or are correct? [Moderate]

- (A) Only Statement I
- (B) Only Statement II
- (C) Both Statement I and Statement II
- (D) Neither Statement I nor Statement II
- (E) Cannot be determined

203. Match each software in List I with its correct category in List II. List I: (i) Assembler, (ii) Tally ERP 9, (iii) Device driver, (iv) MS Excel. List II: (P) Application software, (Q) System software. [Moderate]

- (A) (i)-P, (ii)-Q, (iii)-P, (iv)-Q
- (B) (i)-Q, (ii)-P, (iii)-Q, (iv)-P
- (C) (i)-Q, (ii)-Q, (iii)-P, (iv)-P
- (D) (i)-P, (ii)-P, (iii)-Q, (iv)-Q
- (E) None of these

204. Consider the following three statements. I. Every application program is finally executed by the hardware, but its requests for input and output are serviced by the operating system. II. A language translator converts a source program into machine code and is therefore classified as application software. III. If the operating system were removed from a computer, ordinary word-processing software could still be loaded and run on it. Which of the statements is or are correct? [Difficult]

- (A) Only I
- (B) Only I and II
- (C) Only II and III
- (D) All of I, II and III
- (E) None of these

205. Assertion (A): A printer device driver is treated as system software even though it is supplied by the printer manufacturer and not by the vendor of the operating system. Reason (R): Software is classified as system or application software according to the function the program performs, not according to who supplies it. Choose the correct option. [Difficult]

- (A) Both (A) and (R) are true, and (R) is the correct explanation of (A)
- (B) Both (A) and (R) are true, but (R) is not the correct explanation of (A)
- (C) (A) is true but (R) is false
- (D) (A) is false but (R) is true
- (E) Both (A) and (R) are false

206. A bank branch in Nagpur has the following seven items installed on its machines: Windows Server 2022, the Finacle Core Banking package, a disk defragmenter, a PDF reader, the network interface card driver, a C compiler used by the IT cell, and a cheque-printing program written specially for this branch. How many of these seven are application software? [Difficult]

- (A) Two
- (B) Three
- (C) Four
- (D) Five
- (E) None of these

207. Which one of the following statements is TRUE? [Difficult]

- (A) Application software is machine-dependent, whereas system software is completely machine-independent.
- (B) System software is written mainly to solve the specific day-to-day problems of an individual end user.
- (C) The operating system is brought into main memory by a bootstrap loader and stays resident, while application programs are loaded only when they are needed.
- (D) A single computer can run several different operating systems at the same time without any additional software layer.
- (E) None of these

208. An IT firm in Pune develops a payroll package and sells the identical package off the shelf to 200 different companies, each of which uses it without any modification. The same firm separately builds a loan-recovery system for one bank alone, exactly to that bank's own rules. The correct classification of the two products respectively is: [Difficult]

- (A) Both are system software
- (B) First is customised application software; second is general purpose application software
- (C) First is general purpose application software; second is customised (tailor-made) application software
- (D) First is general purpose application software; second is system software
- (E) None of these

209. Which one of the following pairs of Software : Category is correctly matched? [Difficult]

- (A) Linker : Application software
- (B) MS Access : System software
- (C) Interpreter : Application software

- (D) Bootstrap loader : Application software
- (E) None of these

210. Consider the following statements about the relationship between system software and application software. I. System software creates the environment in which application software runs. II. An application may be written in a high-level language, but it must be translated by system software before the processor can execute it. III. The same application software can normally be run without any change on any operating system. Which of the statements is or are correct? [Difficult]

- (A) Only I
- (B) Only I and II
- (C) Only II and III
- (D) All of I, II and III
- (E) None of these

5.3.2 Operating system functions and types

[checked, 1 flagged]

211. Anil Kulkarni has just joined a bank as a probationary officer. During the IT induction session the trainer explains that a certain program starts running the moment the computer is switched on, manages the memory, the processor, the files and the printers, and acts as the interface between the user and the hardware. Without it no other program can run. The program being described is the: [Easy]

- (A) Word processing package
- (B) Antivirus utility
- (C) Language compiler
- (D) Operating system
- (E) None of these

212. A branch manager asks his clerk Meena to list the operating systems installed on the machines in the branch. Which one of the names given below is NOT an operating system? [Easy]

- (A) Windows 11
- (B) Ubuntu Linux
- (C) Android
- (D) MS Excel
- (E) UNIX

213. When the cash counter terminal at a bank branch is switched on in the morning, the operating system is copied from the hard disk into the main memory (RAM) and takes control of the machine. This start-up process is technically called: [Easy]

- (A) Formatting
- (B) Debugging
- (C) Booting
- (D) Defragmenting
- (E) None of these

214. The trainer at a bank's IT centre draws a diagram of the operating system and points to the innermost layer – the part that stays resident in main memory, controls the processor and memory directly, and to which all other parts must speak in order to reach the hardware. This innermost core is called the: [Easy]

- (A) Shell
- (B) Kernel
- (C) Compiler
- (D) Boot sector
- (E) None of these

215. Sunita, a clerk at a bank branch, keeps a spreadsheet of daily cash balances open, an e-mail client running and a browser session with the core banking portal active, all at the same time on her single desktop, and switches freely between them. The capability of the operating system that makes this possible is called: [Easy]

- (A) Batch processing
- (B) Multiprocessing
- (C) Multitasking
- (D) Booting
- (E) None of these

216. An old stand-alone terminal in the record room of a bank shows only a black screen with a `C:\>` prompt, where the operator must type commands such as `DIR` and `COPY`; there are no icons, windows or mouse pointer. The operating system on this machine is best described as one having: [Easy]

- (A) A command line interface (CLI)
- (B) A graphical user interface (GUI)
- (C) A touch interface
- (D) A voice interface
- (E) None of these

217. Which one of the following is NOT a function of an operating system? [Easy]

- (A) Memory management
- (B) Process scheduling
- (C) File and directory management
- (D) Input/output device management
- (E) Calculating the monthly interest payable on a customer's savings account

218. At a large bank branch, 12 clerks send passbook printing requests to a single shared printer within the same minute. The operating system accepts every request immediately, stores the print jobs in a queue on the hard disk, and releases them to the printer one by one, leaving each clerk free to continue working. The technique used by the operating system here is: [Moderate]

- (A) Spooling
- (B) Compiling
- (C) Formatting
- (D) Defragmentation
- (E) None of these

219. A bank's data centre installs a server that contains four physical CPUs. The operating system distributes the day's transaction-posting work so that all four CPUs execute instructions genuinely at the same instant, and if one CPU fails the remaining three keep the server running. The feature of the operating system being used is: [Moderate]

- (A) Multiprogramming
- (B) Multitasking
- (C) Multiprocessing
- (D) Multithreading
- (E) None of these

220. A clerk opens a large loan-portfolio data file that needs about 10 GB of memory on a machine fitted with only 8 GB of RAM, yet the file opens successfully although somewhat slowly. The operating system has achieved this by treating a reserved area of the hard disk as an extension of the main memory. This facility is known as: [Moderate]

- (A) Cache memory
- (B) Read Only Memory
- (C) Register memory
- (D) Virtual memory
- (E) None of these

221. In a UNIX-based bank server, an officer types a command at the prompt. The typed line is first received by a program that interprets it, checks its syntax and then passes the corresponding request to the core of the operating system for execution. The program that interprets the typed command is the: [Moderate]

- (A) Kernel
- (B) Shell
- (C) Device driver
- (D) Firmware in ROM
- (E) None of these

222. A bank collects all the cheques presented at its branches during the day and, at 9 p.m., a single program processes the entire day's file of cheque records from start to finish without any operator sitting at a terminal to give instructions while it runs. The type of operating environment being used is: [Moderate]

- (A) Batch processing operating system
- (B) Real-time operating system
- (C) Time-sharing operating system
- (D) Distributed operating system
- (E) None of these

223. Which one of the following is the best example of a HARD real-time system, that is, a system in which missing a response deadline amounts to total failure? [Moderate]

- (A) The monthly salary batch run of a bank's payroll department
- (B) A video-on-demand streaming server
- (C) The anti-lock braking (ABS) controller in a car
- (D) The auto-save feature of a word processor
- (E) None of these

224. Consider the following statements about multiprogramming in an operating system:

- I. Multiprogramming is possible only if the computer has more than one CPU.
- II. Its main aim is to keep the CPU busy by switching it to another job whenever the current job waits for an input/output operation.
- III. It requires the main memory to be divided so that more than one job can reside in memory at the same time.

Which of the statements is/are correct?

[Moderate]

- (A) I only
- (B) II only
- (C) II and III only
- (D) I and III only
- (E) All of I, II and III

225. The following four events occur when a bank's branch server is switched on in the morning. Arrange them in the correct chronological order.

- P. The firmware stored in ROM carries out the Power-On Self Test (POST) on the hardware.
- Q. The bootstrap loader held in the boot sector of the hard disk is read into RAM and executed.
- R. The kernel of the operating system is loaded into main memory and assumes control of the machine.
- S. The login screen is displayed and the clerk enters her user ID and password.

[Difficult]

- (A) P, Q, R, S
- (B) Q, P, R, S
- (C) P, R, Q, S
- (D) R, P, Q, S
- (E) None of these

226. A bank's application server is running well until the number of simultaneously active processes is raised sharply. Now the CPU utilisation falls to a very low figure, the disk activity light stays on almost continuously, and every process spends most of its time waiting while pages are swapped between RAM and disk. The condition the server has fallen into is called: [Difficult]

- (A) Deadlock
- (B) External fragmentation
- (C) Starvation
- (D) Thrashing
- (E) Spooling

227. Which one of the following is NOT one of the necessary conditions for a deadlock to occur in an operating system? [Difficult]

- (A) Mutual exclusion
- (B) Hold and wait
- (C) Circular wait
- (D) Pre-emption of a resource by the operating system whenever it wishes
- (E) No pre-emption

228. In a bank's server the operating system uses paging. The logical address space of a process is 64 KB and the page size is 2 KB. Assuming $1 \text{ KB} = 1024 \text{ bytes}$, the number of pages in the logical address space of this process is: [Difficult]

- (A) 16
- (B) 32
- (C) 64
- (D) 128
- (E) None of these

229. A single-CPU bank server uses Round Robin scheduling with a time quantum of 2 ms. Three service requests J1, J2 and J3 arrive together at time 0 and are queued in that order, requiring 4 ms, 3 ms and 2 ms of CPU time respectively. Ignoring context-switch overhead, at what time does request J3 finish? [Difficult]

- (A) 4 ms
- (B) 6 ms
- (C) 8 ms
- (D) 9 ms
- (E) None of these

230. Two ATM transactions on the same joint account reach a bank's server at the same moment, and both need to read the balance, alter it and write it back. To make sure that only one of them at a time is inside the section of code that updates the balance, so that one update is not lost, the operating system provides: [Difficult]

- (A) A semaphore
- (B) A print spooler
- (C) A page table
- (D) An interrupt vector table
- (E) None of these

231. Consider the following statements about types of operating systems:

- I. UNIX is a multi-user, multitasking operating system.
- II. In a distributed operating system, several autonomous computers linked by a network appear to the user as a single coherent system.
- III. MS-DOS supports pre-emptive multitasking of several user programs at the same time.
- IV. Android is built on a modified Linux kernel.

Which of the statements are correct?

[Difficult]

- (A) I and II only
- (B) I, II and IV only
- (C) II, III and IV only
- (D) I, III and IV only
- (E) All of I, II, III and IV

5.3.3 Windows fundamentals and file management

[checked, 3 flagged]

232. While clearing old branch records, Ms. Anita selects a file stored in D:\Branch\Old and wants to remove it straight away, without it being sent to the Recycle Bin. Which key combination should she use? [Easy]

- (A) Ctrl + Delete
- (B) Shift + Delete
- (C) Alt + Delete
- (D) Ctrl + Shift + Delete
- (E) None of these

233. Mr. Rakesh prepares a loan-recovery statement in MS Excel 2019 and saves it using the default file format offered by the Save dialog box. Which extension will the saved file carry? [Easy]

- (A) .xls
- (B) .xlsm
- (C) .csv
- (D) .xlsx
- (E) .xlt

234. A data-entry operator at a bank branch is naming a scanned document in Windows. Which one of the following characters is NOT allowed anywhere in a Windows file name? [Easy]

- (A) Hyphen (-)
- (B) Underscore (_)
- (C) Ampersand (&)
- (D) Blank space
- (E) Colon (:)

235. Mr. Suresh connects a USB pen drive to his office computer, selects a file on the pen drive and presses the Delete key, confirming the prompt. Where does the file go? [Easy]

- (A) To the Recycle Bin of the C: drive
- (B) To a separate Recycle Bin created on the pen drive
- (C) It is removed permanently and cannot be picked up from the Recycle Bin
- (D) To the Documents folder of the logged-in user
- (E) None of these

236. Ms. Kavita wants to open File Explorer ("This PC") directly from the desktop using the keyboard alone. Which shortcut should she press? [Easy]

- (A) Windows key + D
- (B) Windows key + R
- (C) Windows key + L
- (D) Windows key + E
- (E) None of these

237. In File Explorer, a clerk clicks once on the file ledger.docx to select it and then presses the F2 key. What happens? [Easy]

- (A) The contents of the folder are refreshed
- (B) The Windows Help window opens
- (C) The file name becomes editable so that it can be renamed
- (D) The file is copied to the clipboard
- (E) The file is moved to the Recycle Bin

238. Consider the full path C:\Users\Anita\Documents\loan.docx. Which part of this path represents the root directory of the drive? [Easy]

- (A) Users
- (B) Documents
- (C) loan.docx
- (D) C:\
- (E) None of these

239. Using the left mouse button, and without holding down any key on the keyboard, Mr. Suresh drags the file `audit.pdf` from the folder `D:\Reports` and drops it into the folder `D:\Archive`. What is the result? [Moderate]

- (A) The file is copied; the original also stays in `D:\Reports`
- (B) The file is moved; it no longer exists in `D:\Reports`
- (C) A shortcut to the file is created in `D:\Archive`
- (D) The file is deleted and sent to the Recycle Bin
- (E) None of these

240. The folder `C:\Bank` contains exactly these five files: `Loan.xlsx`, `Loan1.xlsx`, `Loan12.xlsx`, `Loans.docx` and `Loan1.docx`. A clerk searches the folder using the pattern `Loan?.xlsx`. How many files will match? [Moderate]

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) None of these

241. A branch manager has to carry daily backup files, each of size 250 MB, on a pen drive whose full capacity of 2 GB is free. Taking $1\text{ GB} = 1024\text{ MB}$, how many complete backup files can be stored on the pen drive? [Moderate]

- (A) 8
- (B) 9
- (C) 10
- (D) 7
- (E) None of these

242. In Folder A, Mr. Ramesh selects `report1.docx` and presses `Ctrl + X`. Before pasting, he notices another file, selects `report2.docx` in the same folder and presses `Ctrl + C`. He then opens Folder B and presses `Ctrl + V`. What is the outcome? [Moderate]

- (A) Both files are moved to Folder B
- (B) Only `report1.docx` is moved to Folder B
- (C) Only `report2.docx` is placed in Folder B, and both original files remain in Folder A
- (D) Only `report2.docx` is moved to Folder B and deleted from Folder A
- (E) None of these

243. An application has stopped responding on a Windows PC at a bank branch. The clerk wants to open Task Manager directly, in one step, so as to end the stuck task. Which key combination does that? [Moderate]

- (A) `Ctrl + Alt + Del`
- (B) `Alt + F4`
- (C) `Ctrl + Esc`
- (D) Windows key + Tab
- (E) `Ctrl + Shift + Esc`

244. While organising branch records, Ms. Latha creates new folders inside `D:\Bank`. Which one of the following folder names will Windows REFUSE to create, even though it contains no illegal character? [Moderate]

- (A) PRN
- (B) PRINT
- (C) Print_2024
- (D) COM10
- (E) LPT

245. Ms. Priya deletes the file `Report.docx` from the folder `D:\Audit` using the Delete key. She then renames the folder `D:\Audit` to `D:\Audit2024`. Later she opens the Recycle Bin, right-clicks `Report.docx` and chooses “Restore”. What happens? [Moderate]

- (A) The file is restored into `D:\Audit2024`, because that is the renamed folder
- (B) The file is restored to the Desktop of the current user
- (C) Restore fails and the file is permanently lost
- (D) Windows re-creates a folder named `D:\Audit` and restores the file into it
- (E) None of these

246. A branch stores 1,250 scanned KYC forms of 1.6 MB each, together with one database backup of 350 MB, on an external drive of capacity 4 GB that was completely empty. Taking $1\text{ GB} = 1024\text{ MB}$, how much free space is left on the drive? [Difficult]

- (A) 1746 MB
- (B) 1650 MB
- (C) 1846 MB
- (D) 2096 MB
- (E) None of these

247. A folder contains exactly these six files: `Loan_Report_2024.pdf`, `LoanSummary2024Q1.pdf`, `Loan2023_2024.pdf`, `Loans2024.docx`, `Report_Loan_2024.pdf` and `Loan2024.pdf`. A search is run with the pattern `Loan*2024*.pdf`. How many files match? [Difficult]

- (A) 3
- (B) 4
- (C) 5
- (D) 6
- (E) None of these

248. In Details view a folder lists 12 files in alphabetical order. Ms. Meera clicks on the 3rd file, then holds Shift and clicks on the 9th file, then holds Ctrl and clicks on the 5th file, and finally holds Ctrl and clicks on the 11th file. How many files are selected at the end? [Difficult]

- (A) 6
- (B) 7
- (C) 8
- (D) 9
- (E) None of these

249. A bank’s IT assistant tries to copy a single database backup file of size 6.2 GB onto a 16 GB pen drive that is formatted as FAT32 and has about 12 GB of free space. What will happen? [Difficult]

- (A) The file will copy normally, since free space exceeds the file size
- (B) The copy will fail, because FAT32 supports a maximum volume size of 2 GB
- (C) The file will copy but will automatically be split into two visible files
- (D) The copy will fail, because FAT32 cannot hold a single file larger than 4 GB
- (E) None of these

250. The current working folder in a command window is `C:\Bank\Chennai\Reports`. An officer types the relative path `..\..\Mumbai\KYC\form.pdf`. Which absolute path does this refer to? [Difficult]

- (A) `C:\Bank\Chennai\Mumbai\KYC\form.pdf`

- (B) C:\Bank\Mumbai\KYC\form.pdf
- (C) C:\Mumbai\KYC\form.pdf
- (D) C:\Bank\Chennai\Reports\Mumbai\KYC\form.pdf
- (E) None of these

251. A folder is being copied to an external drive at a steady transfer rate of 25 MB per second. The folder holds 3.5 GB of data. Taking $1\text{ GB} = 1024\text{ MB}$, approximately how long will the copy take?

[Difficult]

- (A) About 2 minutes 20 seconds
- (B) About 2 minutes 30 seconds
- (C) About 2 minutes 12 seconds
- (D) About 2 minutes 23 seconds
- (E) None of these

252. A folder shows “15 items” in the status bar of File Explorer while the “Hidden items” box in the View tab is unticked. On ticking that box, the count rises to 19. The clerk then permanently removes 3 of the hidden files using Shift + Delete and creates 2 new ordinary folders inside the same folder. If she now unticks “Hidden items” again, what count will the status bar show?

[Difficult]

- (A) 16
- (B) 17
- (C) 18
- (D) 19
- (E) None of these

5.3.4 Programming language basics; compiler vs interpreter

[checked]

253. Anjali Deshmukh, a newly recruited IBPS clerk, is being shown how the branch’s interest-calculation software is prepared. The trainer explains that a special system program reads the *entire* high-level source program in one go, checks it completely and then produces an equivalent machine-language program. The system program being described is a:

[Easy]

- (A) Compiler
- (B) Interpreter
- (C) Assembler
- (D) Loader
- (E) None of these

254. During a computer-awareness class for IBPS Clerk aspirants, the faculty asks: which of the following is the only language that the CPU of a computer can execute directly, without any translation whatsoever?

[Easy]

- (A) Assembly language
- (B) Machine language
- (C) High-level language
- (D) Fourth-generation query language
- (E) None of these

255. Rakesh writes a 60-line program for computing simple interest. When he runs it, the translator executes line 1, then line 2, and so on, and the moment it reaches an incorrect statement on line 23 it halts and displays the error, having already executed the first 22 lines. The translator he is using is a:

[Easy]

- (A) Compiler
- (B) Linker
- (C) Assembler
- (D) Interpreter
- (E) None of these

256. The system software whose input is a program written in mnemonic codes such as ADD, SUB and MOV, and whose output is the equivalent machine-code program, is called an:

[Easy]

- (A) Compiler
- (B) Interpreter
- (C) Assembler
- (D) Debugger
- (E) None of these

257. A programmer in the IT department of a bank types out the instructions of a loan-EMI program in the C language and saves the file. The program in this original, human-written, untranslated form is technically known as: [Easy]

- (A) Object code
- (B) Machine code
- (C) Source code
- (D) Executable code
- (E) None of these

258. Which one of the following, as listed, is a *low-level* programming language? [Easy]

- (A) Python
- (B) COBOL
- (C) Java
- (D) BASIC
- (E) None of these

259. In the hierarchy of programming languages, the language that uses symbolic names and mnemonics in place of binary opcodes, but still stays machine-dependent and works at the level of individual CPU instructions, is: [Easy]

- (A) Machine language
- (B) Assembly language
- (C) COBOL
- (D) SQL
- (E) None of these

260. A bank's software team has the same cheque-clearing program available in two forms: one is compiled, the other is interpreted. Which of the following statements correctly brings out the difference between the two translators? [Moderate]

- (A) A compiler produces an object program that can be executed again and again without the compiler being present, whereas an interpreter must translate the source code afresh on every run.
- (B) An interpreter produces a permanent object file whereas a compiler does not.
- (C) Both a compiler and an interpreter produce identical object files, differing only in speed.
- (D) A compiler can translate only low-level languages, while an interpreter can translate only high-level languages.
- (E) None of these

261. The IT cell of a bank must process 5 lakh transaction records every night. The same processing logic is available as a compiled program and as an interpreted program. Which will finish faster at run time, and for what reason? [Moderate]

- (A) The interpreted version, because translating one line at a time is quicker than translating the whole file.
- (B) The compiled version, because translation is completed once in advance and thereafter pure machine code runs, with no translation overhead during execution.
- (C) Both take exactly the same time, since the logic is identical.
- (D) The interpreted version, because it does not have to create an object file.
- (E) None of these

262. A Java-based internet-banking module is first translated into a platform-independent intermediate code, which is then processed statement by statement by the Java Virtual Machine at run time. In terms of translators, Java therefore makes use of: [Moderate]

- (A) Only a compiler
- (B) Only an interpreter
- (C) Only an assembler
- (D) Both a compiler and an interpreter
- (E) None of these

263. While coding an interest routine, Suresh writes the formula as $\frac{P \times R \times T}{50}$ instead of $\frac{P \times R \times T}{100}$. The program compiles cleanly with no message, runs to completion, and prints exactly double the correct interest. The error committed by Suresh is best classified as a: [Moderate]

- (A) Syntax error, which the compiler failed to report
- (B) Linker error
- (C) Run-time error that aborts the program
- (D) Logical error, which a compiler cannot detect
- (E) None of these

264. An officer at a bank's data centre extracts a report by writing a statement that names *what* data is required from the customer table without specifying *how* the system should retrieve it, record by record. Such a non-procedural language belongs to which generation of programming languages? [Moderate]

- (A) First generation
- (B) Second generation
- (C) Third generation
- (D) Fourth generation
- (E) None of these

265. A large C program in a bank is compiled into several object modules. The system program that then combines these object modules together with the required standard library routines into a single executable file is the: [Moderate]

- (A) Loader
- (B) Linker
- (C) Interpreter
- (D) Assembler
- (E) None of these

266. A trainee developer is repeatedly testing and correcting a small utility program and wants a translator that will point out an error the moment it is reached and let her re-run immediately after each small correction. Which translator suits this stage of work best, and why? [Moderate]

- (A) A compiler, because it hides errors until the program is complete
- (B) An interpreter, because it flags the error at the offending statement during execution and the program can be re-run at once without rebuilding the entire executable
- (C) A linker, because it reports errors module by module
- (D) A loader, because it checks the program while placing it in memory
- (E) None of these

267. The compilation of a high-level program passes through several analysis phases before machine code is produced. Which of the following gives the correct order of these phases? [Difficult]

- (A) Syntax analysis, Lexical analysis, Semantic analysis, Code generation
- (B) Semantic analysis, Lexical analysis, Syntax analysis, Code generation
- (C) Lexical analysis, Syntax analysis, Semantic analysis, Code generation
- (D) Lexical analysis, Semantic analysis, Syntax analysis, Code generation
- (E) None of these

268. A utility written in C is compiled on the bank's Windows server and the resulting executable runs there perfectly, but the identical executable refuses to run on the branch's Linux server, whereas a Java program's compiled output runs on both. The best explanation is: [Difficult]

- (A) C source code cannot be written for Linux at all
- (B) Java programs are never compiled, and only compiled programs are platform-dependent
- (C) Linux servers can execute only interpreted programs and never compiled ones
- (D) The output of a C compiler is machine- and operating-system-specific machine code, so it must be recompiled for the other platform, whereas a Java compiler emits platform-independent bytecode that any machine's JVM can execute
- (E) None of these

269. Consider the following four statements. (i) A compiler translates the entire source program before execution begins. (ii) An interpreter does not produce a separate object program on disk. (iii) An assembler translates a high-level language into machine language. (iv) The object code produced by a compiler is in machine-readable form. How many of these statements are correct? [Difficult]

- (A) One
- (B) Two
- (C) Three
- (D) Four
- (E) None of these

270. Which one of the following statements about compilers and interpreters is *FALSE*? [Difficult]

- (A) A compiler typically scans the whole source program and can report many syntax errors together in one listing.
- (B) An interpreter normally halts at the first error it encounters and reports that error before going further.
- (C) Once a program has been compiled and linked, the resulting executable can be run repeatedly without translating the source again.
- (D) An interpreter converts the complete source program into machine code and stores it before execution starts.
- (E) None of these

271. In the Java-based mobile-banking application of a bank, the file produced by the Java compiler is not native machine code but an intermediate, processor-independent code that the Java Virtual Machine subsequently executes. This intermediate code is known as: [Difficult]

- (A) Source code
- (B) Object code of the host processor
- (C) Bytecode
- (D) Assembly code
- (E) None of these

272. A legacy payroll routine of a bank exists as 250 assembly-language mnemonic instructions. The same routine, rewritten in C, occupies about 40 statements. Which of the following correctly explains the relationship between statements of these languages and machine instructions? [Difficult]

- (A) Each assembly mnemonic corresponds essentially to one machine instruction, while a single C statement usually expands into several machine instructions.
- (B) Each assembly mnemonic expands into many machine instructions, while each C statement produces exactly one machine instruction.
- (C) Statements of both assembly and C correspond one-to-one with machine instructions.
- (D) Neither assembly nor C statements are ever converted into machine instructions.

(E) None of these

273. A bank is developing firmware for its new ATM machines, whose processor is quite different from the desktop processors on which the developers work. They therefore use a translator that runs on the development machine but generates machine code meant to run on the ATM's processor. Such a translator is called a: [Difficult]

(A) Cross-compiler

(D) Interpreter

(B) Decompiler

(E) None of these

(C) Assembler

Section 5.4

5.4.1 MS Word: features and shortcuts

[checked, 1 flagged]

274. Sunita, a clerk at a branch of Bank of Baroda, has typed the heading "ANNUAL DEPOSIT STATEMENT" at the top of a circular. She selects the heading and presses *Ctrl + E*. What happens to the heading? [Easy]

(A) It becomes bold

(B) It is aligned to the centre of the page

(C) It is erased from the document

(D) It is exported to an e-mail message

(E) None of these

275. A candidate preparing for IBPS Clerk saves his practice notes in MS Word 2019 without changing any setting in the Save dialog. The default extension given to the saved file is: [Easy]

(A) .txt

(D) .pdf

(B) .wrd

(E) .rtf

(C) .docx

276. While drafting a loan sanction letter, Ramesh wants MS Word to check the whole document for spelling and grammar mistakes. Without using the mouse, which single key should he press? [Easy]

(A) *F1*

(D) *F9*

(B) *F5*

(E) *F12*

(C) *F7*

277. Meena has scrolled to page 47 of a long branch inspection report. She now presses *Ctrl + Home*. The insertion point moves to: [Easy]

(A) The very beginning of the document

(B) The beginning of the current line

(C) The beginning of page 47

(D) The very end of the document

(E) None of these

278. A bank wishes to send the same festival greeting letter to 1,200 savings-account customers, with each letter carrying that customer's own name and address picked up from an Excel list. In MS Word 2016, the Mail Merge command used for this task is found on which tab of the Ribbon? [Easy]

- (A) Insert
- (B) References
- (C) Review
- (D) Mailings
- (E) Design

279. In a customer-service manual being typed in MS Word, Anil selects the words “RBI website” and presses *Ctrl + K*. Which dialog box opens? [Easy]

- (A) Insert Hyperlink
- (B) Insert Table
- (C) Keyboard Customisation
- (D) Paragraph
- (E) None of these

280. Kavita has finished typing the covering letter of a tender document and wants the next matter – the annexure – to begin compulsorily on a fresh page, so that it stays on a fresh page even if she later adds lines to the letter. The correct keystroke is: [Easy]

- (A) *Enter* pressed repeatedly until a new page appears
- (B) *Ctrl + Enter*
- (C) *Shift + Enter*
- (D) *Alt + Enter*
- (E) *Ctrl + Shift + Enter*

281. A document is typed in Calibri 12 pt. Deepak selects a phrase and wants to enlarge it to exactly 13 pt using a keyboard shortcut. Which shortcut should he use? [Moderate]

- (A) *Ctrl +]*
- (B) *Ctrl + Shift + >*
- (C) *Ctrl + Shift + P*
- (D) *Ctrl + D*
- (E) None of these

282. Priya has pasted a paragraph copied from a website into her branch report. The pasted text has arrived in blue, bold, underlined Verdana, although the paragraph alignment and indents are fine. She selects it and wants to strip only the character formatting so that the text returns to the plain style of the underlying paragraph. She should press: [Moderate]

- (A) *Ctrl + Q*
- (B) *Ctrl + Z*
- (C) *Ctrl + Shift + N*
- (D) *Ctrl + U*
- (E) *Ctrl + Spacebar*

283. Inside a numbered list of loan conditions, Suresh has typed condition number 5 and now wants a second line under that same number – that is, a new line that does NOT create condition number 6. Which key combination should he press at the end of the first line? [Moderate]

- (A) *Ctrl + Enter*
- (B) *Enter*
- (C) *Tab*
- (D) *Shift + Enter*
- (E) None of these

284. Anjali has already saved a file as **Audit_Note.docx**. Her manager now asks her to keep the original untouched and produce a second copy named **Audit_Note_Final.docx**. Which single function key opens the dialog that lets her do this in one step? [Moderate]

- (A) *F12*
- (B) *Shift + F12*
- (C) *Ctrl + F12*
- (D) *Alt + F12*
- (E) *F11*

285. A 40-page policy document has one sub-heading formatted in 14 pt bold small-caps with 6 pt spacing above it. Vinod wants three other sub-headings, scattered through the document, to look exactly the same, using only the keyboard. The most appropriate procedure is: [Moderate]

- (A) Select the model sub-heading, press *Ctrl + C*, then select each other sub-heading and press *Ctrl + V*
- (B) Select the model sub-heading and press *Ctrl + Shift + D* three times
- (C) Select each sub-heading in turn and press *Ctrl + Y*
- (D) Select the model sub-heading, press *Ctrl + Shift + C*, then select each other sub-heading and press *Ctrl + Shift + V*
- (E) None of these

286. In MS Word, Rekha has created a table of 4 columns and 6 rows to show branch-wise deposits. The cursor is in the last cell of the sixth row, and she presses the *Tab* key. What happens? [Moderate]

- (A) The cursor jumps out of the table to the paragraph below it
- (B) A tab space of 0.5 inch is inserted inside that cell
- (C) A new seventh row is added to the table and the cursor moves into its first cell
- (D) A new fourth column is added to the table
- (E) Nothing happens because there is no next cell

287. The head office has instructed that the body text of all circulars must carry 1.5-line spacing. Mohan selects the body text of his circular. The correct keyboard shortcut to apply 1.5-line spacing is: [Moderate]

- (A) *Ctrl + 1*
- (B) *Ctrl + 2*
- (C) *Ctrl + 5*
- (D) *Ctrl + 1.5*
- (E) *Ctrl + Shift + 2*

288. A 12-page inspection report is set to portrait orientation. Page 7 contains a wide branch-wise comparison table that must be printed in landscape, while pages 1–6 and 8–12 must stay portrait. Which approach achieves this? [Difficult]

- (A) Insert a page break before and after page 7, then set page 7 to landscape
- (B) Insert a Next Page section break before and after page 7, click inside page 7 and set orientation to landscape
- (C) Select the table on page 7 and apply landscape orientation from the Layout tab
- (D) Set the whole document to landscape and then rotate the text on the other pages
- (E) None of these

289. Ravi was editing paragraph 9 on page 23 of a manual yesterday. He closed the file, and today he reopens it – Word shows him page 1. Without scrolling and without using Find, which shortcut takes him straight back to the spot he was last editing? [Difficult]

- (A) *Ctrl + F5*
- (B) *Alt + F5*
- (C) *Ctrl + End*
- (D) *Shift + F5*
- (E) *F5* followed by *Enter*

290. The cursor is placed in the middle of the sentence “The branch shall report all cash transactions above Rs. 10,00,000.” in a Word document. The user now presses the *F8* key three times in succession. What is selected at the end? [Difficult]

- (A) Nothing; *F8* only switches on Extend mode
- (B) The single word in which the cursor stands
- (C) The whole sentence in which the cursor stands
- (D) The whole paragraph in which the cursor stands
- (E) The whole document

291. A regional manager receives a draft policy note and must return it showing every insertion and deletion he makes, attributed to his name, so that the author can accept or reject each change individually. Which single shortcut switches on the required feature? [Difficult]

- (A) *Alt + Ctrl + M*
- (B) *Ctrl + Shift + E*
- (C) *Ctrl + Shift + C*
- (D) *Alt + Shift + C*
- (E) None of these

292. In a letter, the designation “Dy. General Manager” keeps breaking at the end of a line, with “Dy.” left on one line and “General Manager” pushed to the next. To force the two parts to stay together on the same line without changing the margins or the font, the space between them should be replaced by pressing: [Difficult]

- (A) *Ctrl + Spacebar*
- (B) *Shift + Spacebar*
- (C) *Ctrl + Shift + Spacebar*
- (D) *Alt + Spacebar*
- (E) *Ctrl + Hyphen*

293. A statement typed in MS Word lists account numbers, names and balances separated by tab stops. Sameer wants to select only the balances – that is, a narrow vertical block of text running down the right-hand side of several lines – and delete it. Which technique should he use? [Difficult]

- (A) Hold *Shift* and drag the mouse down the column
- (B) Hold *Ctrl* and drag the mouse down the column
- (C) Hold *Alt* and drag the mouse down the column
- (D) Press *Ctrl + A* and then *Delete*
- (E) None of these

294. In a list of references at the end of a bank’s training manual, each entry must have its first line starting at the left margin while every later line of the same entry is indented by 0.5 inch. This arrangement is called a hanging indent. After selecting the entries, which shortcut applies it? [Difficult]

- (A) *Ctrl + M*
- (B) *Ctrl + Shift + M*
- (C) *Ctrl + Shift + T*
- (D) *Ctrl + Tab*
- (E) *Ctrl + T*

5.4.2 MS Excel: formulae, functions, charts

[checked, 3 flagged]

295. Ramesh, a clerk at the Tiruppur branch, records three cash receipts in an Excel sheet: cell B2 holds Rs. 12,500, cell B3 holds Rs. 8,750 and cell B4 holds Rs. 4,250. In cell B5 he types the formula =SUM(B2:B4). What amount will Excel display in B5? [Easy]

- (A) Rs. 21,250 (D) Rs. 20,750
 (B) Rs. 25,500 (E) None of these
 (C) Rs. 25,000

296. In a customer register the range A1:A8 contains eight cells: five of them contain numeric account balances, two contain the text "Closed" and one cell is completely blank. What value is returned by the formula =COUNT(A1:A8)? [Easy]

- (A) 8 (D) 5
 (B) 7 (E) None of these
 (C) 6

297. Cell C5 of a loan-interest worksheet contains the formula =\$A\$1+B5. The user copies cell C5 and pastes it into cell C6. What formula will now appear in cell C6? [Easy]

- (A) =\$A\$1+B6 (D) =\$A\$2+B5
 (B) =\$A\$2+B6 (E) =A1+B6
 (C) =\$A\$1+B5

298. The monthly incentives of five field officers are entered in D2:D6 as Rs. 4,200, Rs. 3,800, Rs. 5,000, Rs. 4,600 and Rs. 4,400. What will the formula =AVERAGE(D2:D6) return? [Easy]

- (A) Rs. 4,200 (D) Rs. 4,600
 (B) Rs. 4,500 (E) None of these
 (C) Rs. 4,400

299. A branch manager wants a single chart that shows what share each of five deposit schemes contributes to the branch's total deposits, expressed as a proportion of the whole. Which chart type in MS Excel is most appropriate? [Easy]

- (A) Line chart (D) Area chart
 (B) Scatter (XY) chart (E) None of these
 (C) Pie chart

300. While preparing a salary statement, a user finds that one cell displays ##### instead of the figure that was typed. What does this display indicate in MS Excel? [Easy]

- (A) The formula in that cell contains a circular reference
 (B) The formula refers to a cell that has been deleted
 (C) The column is not wide enough to display the value
 (D) The cell has been protected against editing
 (E) None of these

301. In cell A1 a user types the formula ="IBPS"&" "&"Clerk". What will cell A1 display? [Easy]

- (A) IBPSClerk (D) #VALUE!
 (B) IBPS Clerk (E) None of these
 (C) IBPS&Clerk

302. The daily cash deposits (in rupees) at the Erode branch for six working days are entered in B2:B7 as 45000, 62000, 38500, 71000, 55000 and 38500. The manager types =MAX(B2:B7)-MIN(B2:B7) in cell B9. What value appears in B9? [Moderate]

- (A) Rs. 71,000
(B) Rs. 38,500
(C) Rs. 26,000
- (D) Rs. 32,500
(E) None of these

303. A bank grades its customers using the formula =IF(C2>=50000,"Gold",IF(C2>=25000,"Silver","Basic")) Customer Anjali Menon has an average quarterly balance of exactly Rs. 25,000 in cell C2. What will the formula display for her? [Moderate]

- (A) Gold
(B) Silver
(C) Basic
- (D) FALSE
(E) None of these

304. The range D2:D11 contains ten sanctioned loan amounts (in rupees): 35000, 42000, 40000, 58000, 39500, 40000, 75000, 28000, 61000 and 40500. What is returned by =COUNTIF(D2:D11,">40000")? [Moderate]

- (A) 3
(B) 4
(C) 5
- (D) 6
(E) None of these

305. In a commission sheet, A2:A7 holds branch names and B2:B7 holds the corresponding commission earned. The six rows are: Chennai Rs. 12,000; Madurai Rs. 9,000; Chennai Rs. 15,000; Salem Rs. 7,000; Chennai Rs. 8,000; Madurai Rs. 6,000. What does =SUMIF(A2:A7,"Chennai",B2:B7) return? [Moderate]

- (A) Rs. 27,000
(B) Rs. 32,000
(C) Rs. 43,000
- (D) Rs. 35,000
(E) None of these

306. Cell C3 contains the formula =A1*B2, in which both references are relative. The cell is copied and pasted into cell E6. What formula will cell E6 contain? [Moderate]

- (A) =C4*D5
(B) =A1*B2
(C) =C3*D4
- (D) =E6*F7
(E) None of these

307. A lookup table occupies A2:D8. Column A holds customer names, column B holds account numbers, column C holds branch names and column D holds balances. The row for Kavita reads: Kavita, 10234, Erode, 68500. What is returned by =VLOOKUP("Kavita",A2:D8,3,FALSE)? [Moderate]

- (A) 10234
(B) 68500
(C) Erode
- (D) #N/A
(E) None of these

308. Cells A1 to A5 of a worksheet contain, in order: 1200, a completely blank cell, 1800, 2400 and 0. What value does =AVERAGE(A1:A5) return? [Moderate]

- (A) 1080
(B) 1350
(C) 1800
- (D) 2100
(E) None of these

309. What value will MS Excel display for the formula =10+20*3^2/6-4? [Difficult]

- (A) 34
- (B) 40
- (C) 46
- (D) 30
- (E) None of these

310. In a purchase register, A2:A5 holds the quantities 12, 8, 15 and 10, while B2:B5 holds the corresponding unit rates in rupees: 250, 400, 150 and 320. What does =SUMPRODUCT(A2:A5,B2:B5) return? [Difficult]

- (A) Rs. 11,650
- (B) Rs. 10,450
- (C) Rs. 12,300
- (D) Rs. 9,850
- (E) None of these

311. Cell D2 contains the formula =B\$1*\$A2. The cell is copied and pasted into cell F5. What formula will cell F5 contain? [Difficult]

- (A) =B\$1*\$A5
- (B) =D\$1*\$A5
- (C) =D\$4*\$A5
- (D) =F\$1*\$A2
- (E) None of these

312. A worksheet has eight data rows (rows 2 to 9). Column A holds the branch, column B the transaction amount and column C the commission. The rows are: (Coimbatore, 6000, 300); (Erode, 8000, 400); (Coimbatore, 4500, 225); (Coimbatore, 9000, 450); (Salem, 5000, 250); (Coimbatore, 5000, 250); (Erode, 3000, 150); (Coimbatore, 12000, 600). What does =SUMIFS(C2:C9,A2:A9,"Coimbatore",B2:B9,">=5000") return? [Difficult]

- (A) Rs. 1,350
- (B) Rs. 1,225
- (C) Rs. 1,600
- (D) Rs. 1,825
- (E) None of these

313. A training institute uses =IF(AND(B2>=60,C2>=60),"Pass",IF(OR(B2>=60,C2>=60),"Reappear","Fail")). For candidate Suresh Iyer, B2 contains 72 and C2 contains 55. What will the formula display? [Difficult]

- (A) Pass
- (B) Fail
- (C) FALSE
- (D) Reappear
- (E) None of these

314. A regional head has, for each of 40 branches, the annual advertising spend and the annual deposit growth. He wants a chart in which each branch appears as one plotted point, so that he can judge whether higher advertising spend is associated with higher deposit growth. Which chart type should he choose? [Difficult]

- (A) Stacked column chart
- (B) Line chart
- (C) Scatter (XY) chart
- (D) Doughnut chart
- (E) None of these

315. The range B2:B6 contains the five monthly disbursement figures Rs. 41,250, Rs. 38,700, Rs. 45,900, Rs. 39,400 and Rs. 42,150. What does the formula =ROUND(AVERAGE(B2:B6),-2) return? [Difficult]

- (A) Rs. 41,480
(B) Rs. 41,500
(C) Rs. 41,400
- (D) Rs. 42,000
(E) None of these

5.4.3 MS PowerPoint

[checked, 1 flagged]

316. Ms. Kavita Iyer, a probationary officer at Bank of Baroda, prepares a presentation on the bank's new gold loan scheme using MS PowerPoint 2016 and saves it normally without changing any setting in the Save dialog box. The extension of the file created on her computer is: [Easy]

- (A) .docx
(B) .pptx
(C) .xlsx
- (D) .potx
(E) .ppsx

317. During a training session at the IBPS coaching centre in Pune, the faculty asks a student to run the open presentation as a full-screen slide show starting from the very first slide, using a single keystroke. The key to be pressed is: [Easy]

- (A) F1
(B) F2
(C) F5
- (D) F7
(E) F12

318. Mr. Anand Deshmukh has made a 40-slide presentation on digital banking. He now wants to see many slides together as small thumbnails on one screen so that he can drag and drop them into a better order. The most suitable view is: [Easy]

- (A) Normal view
(B) Reading view
(C) Slide Sorter view
- (D) Notes Page view
(E) Outline view

319. While preparing a presentation on mutual funds, Ms. Rekha Nair wants to add one more slide immediately after the slide she is currently working on. The keyboard shortcut that inserts a new slide is: [Easy]

- (A) *Ctrl + N*
(B) *Ctrl + M*
(C) *Ctrl + D*
- (D) *Ctrl + K*
(E) None of these

320. The IT department of Canara Bank wants the bank's logo and the footer text "Confidential" to appear automatically in the same position on every slide of a 60-slide presentation, including any slide added later, without inserting them one by one. The feature that should be used is: [Easy]

- (A) Slide Master
(B) Slide Transition
(C) Custom Animation
- (D) Slide Sorter
(E) Rehearse Timings

321. In MS PowerPoint, the special visual effect that is applied to control the manner in which the display moves from one slide to the next slide during a slide show is called: [Easy]

- (A) Animation
- (B) Transition
- (C) Formatting
- (D) Hyperlink
- (E) Action Button

322. Mr. Sudhir Rao has to address the branch managers of Union Bank of India. He types the key figures he must remember below each slide in the Notes pane. During the slide show projected to the audience, these typed notes will: [Easy]

- (A) Appear at the bottom of each slide for everyone to read
- (B) Appear as a scrolling ticker on the slide
- (C) Not be visible to the audience, though the speaker can see them in Presenter View
- (D) Be automatically converted into bullet points on the slide
- (E) Be deleted as soon as the slide show starts

323. Ms. Preeti Sharma is on slide number 18 of a 30-slide presentation on priority sector lending. The projector has just been switched on and she wants the slide show to begin full screen from slide 18 itself, not from slide 1. She should press: [Moderate]

- (A) *F5*
- (B) *Shift + F5*
- (C) *Ctrl + F5*
- (D) *Alt + F5*
- (E) *Esc*

324. A presentation on the bank's home loan products has to run continuously and unattended on a screen in the lobby of a branch of HDFC Bank, each slide staying for the exact length of time the trainer took while practising. Before setting it to loop, the trainer should first use: [Moderate]

- (A) Hide Slide
- (B) Rehearse Timings
- (C) Slide Master
- (D) Compress Pictures
- (E) Format Painter

325. The head office of Indian Overseas Bank wants to circulate a presentation to branches in such a way that when a branch manager double-clicks the file, it opens straight into the full-screen slide show instead of opening in the editing window. The file should be saved with the extension: [Moderate]

- (A) .pptx
- (B) .potx
- (C) .ppsx
- (D) .pptm
- (E) .pdf

326. Mr. Rajeev Menon has a 45-slide presentation on the bank's annual results. For the board meeting he must present only slides 4, 9, 12 and 27, in the order 12, 4, 27, 9, while retaining the complete deck untouched for the staff meeting next week. The most appropriate feature is: [Moderate]

- (A) Hide Slide on the remaining slides
- (B) Custom Slide Show
- (C) Delete the unwanted slides and use Undo later
- (D) Section Header layout
- (E) Save a copy and reorder it in Slide Sorter view

327. A slide show is running in full screen at a seminar. A delegate asks a question relating to slide 7, while the presenter is on slide 23. Without leaving the full-screen show, the quickest way for the presenter to move to slide 7 is to: [Moderate]

- (A) Press *Esc*, click slide 7 and press *F5* again
- (B) Press the *Backspace* key sixteen times
- (C) Type 7 and press *Enter*
- (D) Press *Ctrl + G* and type 7
- (E) Press *Ctrl + 7*

328. A presenter is running a slide show and wishes to pause the visual display so that the audience looks at him instead of the screen, turning the screen completely black without ending the show. He should press: [Moderate]

- (A) *B*
- (B) *W*
- (C) *Esc*
- (D) *Ctrl + P*
- (E) *End*

329. Ms. Neha Gupta has spent a long time setting a Fly In entrance animation with a specific direction, duration and delay on one chart. She now wants exactly the same animation settings applied to seven other charts in the presentation, with the least effort. She should use: [Moderate]

- (A) Format Painter
- (B) Animation Painter
- (C) Slide Master
- (D) Copy and Paste Special
- (E) None of these

330. A presentation of Bank of India uses four different slide layouts. In Slide Master view, the designer selects the topmost, larger thumbnail in the left pane and changes the heading font there. The effect of this change will be that the new heading font is applied to: [Difficult]

- (A) Only the slides that currently use the Title Slide layout
- (B) Only the slide that was selected before entering Slide Master view
- (C) All the layouts under that master, and hence to every slide based on them, except where a layout or slide has been given its own overriding font
- (D) Nothing at all, because fonts can be changed only slide by slide
- (E) Only the slides added after the change is made

331. Mr. Vikram Sethi is building a deck that uses his bank's blue corporate theme. He uses Home, New Slide, Reuse Slides to pull in five slides from a colleague's presentation that uses a green theme, and he does not tick the "Keep source formatting" check box. The five inserted slides will: [Difficult]

- (A) Retain the green theme of the source presentation
- (B) Take on the blue theme of the destination presentation
- (C) Appear without any theme, on a plain white background
- (D) Force the whole destination presentation to change to the green theme
- (E) Be inserted as non-editable pictures

332. A presentation designed on Ms. Anjali Verma's laptop uses a decorative font that is installed only on her machine. She must e-mail the .pptx file to the Mumbai office, where the text must appear in the same font, and the office team must still be able to edit the text. The correct step is to: [Difficult]

- (A) Save the file as a PDF before sending it
- (B) Use File, Options, Save and tick "Embed fonts in the file" before saving
- (C) Increase the font size so that substitution does not occur
- (D) Convert every text box into a picture before sending
- (E) Apply a Slide Master so that the font travels with the file

333. On a slide there is a picture of a cheque and a text box explaining the MICR band. The presenter wants the text box to appear only when he clicks on the picture of the cheque itself, and not when he clicks anywhere on the slide. The feature that achieves this is: [Difficult]

- (A) Setting the animation start to “With Previous”
- (B) Setting the animation start to “After Previous”
- (C) Adding a Trigger to the text box animation, set to the picture
- (D) Adding a slide transition of type “Reveal”
- (E) None of these

334. A presentation is to run unattended on a touch-free display at a bank’s exhibition stall, looping endlessly, with the audience unable to advance or change slides by clicking the mouse. Under Slide Show, Set Up Slide Show, the correct choice of show type together with the necessary precondition is: [Difficult]

- (A) “Presented by a speaker (full screen)” with manual advance
- (B) “Browsed by an individual (window)” with manual advance
- (C) “Browsed at a kiosk (full screen)”, with slide timings already set
- (D) “Presented by a speaker (full screen)” with the Esc key disabled
- (E) Any show type, provided “Loop continuously until Esc” is ticked

335. The quarterly NPA figures of a bank are maintained in an Excel workbook. A chart of these figures has to be placed on a PowerPoint slide in such a way that whenever the finance team revises the numbers in the workbook, the chart on the slide shows the revised figures. The chart should be brought in by: [Difficult]

- (A) Copying the chart and using an ordinary Paste, which embeds a copy in the slide
- (B) Copying the chart and using Paste Special with the “Paste link” option
- (C) Taking a screenshot of the chart and inserting it as a picture
- (D) Inserting a new chart in PowerPoint and typing the figures again
- (E) Exporting the chart as a PDF and inserting the PDF as an object

336. On one slide, four objects are animated. The presenter clicks once and the sequence begins at time $t = 0$. Object P : start On Click, delay 0 s, duration 1.5 s. Object Q : start With Previous, delay 2 s, duration 1 s. Object R : start After Previous, delay 0.5 s, duration 2 s. Object S : start With Previous, delay 1 s, duration 1.5 s. The total time from the click until all four animations have finished is: [Difficult]

- (A) 5.5 seconds
- (B) 6.0 seconds
- (C) 6.5 seconds
- (D) 7.0 seconds
- (E) None of these

5.4.4 MS Access basics

[checked, 3 flagged]

337. A branch of Sundaram Bank maintains a table `ACCOUNT_MASTER`, in which one record is stored for every account opened at the branch, with the fields given below. Which one of these fields is the most appropriate choice for the **primary key** of the table? [Easy]

- (A) `Customer_Name`
- (B) `Branch_City`
- (C) `Date_of_Opening`
- (D) `Account_Number`
- (E) `Account_Type`

338. MS Access, which is supplied as a part of the Microsoft Office suite, is best described as which type of software? [Easy]

- (A) A spreadsheet package
- (B) A word processing package
- (C) A relational database management system (RDBMS)
- (D) A presentation package
- (E) An operating system

339. A clerk creates a new database in MS Access 2016 and saves it. By default, the file will be saved with which extension? [Easy]

- (A) .accdb
- (B) .xlsx
- (C) .docx
- (D) .dbf
- (E) .pptx

340. In an MS Access table, the complete set of information about one single customer – his name, account number, branch and balance taken together – occupies one horizontal row. In database terminology such a row is called a: [Easy]

- (A) Field
- (B) Attribute
- (C) Column
- (D) Record
- (E) Data type

341. The clerk at a bank counter wants an on-screen layout that shows **one customer at a time** in a neat, user-friendly manner so that data can be entered and edited comfortably instead of scrolling across a wide datasheet. Which MS Access object should be used? [Easy]

- (A) Table
- (B) Query
- (C) Form
- (D) Report
- (E) Module

342. In an MS Access database, which one of the following objects actually stores the data permanently on the disk? [Easy]

- (A) Query
- (B) Form
- (C) Report
- (D) Macro
- (E) None of these

343. A bank wants a field named **Balance** to store amounts such as Rs. 45,750.50 and to display them automatically with the rupee symbol and two decimal places. Which data type should be assigned to this field in Design View? [Easy]

- (A) Short Text
- (B) Yes/No
- (C) OLE Object
- (D) Hyperlink
- (E) Currency

344. A token-issue table in a bank uses an **AutoNumber** field (New Values property set to Increment) as its primary key. During the day 40 token records are created, and later the records numbered 15 and 22 are deleted from the table. When the very next token is issued, what value will the AutoNumber field give it? [Moderate]

- (A) 39
- (B) 15
- (C) 22
- (D) 41
- (E) None of these

345. In a bank database, the table **CUSTOMER** is joined to the table **ACCOUNT** in such a way that one customer may hold several accounts, but every account belongs to exactly one customer. The relationship established between these two tables is: [Moderate]

- (A) One-to-One
- (B) One-to-Many
- (C) Many-to-Many
- (D) No relationship is possible
- (E) None of these

346. In the table **ACCOUNT**, the field **Cust_ID** is included only so that each account can be traced back to the matching **Cust_ID** which is the primary key of the table **CUSTOMER**. In the **ACCOUNT** table, the field **Cust_ID** is known as a: [Moderate]

- (A) Foreign key
- (B) Primary key
- (C) Candidate key
- (D) Composite key
- (E) Super key

347. The table **CUSTOMER_MASTER** holds these six records: Anil Kumar (Coimbatore, Rs. 78,500); Bhavna Shah (Madurai, Rs. 92,000); Chetan Rao (Coimbatore, Rs. 45,000); Divya Nair (Coimbatore, Rs. 50,000); Eshan Gupta (Madurai, Rs. 61,000); Farida Khan (Coimbatore, Rs. 1,20,000). A select query is run with the criteria **Branch = "Coimbatore"** and **Balance > 50000** placed on the **same criteria row**. How many records will the query return? [Moderate]

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) None of these

348. A bank must record which of its many **schemes** each of its many **customers** has subscribed to; one customer may join several schemes and one scheme may have many customers. To represent this correctly in MS Access, the designer must: [Moderate]

- (A) Join **CUSTOMER** and **SCHEME** directly with a One-to-One relationship
- (B) Merge **CUSTOMER** and **SCHEME** into a single table
- (C) Store all the scheme codes of a customer in one text field of the **CUSTOMER** table
- (D) Create a third (junction) table holding **Cust_ID** and **Scheme_ID**, and link it to both tables by One-to-Many relationships
- (E) None of these

349. Using the same six records – Anil Kumar (Coimbatore, Rs. 78,500); Bhavna Shah (Madurai, Rs. 92,000); Chetan Rao (Coimbatore, Rs. 45,000); Divya Nair (Coimbatore, Rs. 50,000); Eshan Gupta (Madurai, Rs. 61,000); Farida Khan (Coimbatore, Rs. 1,20,000) – a query is designed with **Branch** sorted **Ascending** and **Balance** sorted **Descending**, the **Branch** field being placed to the **left** of **Balance** in the query grid. Which record will appear **first** in the result? [Moderate]

- (A) Anil Kumar
- (B) Bhavna Shah
- (C) Farida Khan
- (D) Chetan Rao
- (E) Eshan Gupta

350. While designing a table, an officer wants every entry in the **IFSC_Code** field to be typed in the fixed 11-character pattern of an IFSC code – four letters, then the digit 0, then six alphanumeric characters – with the pattern shown on screen as the clerk types. Which **field property** should be set in Design View? [Moderate]

- | | |
|-------------------|-----------------|
| (A) Default Value | (D) Description |
| (B) Caption | (E) Input Mask |
| (C) Indexed | |

351. The table **FD_HOLDER** contains 8 records. In 3 of them the **Nominee** field was never filled in and is therefore **Null**; in 1 further record the clerk deliberately stored a **zero-length string** ("") there to show that the holder declined to name a nominee; the remaining 4 records carry ordinary nominee names. A Totals query is run with no grouping field, using **Count** on the **Nominee** field. What value will the query display? [Difficult]

- | | |
|-------|-------|
| (A) 3 | (D) 7 |
| (B) 4 | (E) 8 |
| (C) 5 | |

352. A **LOAN** table has these rows – Salem: Rs. 1,20,000; Erode: Rs. 80,000; Salem: Rs. 60,000; Trichy: Rs. 45,000; Erode: Rs. 1,00,000; Salem: Rs. 20,000. A **Totals query** is created that groups by **Branch** and takes **Sum of Loan_Amount**. How many rows will the result contain, and what will the **largest** group total be? [Difficult]

- | | |
|--------------------------|--------------------------|
| (A) 6 rows; Rs. 4,25,000 | (D) 3 rows; Rs. 2,00,000 |
| (B) 3 rows; Rs. 1,80,000 | (E) None of these |
| (C) 6 rows; Rs. 2,00,000 | |

353. A small table holds three accounts with balances Rs. 9,500, Rs. 10,000 and Rs. 12,000. An **Update Query** is run that increases **Balance** by 8% for every record where **Balance** < 10000. What will be the **total** of the three balances after the query is executed? [Difficult]

- | | |
|----------------|-------------------|
| (A) Rs. 32,260 | (D) Rs. 31,500 |
| (B) Rs. 33,060 | (E) None of these |
| (C) Rs. 34,020 | |

354. Table **CUSTOMER** has 6 records with **Cust_ID** 101 to 106. Table **ACCOUNT** has 8 records whose **Cust_ID** values are 101, 101, 102, 103, 103, 103, 105 and 106. Two queries are built on the join between them: Query 1 uses an **inner join** (only matching rows), Query 2 uses a **left outer join** showing **all** **CUSTOMER** records with their matching **ACCOUNT** records. How many rows will Query 1 and Query 2 return respectively? [Difficult]

- | | |
|--------------|-------------------|
| (A) 8 and 9 | (D) 9 and 8 |
| (B) 6 and 8 | (E) None of these |
| (C) 8 and 14 | |

355. A table **BRANCH_PRODUCT** records which products each branch offers. **Branch_Code** repeats because one branch offers many products, and **Product_Code** repeats because one product is offered by many branches, but no branch-product pair is ever repeated. The correct primary key for this table is: [Difficult]

- (A) Branch_Code alone
- (B) Product_Code alone
- (C) Branch_Code and Product_Code taken together as a composite key
- (D) Any one of Branch_Code or Product_Code, since both are keys
- (E) None of these

356. In the query design grid, the field **Branch** is given the criterion "**Salem**" and the field **Balance** is given **>50000** on the **same** row; in addition, the **or** row below carries "**Erode**" under **Branch** only. The table has: (Salem, Rs. 80,000); (Salem, Rs. 30,000); (Erode, Rs. 15,000); (Erode, Rs. 90,000); (Trichy, Rs. 95,000); (Salem, Rs. 55,000). How many records will the query return? [Difficult]

- (A) 2
- (B) 3
- (C) 4
- (D) 5
- (E) 6

357. In the Relationships window, a One-to-Many link is set from **CUSTOMER** to **ACCOUNT** with **Enforce Referential Integrity** ticked and **Cascade Delete Related Records** also ticked. Customer 103, who holds 3 accounts in the **ACCOUNT** table, is now deleted from **CUSTOMER**. What will be the result? [Difficult]

- (A) The customer record and all 3 related account records are deleted, i.e. 4 records in all
- (B) Access will block the deletion and display an error message
- (C) Only the customer record is deleted; the 3 account records remain with a blank Cust_ID
- (D) The 3 account records are deleted but the customer record is retained
- (E) None of these

Section 5.5

5.5.1 Network types: LAN, MAN, WAN

[checked, 1 flagged]

358. At the Karol Bagh branch of a public sector bank, all 18 desktop computers, two passbook printers and one shared laser printer are connected together through a switch installed inside the same branch building. The network so formed is best classified as a: [Easy]

- (A) LAN
- (B) MAN
- (C) WAN
- (D) SAN
- (E) None of these

359. In a computer awareness class for bank aspirants, the trainer asks for the full form of the abbreviation WAN. The correct expansion is: [Easy]

- (A) Wireless Access Network
- (B) Wide Area Network
- (C) Widespread Analog Network
- (D) Web Area Node
- (E) Wired Access Node

360. A commercial bank has its head office in Mumbai and branches in Delhi, Kolkata, Chennai and Guwahati, all linked to the core banking server through leased circuits hired from a telecom service provider. The network that connects these offices is an example of a: [Easy]

- (A) PAN
- (B) LAN
- (C) MAN
- (D) WAN
- (E) None of these

361. A co-operative bank has 14 branches spread across different localities of Pune city. All these branches are joined by an optical fibre network that stays entirely within the municipal limits of the city. This network is best described as a: [Easy]

- (A) LAN
- (B) MAN
- (C) WAN
- (D) PAN
- (E) None of these

362. Among the three standard categories of networks classified by geographical coverage, the one that normally provides the highest data transfer rate is: [Easy]

- (A) MAN
- (B) WAN
- (C) LAN
- (D) All three give exactly the same data rate
- (E) None of these

363. The Internet, which links millions of computers and networks all over the world, is most correctly described as: [Easy]

- (A) The largest LAN in the world
- (B) The largest MAN in the world
- (C) The largest WAN in the world
- (D) A PAN of global size
- (E) None of these

364. Rakesh Nair, a relationship manager, pairs his mobile phone with his laptop over Bluetooth to transfer a customer file, the two devices being about 2 metres apart. The network formed between the phone and the laptop is an example of a: [Easy]

- (A) PAN
- (B) MAN
- (C) WAN
- (D) CAN
- (E) None of these

365. Which one of the following statements about network types is INCORRECT? [Moderate]

- (A) A LAN is generally confined to a single building or a small campus.
- (B) A WAN often uses leased lines obtained from telecom service providers.
- (C) A MAN typically spans a city or a large town.
- (D) The data transfer rate of a typical WAN link is higher than that of a typical LAN link.
- (E) LANs are usually owned and administered privately by a single organisation.

366. Arrange the following four network categories in ascending order of the geographical area they normally cover: (i) MAN (ii) PAN (iii) WAN (iv) LAN [Moderate]

- (A) (ii), (iv), (i), (iii)
- (B) (iv), (ii), (i), (iii)
- (C) (ii), (i), (iv), (iii)
- (D) (iii), (i), (iv), (ii)
- (E) None of these

367. A telecom company lays a high speed fibre ring around Hyderabad and sells connectivity on it to several banks, hospitals and colleges located in different parts of the same city, each of which uses it to join its own offices within the city. The network operated by the telecom company is best classified as a: [Moderate]

- (A) LAN, because each subscriber uses it only for its own offices
- (B) MAN, because it covers a metropolitan area and serves multiple organisations in that city
- (C) WAN, because it is owned by a telecom carrier
- (D) PAN, because each subscriber gets a personal connection
- (E) None of these

368. Which of the following is the most appropriate example of a Metropolitan Area Network? [Moderate]

- (A) A Wi-Fi network set up inside a two bedroom flat
- (B) A cable television distribution network serving subscribers throughout one city
- (C) The Internet
- (D) A Bluetooth link between a smart watch and a mobile phone
- (E) Two computers in the same room joined by a single crossover cable

369. The IT head of a bank wants to connect the LAN of the Nashik branch to the bank's country wide network so that branch terminals can reach the central server in Mumbai. The networking device most appropriate for joining a LAN to a WAN is a: [Moderate]

- | | |
|--------------|-------------------|
| (A) Hub | (D) Switch |
| (B) Repeater | (E) None of these |
| (C) Router | |

370. Consider the following two statements.

I. Several LANs situated in different cities can be interconnected to form a WAN.

II. Several WANs situated in different countries can be interconnected to form a LAN.

Which of the statements is/are true?

[Moderate]

- | | |
|-------------------|----------------------|
| (A) Only I | (D) Neither I nor II |
| (B) Only II | (E) None of these |
| (C) Both I and II | |

371. In terms of the transmission media and links normally used, which of the following pairings is INCORRECT? [Moderate]

- (A) LAN – twisted pair Ethernet cable inside an office
- (B) LAN – Wi-Fi within a branch premises
- (C) WAN – satellite and undersea fibre optic links
- (D) WAN – leased lines hired from a public telecom carrier
- (E) LAN – transmission circuits hired from a public telecom carrier for links between cities

372. Match the network category in Column I with its usual coverage in Column II.

Column I: (a) PAN (b) LAN (c) MAN (d) WAN

Column II: (i) hundreds to thousands of kilometres, across states and countries (ii) up to about 10 metres around a single user (iii) roughly 5 km to 50 km, within one city (iv) a few metres up to about 1 km, within a building or small campus [Difficult]

- (A) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
- (B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

- (C) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
- (D) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)
- (E) None of these

373. A bank operates the following three arrangements.

- (i) 22 terminals in the Coimbatore Gandhipuram branch connected through switches inside that branch building.
- (ii) All 9 branches located within Coimbatore city joined to one another by fibre cable that never leaves the city.
- (iii) The Coimbatore regional office connected to the head office in Mumbai and to regional offices in five other states.

The correct classification of (i), (ii) and (iii) respectively is:

[Difficult]

- | | |
|-------------------|-------------------|
| (A) LAN, WAN, MAN | (D) LAN, LAN, MAN |
| (B) LAN, MAN, WAN | (E) None of these |
| (C) MAN, LAN, WAN | |

374. To let the Vijayawada branch reach the data centre at Chennai, the bank's IT team stops hiring a dedicated leased line and instead sets up an encrypted VPN tunnel that carries the branch traffic over the public Internet. In terms of network classification, the arrangement after this change is best described as:

[Difficult]

- (A) A LAN, because the tunnel makes the two sites behave as though they were on one private network
- (B) A MAN, because a VPN tunnel can operate only within the limits of a single city
- (C) A WAN, because the traffic still travels between two cities; the VPN only adds privacy over shared public links
- (D) A PAN, because each branch user is given a personal login to the tunnel
- (E) None of these

375. Which IEEE standard family is associated with Wireless Metropolitan Area Networks, commonly marketed under the name WiMAX?

[Difficult]

- | | |
|-----------------|-------------------|
| (A) IEEE 802.3 | (D) IEEE 802.16 |
| (B) IEEE 802.11 | (E) None of these |
| (C) IEEE 802.15 | |

376. Consider the following statements.

- I. A LAN is normally owned, controlled and managed by a single organisation.
- II. A WAN usually makes use of transmission facilities provided by public telecom carriers.
- III. The bit error rate on a typical WAN link is lower than that on a typical LAN link.

Which of the statements is/are true?

[Difficult]

- | | |
|---------------------|--------------------------|
| (A) Only I | (D) All of I, II and III |
| (B) Only I and II | (E) None of these |
| (C) Only II and III | |

377. Network P consists of 500 computers, all located inside one large office building of a bank and joined by the bank's own cabling. Network Q consists of only 12 computers, four each in Jaipur, Bhopal and Ranchi, joined through leased circuits. Which of the following is correct?

[Difficult]

- (A) P is a WAN and Q is a LAN, because P has far more computers
- (B) P is a LAN and Q is a WAN

- (C) Both P and Q are LANs, because both are owned by one bank
- (D) Both P and Q are WANs, because both have many computers
- (E) None of these

378. A bank runs a private data network that links all its offices across India over leased lines. Only its own employees can log in to it, and it hosts the bank's internal circulars, HR portal and core banking screens. The most accurate description of this network is: [Difficult]

- (A) A LAN functioning as the Internet
- (B) A MAN functioning as an extranet
- (C) A WAN functioning as the bank's intranet
- (D) A PAN functioning as an intranet
- (E) None of these

5.5.2 Topologies and transmission media

[checked, 1 flagged]

379. Pratibha Bank's Vellore branch has 14 teller terminals, and each terminal is connected by its own separate cable to a single switch kept in the server room. One morning the switch failed and every terminal lost connectivity, although not a single terminal cable was damaged. Which topology is the branch LAN using? [Easy]

- (A) Bus topology
- (B) Ring topology
- (C) Star topology
- (D) Full mesh topology
- (E) None of these

380. Which one of the following is an *unguided* (wireless) transmission medium? [Easy]

- (A) Unshielded twisted pair (UTP) cable
- (B) Coaxial cable
- (C) Optical fibre cable
- (D) Terrestrial microwave radio link
- (E) Shielded twisted pair (STP) cable

381. A technician at Sindhu Bank is crimping Category 6 UTP cable to connect a desktop to the wall socket of the branch LAN. Which connector is the standard choice for this cable? [Easy]

- (A) BNC connector
- (B) RJ-11 connector
- (C) RJ-45 connector
- (D) ST connector
- (E) None of these

382. While cabling the new counter hall of Kaveri Bank, the engineer must place a switch so that no single Category 5e or Category 6 UTP run from a workstation to the switch exceeds the limit laid down in the Ethernet structured cabling standard. That maximum permissible length of one UTP run is: [Easy]

- (A) 10 metres
- (B) 100 metres
- (C) 185 metres
- (D) 500 metres
- (E) None of these

383. In the leased link connecting two offices of Ananya Bank, the data travels as pulses of light that are kept inside the core by total internal reflection. The transmission medium being described is: [Easy]

- (A) Coaxial cable
- (B) Optical fibre cable
- (C) Shielded twisted pair cable
- (D) Category 5e UTP cable
- (E) None of these

384. In a bus topology the two far ends of the backbone cable are fitted with terminators. The main purpose of a terminator is to: [Easy]

- (A) amplify the signal so that it can travel a longer distance
- (B) absorb the signal at the end of the cable and stop it from reflecting back on to the bus
- (C) convert the digital signal into an analog signal
- (D) allot an IP address to every node on the bus
- (E) None of these

385. Nine ATMs of Chandra Bank are connected in a ring topology, each machine being linked to exactly two neighbours so that the loop is closed. How many links (cable segments) does this ring contain? [Easy]

- (A) 8
- (B) 9
- (C) 16
- (D) 18
- (E) None of these

386. Twelve branch routers of Sindhu Bank are to be connected in a full mesh, every branch having a direct dedicated line to every other branch. How many lines are needed in total, and how many input/output ports must each individual branch router provide for these lines? [Moderate]

- (A) 66 lines, 12 ports per router
- (B) 66 lines, 11 ports per router
- (C) 132 lines, 11 ports per router
- (D) 78 lines, 12 ports per router
- (E) None of these

387. Ananya Bank has to network 10 computers in its clearing section. In a star layout one cable runs from each computer to a central switch; in a full mesh layout a cable runs between every pair of computers. How many fewer cables does the star layout need as compared with the full mesh layout? [Moderate]

- (A) 25
- (B) 30
- (C) 35
- (D) 45
- (E) None of these

388. The back-office cabin of Kaveri Bank lies next to a heavy-duty lift motor, and the UTP run passing that wall shows frequent data errors. Replacing that run with STP cable removes the errors, mainly because STP cable: [Moderate]

- (A) carries a metallic foil or braid shield around the pairs that reduces electromagnetic interference and crosstalk
- (B) carries light instead of electricity and is therefore unaffected by any motor
- (C) uses a single thick conductor in place of twisted pairs
- (D) is an unguided medium and so bypasses the wall completely
- (E) None of these

389. Which one of the following statements about optical fibre cable is **INCORRECT**? [Moderate]

- (A) It is highly immune to electromagnetic interference.
- (B) It offers a much higher bandwidth than twisted pair cable.
- (C) Its core is made of copper, along which electrons carry the signal.
- (D) It suffers much lower attenuation than coaxial cable over long distances.
- (E) Light is retained inside the core by total internal reflection at the core-cladding boundary.

390. Chandra Bank must interconnect 20 workstations in one hall. Which topology will require the *largest* total amount of cabling as well as the largest number of ports on every individual workstation?
[Moderate]

- (A) Bus topology
- (B) Star topology
- (C) Ring topology
- (D) Full mesh topology
- (E) None of these

391. In the zonal network of Pratibha Bank a main backbone cable runs along the corridor; several hubs are tapped on to this backbone, and each hub in turn serves a group of terminals through individual cables. This hierarchical arrangement is best described as:
[Moderate]

- (A) a pure ring topology
- (B) a tree (hierarchical) topology, i.e. a bus of stars
- (C) a pure full mesh topology
- (D) a simple point-to-point topology
- (E) None of these

392. Ten workstations of Ananya Bank are wired as a simple unidirectional ring in which each station regenerates and passes on the signal it receives. The network interface card of one station fails completely, so it neither receives nor repeats. What is the immediate effect?
[Moderate]

- (A) Only that one station is affected; the remaining nine continue to communicate normally.
- (B) The whole ring stops working until the faulty station is bypassed or removed from the loop.
- (C) The ring automatically converts itself into a bus and keeps running.
- (D) All traffic is automatically rerouted through the central hub of the ring.
- (E) None of these

393. The data centre of Sindhu Bank presently has 8 servers connected in a full mesh. Four more servers are added and the full mesh is maintained among all servers. How many *additional* cables have to be laid?
[Difficult]

- (A) 28
- (B) 32
- (C) 38
- (D) 66
- (E) None of these

394. An audit of Kaveri Bank's inter-office network shows that it is a complete mesh containing exactly 78 direct point-to-point links. How many offices are on this network?
[Difficult]

- (A) 12
- (B) 13
- (C) 14
- (D) 39
- (E) None of these

395. Pratibha Bank lays a 240 km optical fibre link between its Chennai and Bengaluru offices. The optical signal can travel at most 50 km before it must be regenerated. Taking the transmitting and receiving equipment at the two end offices as already provided, what is the minimum number of repeaters to be installed at intermediate points along the route?
[Difficult]

- (A) 4
- (B) 5
- (C) 6
- (D) 48
- (E) None of these

396. A nightly backup file of size 900 MB is sent from a branch of Chandra Bank to the data centre over a dedicated 100 Mbps link. Taking 1 byte = 8 bits and 1 MB = 10^6 bytes, and ignoring all protocol overhead, how long does the transfer take? [Difficult]

- (A) 9 seconds
- (B) 72 seconds
- (C) 90 seconds
- (D) 720 seconds
- (E) None of these

397. Which one of the following correctly distinguishes single-mode optical fibre from multimode optical fibre? [Difficult]

- (A) Single-mode fibre has a much narrower core, is normally driven by a laser source and supports far longer distances with less dispersion.
- (B) Single-mode fibre has a much wider core, is driven by an inexpensive LED source and is meant only for short in-building runs.
- (C) Multimode fibre has no cladding, which is why many light paths can escape and travel in parallel.
- (D) Single-mode fibre carries an electrical signal whereas multimode fibre carries light.
- (E) None of these

398. In the new premises of Ananya Bank there are 4 hubs. Each hub is connected to 5 terminals by a separate cable to every terminal, and the 4 hubs themselves are joined one after another in a single line by backbone segments. Counting every hub-to-terminal cable and every hub-to-hub backbone segment, how many cable segments are there in all? [Difficult]

- (A) 20
- (B) 23
- (C) 24
- (D) 26
- (E) None of these

399. Consider the following statements. (i) In a star topology, the failure of the cable of one node does not stop the other nodes from communicating. (ii) In a full mesh of n devices, each device needs n input/output ports for the mesh links. (iii) Coaxial cable offers a higher bandwidth than ordinary unshielded twisted pair telephone cable. (iv) Radio waves are an example of a guided transmission medium. Which of the statements are correct? [Difficult]

- (A) (i) and (ii) only
- (B) (i) and (iii) only
- (C) (ii) and (iii) only
- (D) (i), (iii) and (iv) only
- (E) None of these

5.5.3 OSI and TCP/IP models

[checked, 1 flagged]

400. During an IT induction session at Canara Bank, the trainer draws the complete OSI reference model on the board. How many layers does the OSI model contain? [Easy]

- (A) 4
- (B) 5
- (C) 6
- (D) 7
- (E) None of these

401. A data packet travelling from the Mumbai data centre of a bank to its Nagpur branch must be forwarded through several intermediate networks. Which layer of the OSI model is primarily responsible for routing such packets? [Easy]

- (A) Data Link layer
- (B) Network layer
- (C) Transport layer
- (D) Session layer
- (E) Physical layer

402. Shalini, a probationary officer, is asked how many layers the TCP/IP reference model (the protocol suite actually used on the Internet) is organised into. The correct reply is [Easy]

- (A) 3
- (B) 4
- (C) 5
- (D) 7
- (E) None of these

403. The leased line connecting a bank branch to its regional office carries the actual electrical signals representing 0s and 1s. Transmission of these raw bits over the physical medium is the function of which OSI layer? [Easy]

- (A) Physical layer
- (B) Data Link layer
- (C) Network layer
- (D) Session layer
- (E) Presentation layer

404. A customer opens the net-banking portal of his bank in a browser, which uses the HTTP/HTTPS protocol. HTTP belongs to which layer of the OSI model? [Easy]

- (A) Transport layer
- (B) Network layer
- (C) Application layer
- (D) Session layer
- (E) Data Link layer

405. Before a customer's account statement is sent out from a bank server, the data is compressed and encrypted so that it is unreadable in transit. In the OSI model, encryption, decryption and compression are the responsibility of which layer? [Easy]

- (A) Session layer
- (B) Presentation layer
- (C) Application layer
- (D) Transport layer
- (E) None of these

406. In the TCP/IP protocol suite, which of the following is a connection-oriented Transport layer protocol that guarantees reliable, in-order delivery of data? [Easy]

- (A) UDP
- (B) IP
- (C) TCP
- (D) ICMP
- (E) ARP

407. During a video-KYC call, the bank's software establishes a dialogue between the customer's device and the officer's terminal, inserts synchronisation checkpoints so that an interrupted verification can resume from the last checkpoint instead of restarting, and finally closes the dialogue. Which OSI layer provides these dialogue control and synchronisation services? [Moderate]

- (A) Transport layer
- (B) Session layer
- (C) Presentation layer
- (D) Application layer
- (E) Network layer

408. When the seven-layer OSI model is compared with the four-layer TCP/IP model, two OSI layers have no separate existence in TCP/IP and their functions are absorbed into the TCP/IP Application layer. These two layers are [Moderate]

- (A) Physical and Data Link
- (B) Session and Presentation
- (C) Network and Transport
- (D) Transport and Session
- (E) None of these

409. A cheque-clearing file is sent from an application on a bank server down through the OSI stack. Which of the following gives the layers in the correct top-to-bottom order? [Moderate]

- (A) Application, Session, Presentation, Transport, Network, Data Link, Physical
- (B) Application, Presentation, Session, Transport, Network, Data Link, Physical
- (C) Application, Presentation, Session, Network, Transport, Data Link, Physical
- (D) Physical, Data Link, Network, Transport, Session, Presentation, Application
- (E) None of these

410. A bank branch uses a switch to interconnect the counter terminals and a router to reach the regional office over a WAN link. With reference to the OSI model, which pairing is correct? [Moderate]

- (A) Router – Layer 2, Switch – Layer 3
- (B) Router – Layer 3, Switch – Layer 2
- (C) Router – Layer 3, Switch – Layer 1
- (D) Router – Layer 4, Switch – Layer 2
- (E) None of these

411. The network administrator at a bank types the ping command to test whether the ATM switch server is reachable, and receives 'Destination host unreachable'. Which TCP/IP Internet layer protocol generates such error and status messages? [Moderate]

- (A) SMTP
- (B) ICMP
- (C) FTP
- (D) UDP
- (E) None of these

412. An ATM terminal has a burnt-in 48-bit hardware address on its network card and is also configured with an IP address by the bank's network team. In the OSI model, the hardware (MAC) address is used by which layer and the IP address by which layer respectively? [Moderate]

- (A) Network layer, Data Link layer
- (B) Data Link layer, Network layer
- (C) Physical layer, Network layer
- (D) Data Link layer, Transport layer
- (E) None of these

413. A large NEFT batch file is broken into smaller units at the sending host, numbered, and re-assembled in the correct order at the receiving host, with end-to-end flow control and error recovery. These functions belong to which OSI layer? [Moderate]

- (A) Network layer
- (B) Transport layer
- (C) Session layer
- (D) Data Link layer
- (E) None of these

414. Consider the following statements about the OSI and TCP/IP models. (I) The OSI model has seven layers whereas the TCP/IP model has four. (II) The Network Access layer of the TCP/IP model covers the functions of the Physical and Data Link layers of OSI. (III) The Transport layer of the TCP/IP model supports both a connection-oriented and a connectionless protocol. Which of the statements is/are correct? [Difficult]

- (A) Only I and II
- (B) Only II and III
- (C) Only I and III
- (D) All I, II and III
- (E) None of these

415. As a fund-transfer instruction descends from the Application layer to the Physical layer of a bank's server, its protocol data unit is renamed at successive layers. The correct sequence of PDU names is [Difficult]

- (A) Data, Packet, Segment, Frame, Bits
- (B) Data, Segment, Packet, Frame, Bits
- (C) Data, Frame, Packet, Segment, Bits
- (D) Data, Segment, Frame, Packet, Bits
- (E) None of these

416. In a workshop on core banking networks, five layer-function pairs of the OSI model are listed. Which one of the following pairs is INCORRECTLY matched? [Difficult]

- (A) Physical layer – transmission of raw bits over the transmission medium
- (B) Data Link layer – error detection on a single link using a checksum such as CRC
- (C) Network layer – routing of packets across interconnected networks
- (D) Transport layer – selection of the best physical path between two different networks
- (E) Presentation layer – translation, encryption and compression of data

417. A bank's core banking server runs several services simultaneously and each is identified by a port number, while the server itself is identified on the network by its IP address. In the OSI model, port numbers are used at which layer and IP addresses at which layer respectively? [Difficult]

- (A) Network layer, Transport layer
- (B) Transport layer, Network layer
- (C) Transport layer, Data Link layer
- (D) Application layer, Network layer
- (E) None of these

418. Which one of the following protocol-layer pairs, with reference to the four-layer TCP/IP model, is correctly matched? [Difficult]

- (A) FTP – Internet layer
- (B) UDP – Application layer
- (C) IP – Internet layer
- (D) ICMP – Transport layer
- (E) None of these

419. While studying encapsulation, Ramesh observes that most OSI layers add only a header to the data they receive from the layer above, but one layer adds a header at the front as well as a trailer at the end. That layer is the [Difficult]

- (A) Physical layer
- (B) Data Link layer
- (C) Network layer
- (D) Transport layer
- (E) Presentation layer

420. A bank's head office sends 4,000 bytes of application data to a branch server over TCP/IP. The maximum size of an IP datagram allowed on the path is 1,500 bytes, the TCP header is 20 bytes and the IP header is 20 bytes. What is the minimum number of IP datagrams required to carry this data?

[Difficult]

- (A) 2
- (B) 3
- (C) 4
- (D) 5
- (E) None of these

5.5.4 Internet terminology, protocols, browsers

[unchecked]

421. The core banking portal of a branch is opened using the HTTP protocol. If no port number is written in the address, which is the default port number used by HTTP?

[Easy]

- (A) 21
- (B) 25
- (C) 80
- (D) 110
- (E) 443

422. In internet terminology, URL stands for:

[Easy]

- (A) Uniform Resource Locator
- (B) Universal Reference Link
- (C) Unified Retrieval Language
- (D) Uniform Registry Locator
- (E) None of these

423. A clerk at a bank branch has to upload a large set of scanned KYC documents from the branch computer to the head-office server. Which of the following protocols is specifically designed for transferring files between computers over a network?

[Easy]

- (A) SMTP
- (B) FTP
- (C) SNMP
- (D) ICMP
- (E) None of these

424. Which one of the following is a web browser and NOT a search engine?

[Easy]

- (A) Bing
- (B) Yahoo!
- (C) Google Chrome
- (D) Baidu
- (E) Ask.com

425. In the e-mail address `ramesh.kumar@sbi.co.in`, the portion written after the @ sign is known as the:

[Easy]

- (A) User name
- (B) Protocol
- (C) Domain name
- (D) Hyperlink
- (E) None of these

426. Companies such as BSNL, Airtel and Jio supply households and offices with a connection through which they can access the internet. Such a company is technically called a/an:

[Easy]

- (A) Internet Service Provider (ISP)
- (B) Web hosting server
- (C) Search engine
- (D) Domain registrar
- (E) None of these

427. When a customer logs in to a bank's website, a very small text file is placed on the customer's computer by that website so that his preferences and login session can be remembered on the next visit. This small file is called a: [Easy]

- (A) Cookie
- (B) Applet
- (C) Spam
- (D) Firewall
- (E) None of these

428. An officer sends an e-mail from his desktop client and later downloads the replies to the same client. Which pair of protocols is used for *sending* and *retrieving* e-mail respectively? [Moderate]

- (A) SMTP and FTP
- (B) POP3 and SMTP
- (C) SMTP and POP3
- (D) HTTP and SMTP
- (E) None of these

429. A branch manager types `www.rbi.org.in` in the address bar. Before the page can be fetched, this name must be translated into the numeric address of the server. Which internet service performs this translation? [Moderate]

- (A) DHCP
- (B) DNS
- (C) NAT
- (D) ARP
- (E) None of these

430. A customer opens his internet-banking account at `https://retail.bankofindia.co.in` and no port number is typed in the address. Which port will the browser connect to by default? [Moderate]

- (A) 21
- (B) 25
- (C) 443
- (D) 8080
- (E) 80

431. A regional manager reads his official mail on his office desktop, his laptop and his mobile phone. He wants a message that he has read or deleted on one device to show as read or deleted on the other two as well, with all mail continuing to remain on the server. Which mail-retrieval protocol should he configure? [Moderate]

- (A) POP3
- (B) IMAP
- (C) SMTP
- (D) SNMP
- (E) None of these

432. A customer complains that the bank's deposit-rate page keeps showing yesterday's rates even after the bank has updated them, because the browser is redisplaying a copy of the page that it had already downloaded and saved locally. This locally saved copy is held in the browser's: [Moderate]

- (A) Bookmark list
- (B) Cache
- (C) Address bar
- (D) Plug-in manager
- (E) None of these

433. For transferring an NEFT batch file, the bank's software needs a transport protocol that establishes a connection first, numbers the segments, and retransmits any segment that is lost so that the data arrives complete and in the correct order. Which protocol meets this requirement? [Moderate]

- (A) UDP
- (B) TCP
- (C) ICMP
- (D) ARP
- (E) None of these

434. Consider the following statements: (i) HTTP is a stateless protocol. (ii) FTP normally uses port 25. (iii) HTTPS uses SSL/TLS to encrypt the data exchanged. (iv) SMTP is used to receive mail from the mail server into the client. Which of the statements are correct? [Moderate]

- (A) (i) and (ii) only
- (B) (i) and (iii) only
- (C) (ii) and (iv) only
- (D) (i), (iii) and (iv) only
- (E) All four are correct

435. An IT trainee prepares a chart of protocols and their well-known port numbers for the bank's staff. Which one of the following pairings in his chart is INCORRECT? [Difficult]

- (A) HTTPS – 443
- (B) SMTP – 25
- (C) Telnet – 23
- (D) DNS – 53
- (E) FTP – 23

436. Examine the address `https://www.bankofbaroda.co.in:8443/retail/login.jsp?acctno=12345`. Which part of this address constitutes the *query string*? [Difficult]

- (A) `https`
- (B) `www.bankofbaroda.co.in`
- (C) `8443`
- (D) `/retail/login.jsp`
- (E) `acctno=12345`

437. Match each protocol/technology with the OSI layer at which it principally operates: (i) HTTP (ii) TCP (iii) IP (iv) Ethernet. [Difficult]

- (A) (i) Application, (ii) Transport, (iii) Network, (iv) Data link
- (B) (i) Transport, (ii) Application, (iii) Data link, (iv) Network
- (C) (i) Application, (ii) Network, (iii) Transport, (iv) Data link
- (D) (i) Session, (ii) Transport, (iii) Data link, (iv) Physical
- (E) (i) Network, (ii) Transport, (iii) Application, (iv) Data link

438. Which one of the following statements about HTTPS is NOT correct? [Difficult]

- (A) It encrypts the data travelling between the browser and the web server
- (B) It relies on a digital certificate issued by a Certifying Authority
- (C) It guarantees that the contents of the website are genuine, safe and free from malware
- (D) It normally operates on port 443
- (E) It is HTTP running on top of SSL/TLS

439. Which of the following correctly describes an IPv6 address? [Difficult]

- (A) 32 bits, written as four decimal numbers separated by dots
- (B) 64 bits, written as eight decimal numbers separated by dots

- (C) 128 bits, written as eight groups of hexadecimal digits separated by colons
- (D) 128 bits, written as sixteen decimal numbers separated by dots
- (E) None of these

440. In a web browser, the software component that takes the HTML and CSS received from the server and converts it into the formatted page you actually see on the screen is called the: [Difficult]

- (A) Rendering engine
- (B) Search engine
- (C) Plug-in
- (D) Web server
- (E) None of these

441. Shri Ravi Menon types `www.canarabank.com` into his browser and presses Enter. Which of the following gives the correct sequence of the main events that follow? [Difficult]

- (A) DNS resolution of the name to an IP address; TCP three-way handshake with the server; HTTP request sent; response rendered by the browser
- (B) TCP three-way handshake with the server; DNS resolution of the name to an IP address; HTTP request sent; response rendered by the browser
- (C) HTTP request sent; DNS resolution of the name to an IP address; TCP three-way handshake with the server; response rendered by the browser
- (D) DNS resolution of the name to an IP address; HTTP request sent; TCP three-way handshake with the server; response rendered by the browser
- (E) None of these

5.5.5 Email, search engines, cloud computing basics

[checked, 2 flagged]

442. Meena, a clerk at Sundaram Bank, has to mail a circular to 40 customers in such a way that **no recipient can see the addresses of the other recipients**. In which field of the mail should she place the 40 addresses? [Easy]

- (A) To
- (B) Cc
- (C) Bcc
- (D) Subject
- (E) Attachment

443. When Rakesh clicks the “Send” button in his mail client, the message is pushed from his computer to the mail server. Which protocol performs this **sending** of outgoing mail? [Easy]

- (A) POP3
- (B) SMTP
- (C) FTP
- (D) IMAP
- (E) None of these

444. In the e-mail address `ramesh.kumar@sundarambank.co.in`, which portion is the **domain name** of the mail server? [Easy]

- (A) ramesh
- (B) ramesh.kumar
- (C) sundarambank.co.in
- (D) kumar@sundarambank
- (E) in

445. A bank hires virtual machines, raw disk storage and network bandwidth from a cloud vendor, and then installs its own operating system, database and application software on them. This model of cloud service is called: [Easy]

- (A) Software as a Service (SaaS)
- (B) Platform as a Service (PaaS)
- (C) Infrastructure as a Service (IaaS)
- (D) Network as a Service (NaaS)
- (E) None of these

446. Which **one** of the following is a search engine?

[Easy]

- | | |
|---------------------|----------------------|
| (A) Mozilla Firefox | (D) Bing |
| (B) Google Chrome | (E) Windows Explorer |
| (C) MS Outlook | |

447. Every morning Sunita's mailbox is filled with unsolicited bulk advertisements sent to thousands of addresses at once. Such mail is technically called:

[Easy]

- | | |
|-------------|---------------|
| (A) Spam | (D) Signature |
| (B) Draft | (E) Thread |
| (C) Archive | |

448. Sundaram Bank builds a cloud on its own data centre and allows **only its own branches and staff** to use it; no outside organisation has access. This deployment model is called a:

[Easy]

- | | |
|---------------------|-------------------|
| (A) Public cloud | (D) Hybrid cloud |
| (B) Private cloud | (E) None of these |
| (C) Community cloud | |

449. Anand checks his official mail from his desktop at the branch, from a laptop at home and from his mobile phone. He wants that a mail once read or deleted on any one device should show the **same status on all three devices**, with the messages continuing to reside on the mail server. Which retrieval protocol should he configure?

[Moderate]

- | | |
|----------|-------------------|
| (A) SMTP | (D) HTTP |
| (B) POP3 | (E) None of these |
| (C) IMAP | |

450. Priya wants search results that contain the **exact phrase** *IBPS Clerk syllabus* and that **do not** mention the word *coaching*. Which query should she type into the search engine?

[Moderate]

- (A) IBPS Clerk syllabus coaching
- (B) "IBPS Clerk syllabus" -coaching
- (C) "IBPS Clerk syllabus" +coaching
- (D) IBPS OR Clerk OR syllabus OR coaching
- (E) "IBPS Clerk syllabus coaching"

451. A co-operative bank stops maintaining its own mail servers and instead subscribes to a ready-made web-based office suite (mail, spreadsheet and word processor) hosted by a cloud vendor. The bank neither installs software nor applies patches; it only creates user accounts and pays a monthly fee per user. This is an example of:

[Moderate]

- (A) IaaS
- (B) PaaS
- (C) SaaS
- (D) A private cloud
- (E) None of these

452. Ravi sends one mail with the following recipients — **To:** Anjali, Bhavna, Chetan; **Cc:** Deepak, Esha; **Bcc:** Farhan. Anjali now presses **Reply All** exactly once. How many **distinct persons** receive Anjali's reply? [Moderate]

- (A) 4
- (B) 5
- (C) 6
- (D) 7
- (E) None of these

453. A bank keeps its customer KYC database on servers inside its own data centre for security reasons, but hosts its public marketing website and its festival-season offer portal on a rented public cloud so that it can absorb sudden traffic. The two are linked so that data can move between them. The bank's arrangement is best described as a: [Moderate]

- (A) Pure public cloud
- (B) Pure private cloud
- (C) Hybrid cloud
- (D) Community cloud
- (E) None of these

454. Kavita opens *Mozilla Firefox* on her office computer, types `www.google.com` in the address bar, and then keys in "RTGS timings". Which statement about this sequence is correct? [Moderate]

- (A) Firefox is a search engine and Google is a web browser.
- (B) Firefox is a web browser and Google is a search engine.
- (C) Both Firefox and Google are search engines.
- (D) Both Firefox and Google are web browsers.
- (E) Firefox is an e-mail client and Google is an operating system.

455. A cloud vendor charges Rs. 3 per GB per month for backup storage. A bank branch stores 240 GB of scanned records for 9 months, and the vendor allows a 15% discount on the total for advance payment. What is the amount finally payable? [Moderate]

- (A) Rs. 5,508
- (B) Rs. 6,480
- (C) Rs. 5,832
- (D) Rs. 4,896
- (E) None of these

456. Which **one** of the following sets of protocol descriptions is correct in **every** part? [Difficult]

- (A) SMTP sends mail; POP3 downloads mail and normally removes it from the server; DNS converts domain names into IP addresses.
- (B) SMTP downloads mail; IMAP sends mail; DNS assigns IP addresses to new devices.
- (C) POP3 sends mail; SMTP keeps mail synchronised on the server; HTTP resolves domain names.
- (D) IMAP sends mail; SMTP downloads mail; DHCP converts domain names into IP addresses.
- (E) None of these

457. A search engine answers a query in a fraction of a second even though the web contains billions of pages. Which of the following correctly describes **how** it is able to do so? [Difficult]

- (A) At the moment the query is typed, the engine visits every website on the Internet and reads its pages afresh.

- (B) A program called a *crawler* (spider) visits pages in advance and stores them in an *index*; the query is then matched against this ready-made index and the hits are ranked before being displayed.
- (C) The engine forwards the query to the user's Internet service provider, which keeps a copy of every web page ever visited by its customers.
- (D) The engine searches only the pages already stored in the browser's history and cache on the user's own computer.
- (E) The engine asks each website owner to reply to the query, and displays the replies in the order they arrive.

458. An analyst wants only **PDF documents**, hosted **on the domain rbi.org.in**, containing the **exact phrase** *monetary policy report*, and **not** containing the word *draft*. Which single query meets all four conditions? [Difficult]

- (A) monetary policy report site:rbi.org.in filetype:pdf draft
- (B) "monetary policy report" site:rbi.org.in filetype:pdf -draft
- (C) "monetary policy report" -site:rbi.org.in filetype:pdf draft
- (D) "monetary policy report draft" site:rbi.org.in filetype:doc
- (E) None of these

459. Under the shared-responsibility model of an **IaaS** cloud, which of the following tasks remains the **customer's** responsibility? [Difficult]

- (A) Physical security of the vendor's data centre
- (B) Maintenance and upgrade of the hypervisor
- (C) Applying security patches to the guest operating system running in the customer's virtual machine
- (D) Replacing failed disks in the vendor's storage array
- (E) Providing power and cooling to the server racks

460. A bank runs 3 identical virtual machines on a cloud at Rs. 2.40 per machine per hour, for 18 hours a day over 25 days in a month, and additionally uses 500 GB of block storage billed at Rs. 1.80 per GB per month. What is the total bill for that month? [Difficult]

- (A) Rs. 3,240
- (B) Rs. 4,140
- (C) Rs. 4,320
- (D) Rs. 5,040
- (E) None of these

461. The original e-mail standard could carry only plain 7-bit ASCII text in the message body. Which standard was introduced so that the **same** mail system could also carry JPEG images, PDF attachments and text written in Indian language scripts? [Difficult]

- (A) MIME
- (B) SMTP
- (C) SNMP
- (D) TCP
- (E) None of these

462. Consider the following three statements about cloud computing.

- (I) *Elasticity* means computing resources can be scaled up or down quickly to match changing demand.
- (II) *Multi-tenancy* means the same physical infrastructure is shared by several customers whose data is kept logically separate.
- (III) *Vendor lock-in* means the customer can move an application from one cloud provider to another at no cost or effort.

Which of the statements is/are correct?

[Difficult]

- (A) Only (I)
- (B) Only (I) and (II)
- (C) Only (II) and (III)
- (D) All of (I), (II) and (III)
- (E) Only (III)

Section 5.6

5.6.1 DBMS and RDBMS concepts

[checked, 1 flagged]

463. During an induction programme at a bank's regional training centre, the faculty writes the abbreviation DBMS on the board and asks the probationary officers for its correct expansion. The correct full form of DBMS is: [Easy]

- (A) Data Backup and Mailing System
- (B) Database Management System
- (C) Digital Business Monitoring Software
- (D) Distributed Banking Mainframe Server
- (E) None of these

464. A bank maintains a relational table named CUSTOMER in which the details of one single customer – name, address, mobile number and account number – occupy one horizontal line of the table. In relational database terminology, such a horizontal line is called a: [Easy]

- (A) Attribute
- (B) Domain
- (C) Tuple
- (D) Degree
- (E) Schema

465. In the table ACCOUNT of a core banking database, the column AccountNo has been declared as the PRIMARY KEY. Which one of the following statements about this column is correct? [Easy]

- (A) It may hold duplicate values but never a NULL value
- (B) It may hold NULL values but never duplicate values
- (C) It can hold neither duplicate values nor NULL values
- (D) It can hold both duplicate values and NULL values freely
- (E) None of these

466. A clerk at a branch has to display, from the LOAN table, the names of all borrowers whose outstanding amount exceeds Rs. 5,00,000. Existing data must not be altered in any way. Which SQL statement is meant for this purpose? [Easy]

- (A) SELECT
- (B) UPDATE
- (C) INSERT
- (D) DELETE
- (E) ALTER

467. In a bank's database the table BRANCH has BranchCode as its primary key. The table ACCOUNT also contains a column BranchCode, whose values must always match some BranchCode already present in BRANCH. In the ACCOUNT table, this column BranchCode is known as a: [Easy]

- (A) Primary key
- (B) Candidate key
- (C) Foreign key
- (D) Composite key
- (E) Super key

468. The relational model of data, on which every modern RDBMS such as Oracle, MySQL and SQL Server is based, was first proposed in 1970 by: [Easy]

- (A) Charles Babbage
- (B) E. F. Codd
- (C) Tim Berners-Lee
- (D) Dennis Ritchie
- (E) James Gosling

469. A relational table FIXED_DEPOSIT maintained at a bank has 8 columns and currently stores the details of 250 deposits, one deposit per row. For this relation, the degree and the cardinality respectively are: [Easy]

- (A) 250 and 8
- (B) 8 and 250
- (C) 8 and 8
- (D) 250 and 250
- (E) 2000 and 8

470. The database administrator of a bank executes the following four statements in sequence: (i) CREATE TABLE, (ii) INSERT INTO, (iii) UPDATE, (iv) SELECT. How many of these four statements belong to the Data Definition Language (DDL) category of SQL? [Moderate]

- (A) Only one
- (B) Exactly two
- (C) Exactly three
- (D) All four
- (E) None of these

471. In the CUSTOMER relation of a bank, each of the three attributes CustomerID, PANNumber and AadhaarNumber is unique for every customer and can identify a customer uniquely. The bank finally selects PANNumber as the primary key. The number of alternate keys in this relation is: [Moderate]

- (A) Zero
- (B) One
- (C) Two
- (D) Three
- (E) None of these

472. In a bank database, the BRANCH table stores the branch codes 101, 102 and 103. The ACCOUNT table has BranchCode as a foreign key referring to BRANCH. A clerk tries to insert into ACCOUNT a new row with BranchCode 107. The RDBMS rejects the insertion. The constraint that has caused this rejection is: [Moderate]

- (A) Domain integrity
- (B) Entity integrity
- (C) Referential integrity
- (D) Physical integrity
- (E) None of these

473. A customer transfers Rs. 40,000 from her savings account to a recurring deposit account. The database debits Rs. 40,000 from the savings account, but before the corresponding credit is written the server crashes. On restart the RDBMS undoes the debit so that the money is not lost. The ACID property that guarantees this all-or-nothing behaviour of the transaction is: [Moderate]

- (A) Atomicity
- (B) Consistency
- (C) Isolation
- (D) Durability
- (E) None of these

474. A branch keeps a table in which a single column named ContactNumbers stores, for one customer, the entry 9876543210, 9123456780, 9001122334 inside one cell. Which normal form is directly violated by this design, and what is the standard remedy? [Moderate]

- (A) First normal form; make each cell atomic by moving numbers to separate rows of a related table

- (B) Second normal form; remove the partial dependency on part of the key
- (C) Third normal form; remove the transitive dependency between non-key attributes
- (D) Boyce–Codd normal form; make every determinant a candidate key
- (E) None of these

475. A database administrator wants to empty a large audit table completely, retaining the table structure, its columns and its constraints so that fresh rows can be inserted the next day. She specifically wants the operation classified as a DDL command that removes all rows at once without logging each row deletion individually. She should use: [Moderate]

- (A) DELETE
- (B) DROP
- (C) TRUNCATE
- (D) ALTER
- (E) UPDATE

476. The head office of a bank creates a database object over the ACCOUNT table so that regional managers can see only the columns AccountNo, BranchCode and Balance, without any customer name or address. The object stores no data of its own; it is simply a stored query whose result behaves like a table. This object is called a: [Moderate]

- (A) Index
- (B) View
- (C) Trigger
- (D) Cursor
- (E) None of these

477. A relation is defined as BRANCH_SCHEME(BranchCode, SchemeCode, SchemeName, AmountCollected) with the composite primary key (BranchCode, SchemeCode). All values are atomic. Here SchemeName depends only on SchemeCode, while AmountCollected depends on both attributes of the key. The highest normal form that this relation currently satisfies is: [Difficult]

- (A) First normal form only
- (B) Second normal form but not third normal form
- (C) Third normal form but not BCNF
- (D) Boyce–Codd normal form
- (E) None of these

478. A relation is defined as ACCOUNT_INFO(AccountNo, BranchCode, BranchCity) where AccountNo is the sole primary key. Every account belongs to exactly one branch, so AccountNo determines BranchCode, and every branch lies in exactly one city, so BranchCode determines BranchCity. All values are atomic. This relation is: [Difficult]

- (A) Not even in first normal form
- (B) In 1NF but not in 2NF
- (C) In 2NF but not in 3NF
- (D) In 3NF but not in BCNF
- (E) None of these

479. In a bank’s database the relation LOAN has 4 attributes and 60 tuples, while the relation OFFICER has 3 attributes and 20 tuples, and the two relations have no attribute in common. If the Cartesian product $\text{LOAN} \times \text{OFFICER}$ is computed, its degree and cardinality respectively will be: [Difficult]

- (A) 7 and 80
- (B) 12 and 1200
- (C) 7 and 1200
- (D) 12 and 80
- (E) None of these

480. A relation LOAN_MASTER has exactly five attributes: LoanNo, CustID, BranchCode, Amount and Tenure. LoanNo is its only candidate key. The total number of super keys that can be formed for this relation is: [Difficult]

- (A) 8
- (B) 15
- (C) 16
- (D) 31
- (E) 32

481. In a bank database, ACCOUNT has a foreign key to CUSTOMER and TRANSACTION has a foreign key to ACCOUNT, both declared with ON DELETE CASCADE. A customer named Rakesh Menon holds exactly 3 accounts, which carry 12, 7 and 5 transaction rows respectively. If his single row in CUSTOMER is deleted, the total number of rows removed from the three tables taken together is: [Difficult]

- (A) 24
- (B) 25
- (C) 27
- (D) 28
- (E) None of these

482. Transaction T_1 updates the balance of an account from Rs. 90,000 to Rs. 30,000 but has not yet committed. Meanwhile transaction T_2 reads the value Rs. 30,000 and uses it to sanction a decision. Thereafter T_1 fails and is rolled back, restoring Rs. 90,000, so T_2 has acted on a value that never officially existed. This situation is a dirty read, and the ACID property violated is: [Difficult]

- (A) Atomicity
- (B) Consistency
- (C) Isolation
- (D) Durability
- (E) None of these

483. In a bank database the relation BRANCH has 40 tuples with BranchCode as its primary key, and the relation ACCOUNT has 500 tuples, each carrying a non-NULL BranchCode that is guaranteed to exist in BRANCH. If the natural join of ACCOUNT and BRANCH is computed on BranchCode, the number of tuples in the result will be: [Difficult]

- (A) 40
- (B) 500
- (C) 540
- (D) 20000
- (E) None of these

5.6.2 Keys, tables, and basic SQL

[checked, 1 flagged]

484. In a relational database maintained by Sundaram Bank, which of the following BEST describes a **primary key**? [Easy]

- (A) A column that is allowed to repeat its values across different rows
- (B) A column or set of columns that uniquely identifies each row of a table and cannot be NULL
- (C) A column that must always store numeric data only
- (D) A column that refers to the primary key of some other table
- (E) None of these

485. A clerk at Anna Nagar branch wants to display *all* columns and *all* rows of the table named ACCOUNTS. Which SQL statement should be used? [Easy]

- (A) GET * FROM ACCOUNTS; (D) OPEN TABLE ACCOUNTS;
(B) READ ALL ACCOUNTS; (E) FETCH ACCOUNTS ALL;
(C) SELECT * FROM ACCOUNTS;

486. Sundaram Bank keeps two tables: CUSTOMER (Cust_ID is the primary key) and LOAN (Loan_ID is the primary key, and the column Cust_ID stores the ID of the customer who took the loan). One customer may take several loans. The column Cust_ID inside the LOAN table is a –
[Easy]

- (A) Primary key of LOAN (D) Composite key of LOAN
(B) Foreign key in LOAN (E) None of these
(C) Candidate key of LOAN

487. In relational DBMS terminology, a single *row* of a table (for example, the complete record of one savings account) is also called a –
[Easy]

- (A) Attribute (D) Degree
(B) Domain (E) Schema
(C) Tuple

488. Which SQL clause is used to restrict the *individual rows* that a SELECT statement returns, for example to show only accounts with balance above Rs. 50,000?
[Easy]

- (A) WHERE (D) GROUP BY
(B) HAVING (E) None of these
(C) ORDER BY

489. The IT department wants to remove the table OLD_LEDGER from the database *completely* – both its data and its structure/definition. Which command should be used?
[Easy]

- (A) DELETE (D) DROP
(B) TRUNCATE (E) ALTER
(C) UPDATE

490. A table BRANCH has 6 columns and currently holds 40 records. What are the degree and the cardinality of this relation?
[Easy]

- (A) Degree = 40, Cardinality = 6
(B) Degree = 6, Cardinality = 40
(C) Degree = 6, Cardinality = 6
(D) Degree = 46, Cardinality = 240
(E) None of these

491. The table ACCOUNTS of Sundaram Bank holds these rows (Acc_No, Name, City, Balance in Rs.): (A101, Ramesh, Chennai, 45,000); (A102, Sunita, Madurai, 82,000); (A103, Aravind, Chennai, 91,000); (A104, Meena, Coimbatore, 60,000); (A105, Kavitha, Chennai, 1,20,000). How many rows will the query `SELECT Name FROM ACCOUNTS WHERE City = 'Chennai' AND Balance > 50000;` return?
[Moderate]

- (A) 1 (D) 4
(B) 2 (E) None of these
(C) 3

492. The table STAFF holds (Name, Salary in Rs.): (Deepak, 52,000); (Farhan, 61,000); (Geeta, 48,000); (Harish, 75,000); (Indu, 39,000). The query `SELECT Name FROM STAFF ORDER BY Salary DESC`; is executed. Which name appears *third* in the output? [Moderate]

- (A) Farhan (D) Harish
(B) Geeta (E) None of these
(C) Deepak

493. A table KYC has 8 rows. Its column PAN is left blank (NULL) for 3 customers, while all other columns are filled for every row. What values are returned by `SELECT COUNT(*), COUNT(PAN) FROM KYC`; ? [Moderate]

- (A) 8 and 8 (D) 5 and 8
(B) 8 and 5 (E) None of these
(C) 5 and 5

494. Table BRANCH has 5 rows and 3 columns; table SCHEME has 4 rows and 2 columns. The query `SELECT * FROM BRANCH, SCHEME`; is run *without* any WHERE condition. How many rows and columns does the result have? [Moderate]

- (A) 9 rows, 5 columns (D) 9 rows, 6 columns
(B) 20 rows, 6 columns (E) None of these
(C) 20 rows, 5 columns

495. Table ACCOUNTS has 15 rows: 4 accounts belong to the Salem branch, 3 to Erode and the rest to Chennai. The statement `UPDATE ACCOUNTS SET Balance = Balance + 5000 WHERE Branch = 'Salem'`; is executed. By how much does the total of the Balance column increase? [Moderate]

- (A) Rs. 5,000 (D) Rs. 35,000
(B) Rs. 15,000 (E) Rs. 75,000
(C) Rs. 20,000

496. In Sundaram Bank's database, LOAN.Cust_ID is declared as a foreign key referencing CUSTOMER.Cust_ID, and no ON DELETE action was specified (default behaviour). Customer C07 currently has 2 outstanding loan rows in LOAN. What happens when the DBA runs `DELETE FROM CUSTOMER WHERE Cust_ID = 'C07'`; ? [Moderate]

- (A) The customer row is deleted and the two loan rows are also deleted automatically
(B) The statement is rejected with a referential-integrity error and the customer row remains
(C) The customer row is deleted and the two loan rows get Cust_ID set to NULL
(D) The two loan rows are deleted but the customer row remains
(E) None of these

497. A new table DEPOSITOR has the columns Acc_No, Name, Mobile and Aadhaar. In the existing data, every Acc_No is different; two brothers share the same Name; two customers have registered the same joint Mobile number; and Aadhaar has not yet been collected from one customer (it is NULL). Which column can be declared as the PRIMARY KEY? [Moderate]

- (A) Acc_No
- (B) Name
- (C) Mobile
- (D) Aadhaar
- (E) None of these

498. The table LOAN stores (Branch, Amount in Rs.): (Anna Nagar, 2,00,000); (Anna Nagar, 3,00,000); (Adyar, 1,50,000); (Velachery, 4,00,000); (Velachery, 1,00,000); (Velachery, 2,50,000); (Tambaram, 5,00,000). The query `SELECT Branch, SUM(Amount) FROM LOAN GROUP BY Branch HAVING COUNT(*) >= 2;` is executed. What is the total of all the SUM(Amount) values that appear in the output? [Difficult]

- (A) Rs. 5,00,000
- (B) Rs. 7,50,000
- (C) Rs. 12,50,000
- (D) Rs. 19,00,000
- (E) None of these

499. A relation ENROLMENT(Cust_ID, Scheme_ID, Join_Date) records which customer joined which recurring-deposit scheme. A customer may join many schemes, a scheme may be joined by many customers, but a given customer can join a given scheme at most once. Which is the correct *minimal* primary key? [Difficult]

- (A) Cust_ID alone
- (B) Scheme_ID alone
- (C) Join_Date alone
- (D) The composite key (Cust_ID, Scheme_ID)
- (E) The composite key (Cust_ID, Scheme_ID, Join_Date)

500. CUSTOMER contains 6 customers C1 to C6. In LOAN, customer C1 has 2 loan rows, C3 has 1 loan row, C4 has 3 loan rows, and C2, C5, C6 have none. How many rows are produced by `SELECT * FROM CUSTOMER LEFT JOIN LOAN ON CUSTOMER.Cust_ID = LOAN.Cust_ID;`? [Difficult]

- (A) 6
- (B) 9
- (C) 12
- (D) 18
- (E) None of these

501. CUSTOMER holds (Cust_ID, Name): (C01, Rajesh); (C02, Priya); (C03, Vinod); (C04, Anitha); (C05, Suresh). LOAN holds (Cust_ID, Amount in Rs.): (C01, 1,50,000); (C01, 2,60,000); (C02, 90,000); (C03, 5,00,000); (C03, 3,00,000); (C05, 2,00,000). How many names are returned by `SELECT Name FROM CUSTOMER WHERE Cust_ID IN (SELECT Cust_ID FROM LOAN WHERE Amount > 200000);`? [Difficult]

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) None of these

502. The table TXN stores (Acc_No, Type) as: (A1, CR); (A2, DR); (A1, CR); (A3, CR); (A2, CR); (A3, DR); (A1, DR); (A4, CR); (A4, CR). Let x be the value of `SELECT COUNT(*) FROM TXN WHERE Type = 'CR';` and y be the value of `SELECT COUNT(DISTINCT Acc_No) FROM TXN WHERE Type = 'CR';`. What is $x - y$? [Difficult]

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) None of these

503. Which one of the following statements about keys in a relational database is **correct**? [Difficult]

- (A) A single table can be given two different primary keys if it has two unique columns
- (B) A column with a UNIQUE constraint may hold a NULL value, whereas a primary key column may not
- (C) Every foreign key must also be the primary key of the table in which it appears
- (D) A table cannot be created unless at least one foreign key is defined in it
- (E) None of these

504. The table ACC has the columns Branch, Name and Balance. Which one of the following queries will raise an **error** when executed? [Difficult]

- (A) SELECT Branch, COUNT(*) FROM ACC GROUP BY Branch;
- (B) SELECT Branch, SUM(Balance) FROM ACC GROUP BY Branch HAVING SUM(Balance) > 100000;
- (C) SELECT Branch, Name FROM ACC WHERE Balance > 50000;
- (D) SELECT Branch, COUNT(*) FROM ACC WHERE COUNT(*) > 3 GROUP BY Branch;
- (E) SELECT * FROM ACC ORDER BY Balance DESC;

Section 5.7

5.7.1 Viruses, worms, trojans, malware

[checked, 2 flagged]

505. A malicious program that makes copies of itself and spreads from one computer to another over a network on its own, without attaching itself to any host file and without any action by the user, is called a [Easy]

- | | |
|--------------------|--------------|
| (A) Computer virus | (D) Cookie |
| (B) Computer worm | (E) Firewall |
| (C) Trojan horse | |

506. Shri Ramesh Iyer installs an app named “SBI Balance Checker” from an unofficial website. The app does display his balance correctly, but in the background it quietly sends his debit card number to an unknown server. This app is an example of a [Easy]

- | | |
|-----------------------|--------------------|
| (A) Worm | (D) Trojan horse |
| (B) Firewall | (E) Security patch |
| (C) Boot sector virus | |

507. The type of malware that locks or encrypts the victim’s files and then demands a payment, usually in crypto-currency, in exchange for the decryption key is known as [Easy]

- | | |
|----------------|---------------|
| (A) Adware | (D) Shareware |
| (B) Ransomware | (E) Firmware |
| (C) Freeware | |

508. A program secretly installed on a customer’s computer that records every key pressed on the keyboard, so that the attacker can later read the net-banking user ID and password, is called a [Easy]

- | | |
|-----------------------|-------------------|
| (A) Keylogger | (D) Bootloader |
| (B) Compiler | (E) Search engine |
| (C) Disk defragmenter | |

509. The term “malware” is short for [Easy]

- (A) Malfunctioning hardware
- (B) Malicious software
- (C) Manual software
- (D) Mailing software
- (E) None of these

510. Which one of the following is NOT a type of malware? [Easy]

- (A) Worm
- (B) Trojan horse
- (C) Firewall
- (D) Spyware
- (E) Ransomware

511. A bank instructs all branch computers to update the virus definition files of the antivirus package every day. The main purpose of such an update is [Easy]

- (A) To increase the size of the RAM of the computer
- (B) To change the operating system of the branch computer
- (C) To reformat the hard disk automatically each day
- (D) To enable the antivirus to recognise malware discovered after the software was installed
- (E) To increase the clock speed of the processor

512. On the LAN of a bank branch at Nagpur, a program arrives as an e-mail attachment. As soon as one clerk runs it, the program loads itself into memory, mails a copy of itself to every address in the address book and keeps generating traffic until the network slows down. Investigation shows that it did not attach itself to, or modify, any existing file on the disk. The program is best classified as a [Moderate]

- (A) File infector virus
- (B) Rootkit
- (C) Macro virus
- (D) Worm
- (E) Adware

513. Which one of the following statements about a Trojan horse is TRUE? [Moderate]

- (A) It replicates itself automatically and spreads to other computers on the network
- (B) It always infects the boot sector of the hard disk
- (C) It does not replicate itself; it depends on the user being tricked into installing or running it
- (D) It is a legitimate utility supplied along with every operating system
- (E) It can be removed only by replacing the motherboard

514. A programmer working for a finance company inserted a piece of code into the payroll application which lay dormant and did nothing, but was designed to delete all salary records automatically on 31 March if his own employee ID was no longer present in the master file. Such malicious code is known as a [Moderate]

- (A) Logic bomb
- (B) Worm
- (C) Adware
- (D) Cookie
- (E) Compiler bug

515. Several thousand home computers across India are infected by malware and are then controlled remotely by a single attacker, who makes all of them send requests to a bank’s website at the same time until the site becomes unavailable to genuine customers. The network of such infected, remotely controlled computers is called a [Moderate]

- (A) Botnet
- (B) Intranet
- (C) Extranet
- (D) Honeypot
- (E) None of these

516. A type of malware whose primary purpose is to gain privileged access to a system and then modify the operating system itself so that the malicious processes and files do not appear in the task manager or in directory listings, is called a [Moderate]

- (A) Rootkit
- (B) Adware
- (C) Macro virus
- (D) Spam filter
- (E) Patch

517. A particular virus rewrites and encrypts its own code with a different key every time it infects a new file, so that no two copies of it look alike on the disk. The chief consequence of this behaviour is that [Moderate]

- (A) It becomes harmless to the infected computer
- (B) It can be detected only after the hard disk is defragmented
- (C) It automatically deletes itself after seven days
- (D) It is difficult to detect by simple signature matching, because the stored pattern no longer matches the new copies
- (E) It converts the computer into a server

518. Consider the following three statements. (i) A worm can spread from one computer to another without any action by the user. (ii) A Trojan horse replicates itself in the same way as a virus does. (iii) Ransomware demands a payment from the victim in return for a decryption key. Which of the statements is or are correct? [Moderate]

- (A) Only (i)
- (B) Only (i) and (ii)
- (C) Only (i) and (iii)
- (D) Only (ii) and (iii)
- (E) All of (i), (ii) and (iii)

519. Which one of the following is a characteristic shared by BOTH a computer virus and a computer worm? [Difficult]

- (A) Both must attach themselves to a host file in order to spread
- (B) Both require the user to open an infected file before they can spread
- (C) Both encrypt the victim's data and demand a ransom
- (D) Both are items of computer hardware
- (E) None of these

520. A bank's server is attacked by newly written malware that exploits a flaw the software vendor is not yet aware of, and for which no antivirus vendor has yet published any signature. Which of the following defensive techniques has the best chance of detecting this attack? [Difficult]

- (A) Signature-based scanning against the existing virus definition database
- (B) Heuristic and behaviour-based detection, which flags a program by what it does rather than by what it looks like
- (C) Running a disk defragmentation utility every night
- (D) Compressing all server files into a single archive
- (E) Increasing the monitor resolution of the server console

521. A clerk at a Pune branch opens a word-processor document received by e-mail and enables its macros. Thereafter every new document he creates on that machine is also found to be infected, because the default template of the word processor has itself been infected. The malware involved is best described as a [Difficult]

- (A) Boot sector virus
- (B) Macro virus
- (C) Network worm
- (D) Rootkit
- (E) Remote access Trojan

522. During a forensic audit, investigators find malware that never writes any file to the hard disk. It exists only in the RAM and carries out its work by driving legitimate system utilities such as the command shell and scripting engine already present in the operating system. The most appropriate name for such malware and its main practical implication are [Difficult]

- (A) Boot sector virus; it is removed by replacing the hard disk
- (B) Macro virus; it can be stopped by disabling the printer
- (C) Adware; the only symptom is pop-up advertisements
- (D) Fileless malware; a scanner that only examines files stored on the disk may find nothing
- (E) Firmware; it is a normal part of every computer

523. A worm that spreads across a bank's wide area network is later found to carry no destructive payload at all: it does not delete files, does not encrypt data and does not steal information. Even so, the incident brought branch operations to a halt for several hours. The most appropriate explanation is that [Difficult]

- (A) A worm physically damages the network cables while spreading
- (B) The uncontrolled self-replication itself consumes bandwidth, memory and processor time, so that legitimate banking traffic is slowed down and servers stop responding
- (C) A worm without a payload converts every hard disk into read-only storage
- (D) A worm without a payload automatically reinstalls the operating system on each machine it reaches
- (E) None of these

524. A ransom note appears on a teller terminal in a branch, announcing that all files on it have been encrypted. The terminal is still connected to the branch LAN. Which of the following should be the FIRST action of the branch official? [Difficult]

- (A) Immediately transfer the demanded amount in crypto-currency so that work can resume
- (B) Isolate the affected terminal by disconnecting it from the network and at once inform the IT security team
- (C) Switch the terminal off and on repeatedly until the message disappears
- (D) Delete the operating system folder of the terminal to remove the encryption
- (E) Forward the ransom note by e-mail to all customers of the branch

525. A user downloads what appears to be a free game installer. After installation the attacker is able to browse the user's files, switch on the webcam and issue commands on that computer from a distant location, while the user notices nothing unusual. The malware used here is most precisely described as a [Difficult]

- (A) Remote Access Trojan, which opens a hidden backdoor for the attacker
- (B) Boot sector virus, which infects the master boot record
- (C) Polymorphic worm, which mutates while copying itself over the network
- (D) Adware, which displays advertisements in the browser
- (E) None of these

5.7.2 Phishing, hacking, cyber threats

[checked, 3 flagged]

526. Mrs. Anuradha Iyer receives an e-mail that carries her bank's logo and says: "Your net-banking account will be blocked within 24 hours. Click the link below and re-enter your customer ID, password and debit card PIN to keep it active." The link opens a page that looks exactly like the bank's login page but is hosted on a different domain. This fraudulent attempt is best described as [Easy]

- (A) Phishing
- (B) Defragmentation
- (C) Spooling
- (D) Encryption
- (E) Debugging

527. Shri Mahesh Deshpande, a pensioner, gets a telephone call from a person claiming to be a "bank verification officer" who asks him to read out the OTP just received on his mobile so that his account can be re-activated. Fraud carried out by such a voice call over the telephone is specifically called [Easy]

- (A) Smishing
- (B) Vishing
- (C) Pharming
- (D) Spamming
- (E) Sniffing

528. A malicious program secretly installed on a bank clerk's computer silently records every key the clerk presses, including user IDs and passwords, and mails the recorded file to an attacker. Such a program is called a [Easy]

- (A) Compiler
- (B) Firewall
- (C) Keylogger
- (D) Cookie
- (E) None of these

529. The branch server of a co-operative bank at Nashik is infected by a program that encrypts all customer data files and displays a message demanding payment of Rs. 4,00,000 in crypto-currency in exchange for the decryption key. This type of malware is known as [Easy]

- (A) Adware
- (B) Freeware
- (C) Ransomware
- (D) Shareware
- (E) Firmware

530. A bank appoints a security professional and formally authorises him, in writing, to attack its own internet-banking application so that weaknesses can be found and fixed before criminals discover them. Such a person is usually called a [Easy]

- (A) Black hat hacker
- (B) White hat (ethical) hacker
- (C) Script kiddie
- (D) Cracker
- (E) Phisher

531. On the last day of the month an attacker floods a bank's online payment gateway with a huge volume of bogus requests, so that genuine customers cannot open the site and no transaction goes through, although no data is stolen or altered. The attack primarily damages which security goal? [Easy]

- (A) Confidentiality
- (B) Integrity
- (C) Availability
- (D) Non-repudiation
- (E) None of these

532. Which one of the following practices by a bank customer is *unsafe* and most likely to result in a fraudulent debit from the account? [Easy]

- (A) Typing the bank's web address directly in the browser instead of clicking a link in an e-mail
- (B) Carrying out net banking on a public computer in a cyber cafe and allowing the browser to remember the password
- (C) Logging out of net banking and closing the browser after every session
- (D) Keeping the mobile operating system and antivirus software updated
- (E) Using a password that mixes capital letters, small letters, digits and special characters

533. Shri Vivek Bansal did *not* click any e-mail link. He typed his bank's correct address into the browser himself, yet he landed on a counterfeit login page, because malware had earlier altered the hosts file on his computer so that the bank's name resolved to the attacker's IP address. This attack is best classified as [Moderate]

- (A) Pharming
- (B) Spear phishing
- (C) Clickjacking
- (D) Shoulder surfing
- (E) None of these

534. At an airport a traveller connects to a free open Wi-Fi hotspot named **Free-Airport-WiFi** that has actually been set up by a fraudster. The fraudster silently relays all traffic between the traveller and the real bank site, reading and even modifying the data in transit while both ends believe they are communicating directly. This is an example of [Moderate]

- (A) A logic bomb
- (B) A man-in-the-middle attack
- (C) A brute-force attack
- (D) A macro virus
- (E) None of these

535. Mr. Rakesh Menon, a clerk in a bank's loan department, receives an e-mail that addresses him by name, correctly mentions his employee code and his branch, refers to a training programme he actually attended last week, and asks him to open the attached "revised loan policy" file. Only he and three colleagues received it. This is best described as [Moderate]

- (A) Bulk spam
- (B) Spear phishing
- (C) Smishing
- (D) Whaling
- (E) Adware

536. A fraudster obtained Smt. Kavita Rao's net-banking user ID and password through a fake website and attempted a transfer of Rs. 85,000. The transfer failed because the system also demanded a one-time code delivered to her registered mobile, which the fraudster did not have. The control that defeated the fraud is [Moderate]

- (A) Disk defragmentation
- (B) Two-factor authentication
- (C) Data compression
- (D) Cache memory
- (E) None of these

537. An attacker types the string ' OR '1'='1 into the user-name box of a bank's web application. Because the input is passed unchecked into the database query, the query's condition always evaluates to true and the attacker is logged in without a valid password. This technique is called [Moderate]

- (A) Cross-site scripting
- (B) SQL injection
- (C) Buffer overflow
- (D) Denial of service
- (E) None of these

538. A staff member downloads a free utility advertised as a "PDF speed booster". The utility really does open PDF files, but while running it also quietly installs a hidden remote-access backdoor. It does not attach itself to other files and does not copy itself to other machines on the LAN. The malware is best classified as a [Moderate]

- (A) Worm
- (B) Trojan horse
- (C) Boot sector virus
- (D) Rootkit remover
- (E) None of these

539. Attackers exploit a flaw in a banking software product on the very same day the flaw becomes publicly known, at a time when the vendor has not yet released any corrective patch. Such an exploited flaw is commonly referred to as a [Moderate]

- (A) Legacy bug
- (B) Zero-day vulnerability
- (C) Syntax error
- (D) Deadlock
- (E) None of these

540. A customer reaches a site that displays a padlock icon and an address beginning with `https`, but the domain is `hdfc-bank-secure-verify.in` rather than the bank's real domain. Which single conclusion is technically valid? [Difficult]

- (A) The padlock proves the site belongs to the genuine bank, so the credentials may be entered
- (B) The traffic between the browser and that server is encrypted, but this says nothing about the identity or trustworthiness of the organisation behind it
- (C) The padlock proves the site has been scanned and certified virus-free by the bank's antivirus vendor
- (D) Because the connection uses `https`, any data entered cannot be misused by the site owner
- (E) None of these

541. A bank's internet banking portal becomes unreachable for six hours. Investigation shows the traffic came simultaneously from about 40,000 home routers and CCTV cameras in many countries, each infected earlier by malware and remotely commanded by one attacker. The infected devices collectively are called a _____ and the attack itself is a _____. [Difficult]

- (A) Honeypot; salami attack
- (B) Botnet; distributed denial-of-service attack
- (C) Botnet; single-source denial-of-service attack
- (D) Firewall cluster; brute-force attack
- (E) Rootkit; cross-site scripting attack

542. A programmer in a bank alters the interest-calculation routine so that the fraction of a paisa left over when each of 9,00,000 accounts is rounded off is diverted into one benami account. Each account loses an amount too small to be noticed, but the accumulated sum is large. This classic computer fraud is known as a [Difficult]

- (A) Salami attack
- (B) Logic bomb
- (C) Denial-of-service attack
- (D) Dictionary attack
- (E) Session hijacking

543. An accounts officer receives an urgent e-mail apparently from his Managing Director instructing him to remit Rs. 27,50,000 by RTGS to a new vendor immediately and to "not discuss it with anyone as the deal is confidential". The display name shows the MD's name, but the actual sender domain is one letter different from the bank's domain. The fraud is best described as [Difficult]

- (A) Whaling, because the Managing Director's name appears in the mail
- (B) Business e-mail compromise (CEO fraud) using a look-alike spoofed sender domain
- (C) Pharming, because a domain name is involved
- (D) Cross-site request forgery
- (E) None of these

544. Fraudsters gathered Shri Prakash Nair's name, date of birth and address from his public social-media posts, approached his mobile operator's outlet posing as him, reported the handset lost and obtained a duplicate SIM for the same number. His own SIM went dead, every one-time password thereafter reached the fraudsters' handset, and Rs. 6,00,000 was transferred out of his account. The method by which the bank's second authentication factor was defeated is best described as [Difficult]

- (A) A rainbow table attack on the bank's password database
- (B) SIM swap fraud, achieved by social engineering the mobile operator
- (C) A denial-of-service attack on the telecom network
- (D) Steganography, because the data was hidden inside images
- (E) A buffer overflow in the OTP generation module

545. To study attackers' methods, a bank's security team deliberately sets up a server that is made to look like a poorly protected core-banking machine, fills it with realistic but entirely fake customer records, isolates it from the production network and monitors every action performed on it. Such a system is called a [Difficult]

- (A) Proxy server
- (B) Honeypot
- (C) Demilitarised zone (DMZ)
- (D) Load balancer
- (E) None of these

546. A list of user-name and password pairs leaked from an online shopping portal is used by an attacker, who feeds those exact pairs one by one into a bank's net-banking login page, hoping that some customers reused the same password on both sites. This specific technique is called [Difficult]

- (A) Brute-force attack
- (B) Dictionary attack
- (C) Credential stuffing
- (D) Rainbow table attack
- (E) None of these

5.7.3 Antivirus, firewalls, encryption

[checked]

547. The IT department of Canara Bank updates its antivirus software every night so that it can recognise newly discovered malware. The regularly updated file that stores the known byte-patterns of malicious programs is called the [Easy]

- (A) Swap file
- (B) Cookie file
- (C) Virus signature (definition) file

- (D) Boot sector
- (E) None of these

548. Punjab National Bank installs a device between its branch network and the Internet which examines every incoming and outgoing packet and permits or blocks it according to a set of pre-defined rules. This device is a [Easy]

- (A) Spooler
- (B) Compiler
- (C) Plotter
- (D) Scanner
- (E) Firewall

549. In symmetric key cryptography, which is used by the algorithm AES, the number of distinct keys required by the sender and the receiver together to encrypt and then decrypt a message is [Easy]

- (A) Two, one public and one private
- (B) One, the same key being used for both operations
- (C) Three, one for each direction and one spare
- (D) Four, two at each end
- (E) None of these

550. While scanning a clerk's computer at a Bank of Baroda branch, the antivirus program moves an infected spreadsheet into a special isolated folder instead of deleting it at once. This action is known as [Easy]

- (A) Compiling the file
- (B) Formatting the file
- (C) Booting the file
- (D) Defragmenting the file
- (E) Quarantining the file

551. A customer of HDFC Bank notices that the address of the net-banking page begins with https and a padlock icon is shown. This indicates that the data travelling between the browser and the bank server is protected using [Easy]

- (A) Disk defragmentation
- (B) SSL/TLS encryption
- (C) Batch processing
- (D) Optical character recognition
- (E) Cache memory

552. The process of converting readable plaintext, such as a customer's account number, into an unreadable form that can be restored only with the correct key is called [Easy]

- (A) Fragmentation
- (B) Buffering
- (C) Compilation
- (D) Encryption
- (E) None of these

553. Which one of the following is NOT a function performed by antivirus software installed on a bank's computers? [Easy]

- (A) Detecting and removing known malware
- (B) Scanning files on demand or on a schedule
- (C) Increasing the clock speed of the processor
- (D) Placing suspicious files in quarantine
- (E) Updating its definitions from the vendor

554. An employee of Union Bank downloads an attachment that was created only a few hours earlier, so no antivirus vendor has yet published a pattern for it. The bank's antivirus still blocks it because the file tries to overwrite system files and contact an unknown server. The detection technique used here is [Moderate]

- (A) Disk mirroring
- (B) Heuristic and behaviour-based detection
- (C) Data compression
- (D) Signature-based detection
- (E) None of these

555. Rajesh wants to send a confidential loan proposal to Meena using public key cryptography, in such a way that only Meena can read it and Meena can also be sure that Rajesh sent it. Rajesh should [Moderate]

- (A) Encrypt the message with his own private key and sign it with Meena's public key
- (B) Encrypt and sign the message with his own public key
- (C) Sign the message with his own private key and then encrypt it with Meena's public key
- (D) Encrypt the message with his own public key and sign it with Meena's private key
- (E) Encrypt and sign the message with Meena's private key

556. A bank branch has 8 officers who must be able to exchange encrypted messages with one another. If a symmetric cipher is used, a separate secret key is needed for every pair of officers; if an asymmetric cipher is used, each officer needs one public key and one private key. By how many keys does the symmetric arrangement exceed the asymmetric arrangement? [Moderate]

- | | |
|--------|-------------------|
| (A) 16 | (D) 12 |
| (B) 8 | (E) None of these |
| (C) 20 | |

557. Which type of firewall keeps a table of all currently active connections and allows an incoming packet only if it belongs to a session that was already established from inside the bank's network? [Moderate]

- | | |
|----------------------------------|--------------------|
| (A) Stateful inspection firewall | (D) Network switch |
| (B) Proxy printer | (E) None of these |
| (C) Stateless packet filter | |

558. State Bank of India keeps its public web server in a separate network segment that is reachable from the Internet but is separated by a firewall from the internal core banking network. This segment is commonly called [Moderate]

- | | |
|---------------------|--------------------------------|
| (A) A recycle bin | (D) A demilitarised zone (DMZ) |
| (B) A clipboard | (E) A cache line |
| (C) A registry hive | |

559. Consider the following algorithms used in banking systems: AES, RSA, DES and Diffie-Hellman. Which one of the statements below is correct? [Moderate]

- (A) AES and DES are symmetric ciphers, while RSA is asymmetric
- (B) AES and RSA are symmetric ciphers, while DES is asymmetric
- (C) DES is a hashing algorithm and AES is a compression algorithm

- (D) All four are symmetric ciphers
- (E) All four are asymmetric ciphers

560. A trainee at Axis Bank is asked to encrypt the word BANK using a Caesar cipher in which every letter is replaced by the letter 3 places later in the English alphabet, the alphabet wrapping around after Z. The ciphertext is [Moderate]

- (A) EDPN
- (B) DZKM
- (C) EDQN
- (D) ECPL
- (E) None of these

561. Two bank servers agree on a session key by the Diffie-Hellman method using the public values prime $p = 23$ and base $g = 5$. Server A chooses the secret $a = 6$ and server B chooses the secret $b = 15$. The shared secret key computed by both servers is [Difficult]

- (A) 2
- (B) 19
- (C) 15
- (D) 8
- (E) None of these

562. In an RSA demonstration a bank's training officer takes the primes $p = 3$ and $q = 11$, so that $n = 33$, and chooses the public exponent $e = 3$. If the plaintext number to be sent is $M = 5$, the ciphertext $C = M^e$ reduced modulo n equals [Difficult]

- (A) 14
- (B) 20
- (C) 125
- (D) 26
- (E) None of these

563. Consider the following statements about the security tools used in a bank. I. A firewall can block traffic on the basis of port numbers. II. An antivirus program can detect and remove malware that is already stored on the hard disk. III. Encrypting a file guarantees that the file cannot be deleted by an intruder. Which of the statements is or are correct? [Difficult]

- (A) Only I and III
- (B) All of I, II and III
- (C) Only I and II
- (D) Only II and III
- (E) Only I

564. A digital signature attached to an electronic fund transfer instruction is produced by hashing the message and encrypting the hash with the sender's private key. Such a signature, by itself, does NOT provide [Difficult]

- (A) Non-repudiation by the sender
- (B) Confidentiality of the contents of the message
- (C) Authentication of the sender
- (D) Integrity of the message
- (E) None of these

565. In a one-time pad demonstration the plaintext byte 10110110 is combined with the key byte 11010011 using a bitwise XOR operation. The resulting ciphertext byte is [Difficult]

- (A) 00100100
- (B) 11110111
- (C) 01100101
- (D) 10010010
- (E) None of these

566. A bank firewall applies its access control list from top to bottom and stops at the first rule that matches. The rules are: (1) DENY traffic from 192.168.10.0/24 to port 22; (2) ALLOW traffic from 192.168.10.0/24 to port 443; (3) DENY all traffic to port 443; (4) ALLOW everything else. A packet arrives from 192.168.10.45 addressed to port 443. What happens to it? [Difficult]

- (A) It is allowed, because rule 4 is the first rule that matches
- (B) It is denied, because rule 1 is the first rule that matches
- (C) It is denied, because a deny rule always overrides an allow rule
- (D) It is denied, because rule 3 is the first rule that matches
- (E) It is allowed, because rule 2 is the first rule that matches

567. During a secure net-banking session the browser and the bank server first use RSA to exchange a short random number and thereafter protect all the actual page data with AES using that number as the key. The main reason for using two different cipher families in this way is that [Difficult]

- (A) Asymmetric ciphers solve the key distribution problem but are slow, so they are used only to deliver the fast symmetric session key
- (B) Symmetric ciphers cannot encrypt more than one page of data at a time
- (C) AES cannot be used over the Internet, so RSA must start the session
- (D) Asymmetric ciphers are faster than symmetric ciphers for bulk data
- (E) None of these

5.7.4 Digital signature; IT Act basics

[checked]

568. Meena Raghavan, a loan officer at Kaveri Grameen Bank, digitally signs a sanction letter before mailing it to the applicant. Which key does the signing software actually use to create the digital signature? [Easy]

- (A) The applicant's public key
- (B) The applicant's private key
- (C) Meena's public key
- (D) Meena's private key
- (E) The bank's shared symmetric session key

569. The Information Technology Act, which gives legal recognition to electronic records and digital signatures in India, was enacted in which year? [Easy]

- (A) 1996
- (B) 1998
- (C) 2000
- (D) 2005
- (E) 2008

570. A digital signature attached to an electronic fund-transfer advice provides all of the following assurances EXCEPT one. Which one? [Easy]

- (A) Authentication of the sender
- (B) Integrity of the message content
- (C) Non-repudiation by the sender
- (D) Confidentiality of the message content
- (E) Verifiability by any holder of the sender's public key

571. Under the Information Technology Act, a Digital Signature Certificate is issued to a subscriber by a: [Easy]

- (A) Certifying Authority licensed by the Controller of Certifying Authorities
- (B) Branch Manager of the subscriber's bank
- (C) Registrar of Companies
- (D) Reserve Bank of India
- (E) None of these

572. The fixed-length output produced when a hash function such as SHA-256 is applied to an electronic record is technically called the: [Easy]

- (A) Cipher key
- (B) Message digest
- (C) Digital certificate
- (D) Session token
- (E) Plain text

573. Ashok receives a digitally signed purchase order from a supplier. To verify the signature, Ashok's software must apply: [Easy]

- (A) The supplier's public key to the signature, and compare the result with a freshly computed hash of the order
- (B) The supplier's private key to the signature, and compare the result with the order
- (C) Ashok's private key to the order, and compare the result with the signature
- (D) Ashok's public key to the signature, and compare the result with the supplier's certificate
- (E) None of these

574. As per the Schedule to the Information Technology Act listing documents to which the Act does not apply, which of the following can NOT be validly executed as an electronic record with a digital signature? [Easy]

- (A) An electronic income-tax return
- (B) A will or any testamentary disposition
- (C) An e-mail contract for supply of stationery
- (D) An electronic company filing with the MCA portal
- (E) An online insurance premium payment instruction

575. Sunita is sending a digitally signed board resolution from Pune to her company's auditor. Arrange the steps her software performs, in the correct order: (i) append the result to the resolution and transmit; (ii) encrypt the digest using Sunita's private key; (iii) apply a hash function to the resolution to obtain a digest. [Moderate]

- (A) (i), (ii), (iii)
- (B) (ii), (iii), (i)
- (C) (iii), (ii), (i)
- (D) (iii), (i), (ii)
- (E) (ii), (i), (iii)

576. Ratnagiri Co-operative Bank must send a customer's account statement to its head office so that (a) nobody in between can read it, and (b) the head office can prove which branch sent it. Which combination of operations should the branch perform? [Moderate]

- (A) Encrypt with the branch's private key, then sign with the head office's public key
- (B) Sign with the branch's private key, then encrypt with the head office's public key
- (C) Sign with the head office's public key, then encrypt with the branch's private key
- (D) Encrypt with the branch's public key, then sign with the head office's private key

(E) None of these

577. Rohit opens a digitally signed circular and his e-mail client reports "signature verification failed". Which of the following conclusions is definitely justified from this message alone? [Moderate]

- (A) The circular was certainly altered by an intruder while in transit
- (B) The sender's private key has certainly been stolen
- (C) The circular certainly carries a virus in its attachment
- (D) The sender certainly used a weaker hash function than the recipient
- (E) None of these

578. A branch archives a scanned loan file of size 5 MB and separately a one-page receipt of size 20 KB. Both are hashed with SHA-256 and the digests are written out in hexadecimal. How many hexadecimal characters will each digest contain? [Moderate]

- (A) 32 and 32 respectively
- (B) 40 and 40 respectively
- (C) 64 and 64 respectively
- (D) 128 and 32 respectively
- (E) None of these

579. Sneha's Digital Signature Certificate is suspended by her Certifying Authority on 1 August in the public interest, without her being given a hearing. Consider two statements. (i) If the suspension is to continue beyond fifteen days, the Certifying Authority must first give her an opportunity of being heard. (ii) While the suspension subsists, signatures she creates with that certificate remain fully valid, because only revocation ends a certificate's operation. Which is/are correct? [Moderate]

- (A) Only (i)
- (B) Only (ii)
- (C) Both (i) and (ii)
- (D) Neither (i) nor (ii)
- (E) Cannot be determined

580. Under the Information Technology Act, an Adjudicating Officer appointed to decide claims of compensation arising from contraventions has jurisdiction where the injury or loss claimed does not exceed: [Moderate]

- (A) Rs. 50 lakh
- (B) Rs. 1 crore
- (C) Rs. 2 crore
- (D) Rs. 5 crore
- (E) Rs. 10 crore

581. Kailash creates a fake webpage resembling a bank's net-banking login, tricks depositors into entering their credentials there, and then uses those credentials to transfer funds. Under the Information Technology Act, which provision most directly covers cheating by personation using a computer resource? [Moderate]

- (A) Section 65
- (B) Section 66D
- (C) Section 67
- (D) Section 70
- (E) Section 79

582. A compliance officer at Godavari Bank makes four claims about digital signatures. (i) The length of the signature grows in proportion to the size of the signed document. (ii) The same document signed by two different officers yields two different signatures. (iii) Verification requires the verifier to possess the signer's private key. (iv) A digital signature can be verified by any party who trusts the signer's certificate. How many of these claims are correct? [Difficult]

- (A) Only one
- (B) Only two
- (C) Only three
- (D) All four
- (E) None of these

583. A vendor proposes that Narmada Bank adopt an "encrypt-then-sign" order, in which the bank first encrypts a payment file with the recipient's public key and then signs the resulting ciphertext. Why is "sign-then-encrypt" generally preferred instead? [Difficult]

- (A) Because encrypting first makes the file too large for the signature algorithm to process
- (B) Because an interceptor can strip the outer signature from the ciphertext and re-sign it with his own key, falsely claiming to be the originator
- (C) Because the recipient's public key cannot be applied before a hash has been computed
- (D) Because encryption and signing must always use the same key pair
- (E) None of these

584. A Certifying Authority revoked the Digital Signature Certificate of an officer on 10 March. An auditor later finds a contract carrying that officer's signature and wants to establish that it was validly signed on 2 March. What additional element is essential for the auditor's conclusion to stand? [Difficult]

- (A) A copy of the officer's private key retained by the bank
- (B) A trusted third-party timestamp bound to the signature at the moment of signing
- (C) A fresh certificate issued to the officer after 10 March
- (D) The recipient's confirmation e-mail acknowledging receipt of the contract
- (E) None of these

585. Suppose a researcher demonstrates a practical method of producing two different loan agreements that share exactly the same hash value under a particular hash algorithm. Which security property of the hash function has been defeated, and what is the direct consequence for digital signatures made with it? [Difficult]

- (A) Confidentiality has been defeated; signed messages can now be read by outsiders
- (B) Collision resistance has been defeated; a signature obtained on one agreement is also a valid signature on the other
- (C) Availability has been defeated; the signing service can no longer be reached
- (D) Key length has been defeated; the private key can now be derived from the public key
- (E) None of these

586. Which of the following pairings of a provision of the Information Technology Act with its subject matter is INCORRECT? [Difficult]

- (A) Section 3 – Authentication of electronic records by affixing a digital signature
- (B) Section 17 – Appointment of the Controller of Certifying Authorities
- (C) Section 43A – Compensation for failure of a body corporate to protect sensitive personal data
- (D) Section 66F – Punishment for cyber terrorism
- (E) Section 72 – Legal recognition of electronic signatures

587. Deepak discovers that his private key has been copied by an outsider. Which statement best describes the legal and technical position? [Difficult]

- (A) Nothing changes, because the Certifying Authority still holds the authoritative copy of his private key
- (B) Non-repudiation is undermined, and he is required to communicate the compromise to the Certifying Authority without delay

- (C) Only confidentiality is affected; signatures already verified remain fully enforceable against third parties
- (D) He may continue signing until the certificate's normal expiry date, after which a fresh key pair is generated
- (E) None of these

588. A bank rolls out Aadhaar-based eSign for account-opening forms. Which statement about this facility is correct? [Difficult]

- (A) It is an electronic signature recognised under the IT Act, in which the signer is authenticated by OTP or biometrics and a short-lived certificate is issued for the transaction
- (B) It replaces the need for any Certifying Authority, since Aadhaar authentication alone constitutes the signature
- (C) It requires the signer to purchase and physically hold a USB cryptographic token before each signing
- (D) It works by encrypting the whole application form with the signer's Aadhaar number as the key
- (E) None of these

Section 5.8

5.8.1 Keyboard shortcuts

[checked, 1 flagged]

589. Smt. Kavita Deshmukh has selected a paragraph in an MS Word letter and wants to remove it from its present position so that she can place it lower down in the same letter. Which keyboard shortcut removes the selected text from its place and stores it on the clipboard? [Easy]

- (A) Ctrl + C
- (B) Ctrl + V
- (C) Ctrl + X
- (D) Ctrl + Z
- (E) Ctrl + A

590. In MS Word, pressing Ctrl + Z performs which of the following actions? [Easy]

- (A) Saves the current document
- (B) Reverses the last action performed
- (C) Repeats the last action performed
- (D) Closes the document without saving
- (E) Zooms into the document

591. Shri Anil Bhatt has finished typing a fixed deposit statement and wants to open the Print dialog box to take a hard copy. The correct keyboard shortcut is [Easy]

- (A) Ctrl + N
- (B) Ctrl + O
- (C) Ctrl + P
- (D) Ctrl + F
- (E) Ctrl + D

592. A clerk at a bank branch has to step away from his counter for a few minutes and wants to lock his Windows computer immediately so that no one else can use the open session. Which shortcut should he press? [Easy]

- (A) Windows key + L
- (B) Windows key + E
- (C) Windows key + R
- (D) Ctrl + Alt + L
- (E) Alt + F4

593. In MS Word, the heading “Loan Recovery Statement” has been selected. Pressing Ctrl + B will [Easy]

- (A) Make the selected text bold
- (B) Make the selected text italic
- (C) Underline the selected text
- (D) Insert a bullet before the selected text
- (E) Move the selected text to the clipboard

594. While working in a long MS Word document, the cursor is currently on page 9. Pressing Ctrl + Home will move the cursor to [Easy]

- (A) The beginning of the current line
- (B) The beginning of page 9
- (C) The very beginning of the document
- (D) The very end of the document
- (E) The beginning of the previous page

595. Which of the following key combinations is used to close the currently active window or to quit the currently running application in Windows? [Easy]

- (A) Ctrl + F4
- (B) Alt + F4
- (C) Shift + F4
- (D) Alt + Tab
- (E) Ctrl + Esc

596. Shri Mohan Pillai has copied a block of figures from an MS Excel sheet and now wants to paste only the values, without the formulas and formatting, by opening the Paste Special dialog box. Which keyboard shortcut opens that dialog box? [Moderate]

- (A) Ctrl + V
- (B) Ctrl + Alt + V
- (C) Ctrl + Shift + C
- (D) Alt + V
- (E) Ctrl + Shift + P

597. Ms. Fatima Sheikh has two MS Word documents open at the same time. The document she is working on has edits that have not yet been saved. She presses Ctrl + W once. What happens? [Moderate]

- (A) Both the open documents close at once without any prompt
- (B) Word asks whether the changes should be saved and then closes only the active document, the other document remaining open
- (C) The whole Word application shuts down immediately along with both documents
- (D) The active document is saved silently and both documents remain open
- (E) The unsaved edits in the active document are undone and the document remains open

598. In MS Excel, a user types the formula = A1 + B1 in cell C1. While the cursor is still inside the formula immediately after the reference A1, she presses the F4 key once. The reference A1 will change to [Moderate]

- (A) \$A1
- (B) A\$1
- (C) \$A\$1
- (D) A1 (no change)
- (E) None of these

599. A trainee wants to capture a picture of only the active window on his screen, and not the whole desktop, and place it on the clipboard so that he can paste it into an MS Word report. He should press [Moderate]

- (A) Print Screen
- (B) Alt + Print Screen
- (C) Windows key + Print Screen
- (D) Ctrl + Print Screen
- (E) Shift + Tab

600. In an MS Excel sheet, the branch codes are entered continuously in cells A2 to A40, and cell A41 is empty. The active cell is A2. The user presses Ctrl + Shift + Down Arrow once. What gets selected? [Moderate]

- (A) Only cell A2
- (B) The range A2 to A41
- (C) The range A2 to A40
- (D) The whole of column A up to the last row of the worksheet
- (E) The range A1 to A40

601. In MS Excel, the monthly deposit figures are entered in cells B2 to B13 and the active cell is B14. Pressing Alt + = will [Moderate]

- (A) Insert a new row above row 14
- (B) Insert the SUM function in B14 with the range B2:B13 suggested
- (C) Convert the numbers in B2:B13 into text
- (D) Apply the currency format to B14
- (E) Copy the contents of B13 into B14

602. Which of the following key combinations inserts the current time as a fixed value into the active cell of an MS Excel worksheet? [Moderate]

- (A) Ctrl + T
- (B) Ctrl + Alt + T
- (C) Ctrl + ; (semicolon)
- (D) Ctrl + Shift + T
- (E) None of these

603. An MS Excel sheet has branch names typed continuously in cells A1 to F1, while G1 and everything below row 1 in those columns is empty except for scattered data far away. The active cell is B5. The user presses Ctrl + Home and then presses Ctrl + Right Arrow. Where does the cursor finally rest? [Difficult]

- (A) A1
- (B) B1
- (C) F1
- (D) G1
- (E) The last column of the worksheet

604. Shri Rakesh Nair has an MS Word report that is exactly 4 pages long, with the cursor placed somewhere on page 2. He presses Ctrl + End and then presses Ctrl + Enter. What is the position now? [Difficult]

- (A) The document is still 4 pages and the cursor is at the end of page 4
- (B) The document becomes 5 pages and the cursor is at the top of page 5
- (C) The document becomes 5 pages and the cursor is at the top of page 1
- (D) The document is still 4 pages and the cursor is at the start of page 1
- (E) The document becomes 3 pages as page 4 is deleted

605. In an MS Excel sheet, column B holds the principal amounts and column C the rate factors. In cell D2 the formula $= B2 * C2$ is entered. The user selects D2, presses Ctrl + C, then selects the range D3 to D10 and presses Ctrl + V. Which formula will cell D7 contain? [Difficult]

- (A) $= B2 * C2$
- (B) $= B7 * C7$
- (C) $= B3 * C3$
- (D) $= \$B\$2 * \$C\2
- (E) None of these

606. An MS Excel workbook contains four worksheets arranged in the order Sheet1, Sheet2, Sheet3 and Sheet4, and Sheet2 is currently active. The user presses Ctrl + Page Down twice and then presses Ctrl + Page Up once. Which sheet is active at the end? [Difficult]

- (A) Sheet1
- (B) Sheet2
- (C) Sheet3
- (D) Sheet4
- (E) None of these

607. Ms. Priya Menon has a browser window with 6 tabs open. She presses Ctrl + W three times in succession and then presses Ctrl + Shift + T twice. How many tabs are open at the end? [Difficult]

- (A) 3
- (B) 4
- (C) 5
- (D) 6
- (E) 9

608. A clerk wants every paragraph of an MS Word circular to be double spaced. He first presses Ctrl + A and then presses Ctrl + 2. What is the outcome? [Difficult]

- (A) The whole document is selected and set to single line spacing
- (B) The whole document is selected and set to double line spacing
- (C) Only the current paragraph is set to double line spacing
- (D) The whole document is selected and the font size is doubled
- (E) The whole document is selected and 1.5 line spacing is applied

609. A user has several application windows open on the Windows desktop. He presses Windows key + M once, and then presses Windows key + M a second time. What is the state of the windows after the second press? [Difficult]

- (A) All the windows are restored to their earlier size and position
- (B) All the windows remain minimised
- (C) All the windows are closed
- (D) Only the last active window is restored
- (E) All the windows are maximised to full screen

5.8.2 Computer abbreviations and full forms

[checked, 1 flagged]

610. While upgrading the terminals at its Nashik branch, a bank orders extra RAM for each machine. In computer terminology, RAM stands for: [Easy]

- (A) Readily Available Memory
- (B) Random Access Memory
- (C) Read Adjustable Memory
- (D) Rapid Arithmetic Module
- (E) None of these

611. Mrs. Kavita Deshmukh withdraws Rs. 5,000 from a machine installed outside her bank branch. The machine is called an ATM. The abbreviation ATM stands for: [Easy]

- (A) Automatic Transaction Machine
- (B) Automated Teller Machine
- (C) Any Time Money
- (D) Automated Transfer Mechanism
- (E) None of these

612. A customer types the address of the bank's website into the address bar of the browser. Such an address is called a URL, which stands for: [Easy]

- (A) Universal Reference Link
- (B) Uniform Resource Locator
- (C) Unique Retrieval Location
- (D) Uniform Registry Line
- (E) None of these

613. The component of a computer that is often described as the 'brain' of the machine, because it interprets and executes instructions, is the CPU. CPU stands for: [Easy]

- (A) Central Programming Unit
- (B) Computer Processing Utility
- (C) Central Processing Unit
- (D) Common Peripheral Unit
- (E) None of these

614. A bank circulates its quarterly statement in a file format that looks the same on every device and cannot be edited easily. The file has the extension .pdf. PDF stands for: [Easy]

- (A) Printed Document File
- (B) Portable Data Format
- (C) Portable Document Format
- (D) Public Document File
- (E) None of these

615. The device that converts the computer's digital signals into a form suitable for transmission over a telephone line and converts them back at the receiving end is called a MODEM. The word MODEM is formed from: [Easy]

- (A) Mobile Demodulator
- (B) Modulator-Demodulator
- (C) Modular Device Memory
- (D) Mode Determining Machine
- (E) None of these

616. Shri Ramesh Iyer transfers Rs. 25,000 to his son's account in another bank using the NEFT facility of net banking. NEFT stands for: [Easy]

- (A) National Electronic Funds Transfer
- (B) New Electronic Fund Transaction
- (C) National Electronic Financial Transfer
- (D) Nationwide Express Funds Transfer
- (E) None of these

617. A trainee is asked to prepare a list of abbreviations that denote types of computer memory. Which one of the following does NOT belong to that list? [Moderate]

- (A) ROM
- (B) DRAM
- (C) SMTP
- (D) EEPROM
- (E) SRAM

618. The IT department of a bank has to configure the server that pushes *outgoing* e-mail from staff mailboxes to the Internet. The protocol required for this job has an expansion beginning with the word 'Simple'. Which option gives both the correct abbreviation and its correct expansion? [Moderate]

- (A) POP3 - Post Office Protocol version 3
- (B) IMAP - Internet Message Access Protocol
- (C) SMTP - Simple Mail Transfer Protocol
- (D) SNMP - Simple Network Management Protocol
- (E) None of these

619. Which one of the following abbreviations is matched with its CORRECT full form? [Moderate]

- (A) HTTP - HyperText Transmission Protocol
- (B) FTP - File Transaction Protocol
- (C) GUI - Graphical Utility Interface
- (D) DNS - Domain Name System
- (E) None of these

620. The row of numbers printed in special magnetic ink at the bottom of a cheque is read automatically by a clearing machine. This technology is known as MICR, which stands for: [Moderate]

- (A) Magnetic Ink Cheque Reader
- (B) Magnetic Ink Character Recognition
- (C) Magnetic Image Character Reader
- (D) Manual Ink Code Recognition
- (E) None of these

621. Under the system introduced by the Reserve Bank of India, the physical cheque is stopped at the presenting bank and only its electronic image and MICR data travel onward for clearing. This system is abbreviated as CTS. Its full form is: [Moderate]

- | | |
|----------------------------------|------------------------------|
| (A) Cheque Transfer System | (D) Cheque Tracking Software |
| (B) Clearing Transaction Service | (E) None of these |
| (C) Cheque Truncation System | |

622. The coding scheme that assigns a 7-bit numeric code to each English letter, digit and punctuation mark, so that text can be stored and exchanged uniformly, is ASCII. The abbreviation ASCII stands for: [Moderate]

- (A) American Standard Code for Information Interchange
- (B) American Standard Code for Internet Interchange
- (C) Advanced Standard Coding for Information Interchange
- (D) American System Code for Information Interface
- (E) None of these

623. All of the following abbreviations have been expanded correctly EXCEPT one. Identify the incorrect expansion. [Moderate]

- (A) ALU - Arithmetic Logic Unit
- (B) USB - Universal Serial Bus
- (C) VDU - Visual Display Unit
- (D) BIOS - Basic Integrated Operating System
- (E) NIC - Network Interface Card

624. Consider the following five statements about full forms:

- (i) LAN - Local Area Network
- (ii) PROM - Programmable Random Only Memory

- (iii) ISDN - Integrated Services Digital Network
- (iv) WAN - Wide Area Nodes
- (v) CD-ROM - Compact Disc Read Only Memory

How many of these expansions are correct?

[Difficult]

- | | |
|-----------|-------------------|
| (A) Two | (D) Five |
| (B) Three | (E) None of these |
| (C) Four | |

625. In which one of the following abbreviations does the letter 'P' NOT stand for the word 'Protocol'?

[Difficult]

- | | |
|----------|----------|
| (A) FTP | (D) PDF |
| (B) VoIP | (E) SMTP |
| (C) TCP | |

626. A bank has to digitise two kinds of paper: (1) recruitment answer sheets on which candidates have darkened circular bubbles with a pencil, and (2) typed loan agreements whose printed text must be converted into editable text. Which option correctly names the technology used for job (1) together with its correct full form?

[Difficult]

- (A) OCR - Optical Character Recognition
- (B) OMR - Optical Mark Recognition
- (C) OMR - Optical Manual Reader
- (D) MICR - Magnetic Ink Character Recognition
- (E) None of these

627. Four of the following five abbreviations of computer languages and early computers are expanded correctly. Which one is expanded INCORRECTLY?

[Difficult]

- (A) COBOL - Common Business Oriented Language
- (B) BASIC - Beginner's All-purpose Symbolic Instruction Code
- (C) FORTRAN - Formula Translation
- (D) ALGOL - Algebraic Oriented Language
- (E) UNIVAC - Universal Automatic Computer

628. Consider the following three statements:

I. In 'DNS', the letter 'N' stands for 'Name'.

II. In 'ISP', the letter 'S' stands for 'Server'.

III. 'MAC' in the term MAC address stands for 'Media Access Control'.

Which of the statements is/are correct?

[Difficult]

- | | |
|--------------------|---------------------|
| (A) Only I | (D) Only II and III |
| (B) Only I and II | (E) All three |
| (C) Only I and III | |

629. Smt. Anjali Rao's new debit card carries a 3-digit CVV on the reverse, she receives an OTP for every online purchase, the card has an EMV chip, and the card network is operated by NPCI. Exactly one of the following expansions is correct. Which one?

[Difficult]

- (A) CVV - Card Verification Value
- (B) OTP - One Time Passcode

- (C) EMV - Electronic Master Verification
- (D) NPCI - National Payment Council of India
- (E) None of these

630. Consider the five abbreviations HTML, XML, CSS, SQL and DBMS. In how many of these does the LAST word of the standard full form happen to be 'Language'?

[Difficult]

- | | |
|-----------|-------------------|
| (A) One | (D) Four |
| (B) Two | (E) None of these |
| (C) Three | |

Answer Key

1	2	3	4	5	6	7	8	9	10
B	C	C	C	B	B	B	A	D	B
11	12	13	14	15	16	17	18	19	20
D	C	B	B	A	E	C	E	C	C
21	22	23	24	25	26	27	28	29	30
B	A	D	B	C	B	C	C	A	C
31	32	33	34	35	36	37	38	39	40
B	A	C	B	D	E	C	C	C	A
41	42	43	44	45	46	47	48	49	50
B	C	B	C	D	A	C	D	A	C
51	52	53	54	55	56	57	58	59	60
B	D	C	B	E	A	C	A	C	B
61	62	63	64	65	66	67	68	69	70
E	D	A	D	C	C	B	B	C	B
71	72	73	74	75	76	77	78	79	80
D	C	B	C	C	A	D	B	B	A
81	82	83	84	85	86	87	88	89	90
D	B	E	A	C	C	C	B	B	A
91	92	93	94	95	96	97	98	99	100
B	C	B	B	B	B	E	D	D	A
101	102	103	104	105	106	107	108	109	110
C	C	B	C	B	B	C	A	D	D
111	112	113	114	115	116	117	118	119	120
C	B	C	B	D	B	C	A	C	C
121	122	123	124	125	126	127	128	129	130
C	D	C	A	C	B	B	D	A	D
131	132	133	134	135	136	137	138	139	140
B	B	D	B	C	C	D	D	D	C
141	142	143	144	145	146	147	148	149	150
B	C	C	C	D	A	C	B	A	C
151	152	153	154	155	156	157	158	159	160
D	D	B	E	B	B	A	C	E	C
161	162	163	164	165	166	167	168	169	170
D	C	C	B	C	C	D	C	B	C
171	172	173	174	175	176	177	178	179	180
B	B	B	B	C	B	C	B	A	B
181	182	183	184	185	186	187	188	189	190
C	A	B	B	B	A	B	B	D	C
191	192	193	194	195	196	197	198	199	200
B	D	B	E	B	B	D	C	C	A
201	202	203	204	205	206	207	208	209	210
D	C	B	A	A	B	C	C	E	B
211	212	213	214	215	216	217	218	219	220
D	D	C	B	C	A	E	A	C	D
221	222	223	224	225	226	227	228	229	230
B	A	C	C	A	D	D	B	B	A
231	232	233	234	235	236	237	238	239	240
B	B	D	E	C	D	C	D	B	A
241	242	243	244	245	246	247	248	249	250
A	C	E	A	D	A	B	B	D	B
251	252	253	254	255	256	257	258	259	260
D	B	A	B	D	C	C	E	B	A
261	262	263	264	265	266	267	268	269	270
B	D	D	D	B	B	C	D	C	D
271	272	273	274	275	276	277	278	279	280
C	A	A	B	C	C	A	D	A	B
281	282	283	284	285	286	287	288	289	290

A	E	D	A	D	C	C	B	D	C
291	292	293	294	295	296	297	298	299	300
B	C	C	E	B	D	A	C	C	C
301	302	303	304	305	306	307	308	309	310
B	D	B	C	D	A	C	B	E	A
311	312	313	314	315	316	317	318	319	320
B	C	D	C	B	B	C	C	B	A
321	322	323	324	325	326	327	328	329	330
B	C	B	B	C	B	C	A	B	C
331	332	333	334	335	336	337	338	339	340
B	B	C	C	B	B	D	C	A	D
341	342	343	344	345	346	347	348	349	350
C	E	E	D	B	A	B	D	C	E
351	352	353	354	355	356	357	358	359	360
C	D	A	A	C	C	A	A	B	D
361	362	363	364	365	366	367	368	369	370
B	C	C	A	D	A	B	B	C	A
371	372	373	374	375	376	377	378	379	380
E	A	B	C	D	B	B	C	C	D
381	382	383	384	385	386	387	388	389	390
C	B	B	B	B	B	C	A	C	D
391	392	393	394	395	396	397	398	399	400
B	B	C	B	A	B	A	B	B	D
401	402	403	404	405	406	407	408	409	410
B	B	A	C	B	C	B	B	B	B
411	412	413	414	415	416	417	418	419	420
B	B	B	D	B	D	B	C	B	B
421	422	423	424	425	426	427	428	429	430
C	A	B	C	C	A	A	C	B	C
431	432	433	434	435	436	437	438	439	440
B	B	B	B	E	E	A	C	C	A
441	442	443	444	445	446	447	448	449	450
A	C	B	C	C	D	A	B	C	B
451	452	453	454	455	456	457	458	459	460
C	B	C	B	A	A	B	B	C	B
461	462	463	464	465	466	467	468	469	470
A	B	B	C	C	A	C	B	B	A
471	472	473	474	475	476	477	478	479	480
C	C	A	A	C	B	A	C	C	C
481	482	483	484	485	486	487	488	489	490
D	C	B	B	C	B	C	A	D	B
491	492	493	494	495	496	497	498	499	500
B	C	B	C	C	B	A	C	D	B
501	502	503	504	505	506	507	508	509	510
B	B	B	D	B	D	B	A	B	C
511	512	513	514	515	516	517	518	519	520
D	D	C	A	A	A	D	C	E	B
521	522	523	524	525	526	527	528	529	530
B	D	B	B	A	A	B	C	C	B
531	532	533	534	535	536	537	538	539	540
C	B	A	B	B	B	B	B	B	B
541	542	543	544	545	546	547	548	549	550
B	A	B	B	B	C	C	E	B	E
551	552	553	554	555	556	557	558	559	560
B	D	C	B	C	D	A	D	A	C
561	562	563	564	565	566	567	568	569	570
A	D	C	B	C	E	A	D	C	D
571	572	573	574	575	576	577	578	579	580
A	B	A	B	C	B	E	C	A	D
581	582	583	584	585	586	587	588	589	590

B	B	B	B	B	E	B	A	C	B
591 C	592 A	593 A	594 C	595 B	596 B	597 B	598 C	599 B	600 C
601 B	602 E	603 C	604 B	605 B	606 C	607 C	608 B	609 B	610 B
611 B	612 B	613 C	614 C	615 B	616 A	617 C	618 C	619 D	620 B
621 C	622 A	623 D	624 B	625 D	626 B	627 D	628 C	629 A	630 C

Worked Solutions

Subtopic 5.1.1

1. Charles Babbage designed the Difference Engine and, later, the Analytical Engine, whose design contained the essential parts of a modern computer (input, store, mill, control and output). For this he is called the Father of the Computer. The other names do not fit: Blaise Pascal built the Pascaline, only a mechanical adding machine; Alan Turing gave the theoretical Turing machine model and is called the father of theoretical computer science and artificial intelligence, not of the computer itself; John von Neumann contributed the stored-program architecture in the 1940s, long after Babbage; Herman Hollerith built the punched-card tabulating machine used in the 1890 US census. Hence option B.

2. The generations of computers are classified by their switching component. First generation (about 1940–1956) machines such as ENIAC, EDVAC and UNIVAC-I used vacuum tubes (thermionic valves) as the switching element, along with magnetic drums for memory. Transistors belong to the second generation (1956–1963), integrated circuits to the third generation (1964–1971) and microprocessors to the fourth generation (1971 onward). Since vacuum tube is present as an option, “None of these” is not correct. Hence option C.

3. The integrated circuit, in which many transistors are fabricated on a single silicon chip, was invented by Jack Kilby and Robert Noyce in 1958–59. Computers built around ICs, such as the IBM System/360 and the PDP-8, define the third generation (1964–1971). The first generation used vacuum tubes and the second used discrete transistors, so ICs cannot belong to them. The fourth generation did not introduce the IC; it used a far denser form of it (LSI and VLSI packed into a single microprocessor chip), and the fifth generation uses ULSI with artificial intelligence. First use, therefore, is third generation. Hence option C.

4. A microprocessor places the entire central processing unit on one LSI/VLSI chip. The arrival of the Intel 4004 in 1971 is taken as the starting point of the fourth generation (1971 to the present), which also gave us personal computers, graphical user interfaces and computer networks. The second generation is marked by discrete transistors and the third by small- and medium-scale integrated circuits, both of which pre-date 1971. The fifth generation is defined by artificial intelligence, parallel processing and ULSI, not merely by the presence of a microprocessor. Since “Fourth generation” is available, “None of these” is wrong. Hence option C.

5. The fifth generation (present and beyond) is characterised by artificial intelligence: expert systems, robotics, natural language processing, voice recognition and parallel processing, built on ULSI technology. Vacuum tubes, punched cards and magnetic drums are all first generation features, and discrete transistors are second generation features, so all four of those options describe technologies that are historically much older. Hence option B.

6. The abacus, a frame of beads sliding on rods used for addition and subtraction, is the earliest device credited with mechanised counting, and the bead-and-rod abacus proper (the Chinese suanpan) developed in ancient China, in use by about the 2nd century BC. Japan uses a later adaptation of it called the soroban, so Japan is a derivative and not the origin. India is credited with the decimal place-value system and the concept of zero, not the abacus; Greece is associated with early geometry and the Antikythera mechanism; Egypt with early numeration and surveying. (The much older counting boards of about 3000 BC belong to Mesopotamia, not to any of the countries listed.) Hence option B.

7. Augusta Ada Lovelace, daughter of Lord Byron, translated an Italian account of Babbage’s Analytical Engine and added notes containing a step-by-step sequence for computing Bernoulli numbers on that machine. This sequence is accepted as the first published computer program, making her the first programmer. Grace Hopper is famous much later, for the first compiler and for her work on COBOL; Dennis Ritchie created the C language and co-created UNIX; Charles Babbage designed the machine but did not write the program. Since a correct name is listed, “None of these” is wrong. Hence option B.

8. Fix each technology to its generation and year. Vacuum tube: first generation, from about 1940. Transistor: invented 1947, basis of second generation from about 1956. Integrated circuit: invented 1958–59, basis of third generation from about 1964. Microprocessor: Intel 4004 in 1971, basis of fourth generation. Ordering the years $1940 < 1956 < 1964 < 1971$ gives vacuum tube, transistor, integrated circuit, microprocessor, that is (iv), (iii), (i), (ii). Options B and D wrongly put the IC before the transistor, option C wrongly starts with the transistor, and option E reverses the last two. Hence option A.

9. Recall the memory technology of each generation. First generation: magnetic drum as main memory, with punched cards and paper tape for input/output. Second generation: magnetic core memory, which replaced the drum and was far faster. Third generation: early semiconductor memory along with magnetic core, with keyboards and monitors replacing punched cards. Fourth generation: semiconductor RAM (LSI/VLSI). Testing the options: A swaps the first two generations, B does the same in reverse, C is wrong because punched cards were being phased out in the third generation and were never “main memory” in any case, and E is wrong because no generation used vacuum tubes for memory in the fourth generation. Only D, first generation with magnetic drum, is correct. Hence option D.

10. The transistor was demonstrated at Bell Telephone Laboratories in December 1947 by John Bardeen, Walter Brattain and William Shockley, who shared the 1956 Nobel Prize in Physics for it. The other teams belong to different milestones: Jack Kilby and Robert Noyce independently invented the integrated circuit in 1958–59 (third generation); Eckert and Mauchly built ENIAC and UNIVAC-I (first generation); Howard Aiken built the electromechanical Harvard Mark I and Grace Hopper worked on it and later on COBOL. Since the correct team is listed, “None of these” is wrong. Hence option B.

11. Check each statement against the profile of the second generation (1956–1963). It replaced vacuum tubes with transistors, so A is a genuine feature. It saw the first symbolic assembly languages and the earliest high-level languages FORTRAN and COBOL, so B is genuine. Transistors were smaller, cheaper, faster and consumed far less power and generated less heat than valves, so C is genuine. Magnetic core memory was indeed the standard main memory of this generation, so E is genuine. Integrated circuits, however, appeared only in 1958–59 and became the basis of computers in the third generation from 1964, so D is the feature that does not belong to the second generation. Hence option D.

12. TIFRAC stands for Tata Institute of Fundamental Research Automatic Calculator; it was designed and built in India, commissioned in 1960 and named by Prime Minister Jawaharlal Nehru, and is therefore the first indigenous Indian computer. The others fail on the word “indigenous” or on the date: the HEC-2M installed at the Indian Statistical Institute, Kolkata in 1955 was the first computer in India but it was imported from Britain; the IBM 1401 was an imported American second generation machine widely used by Indian banks and railways in the 1960s; and PARAM 8000, built by C-DAC under Dr. Vijay Bhatkar, is India’s first indigenous supercomputer but dates from 1991, three decades later. Since a correct option exists, “None of these” is wrong. Hence option C.

13. The stored-program principle, set out by John von Neumann in the EDVAC report of 1945, requires the program to be held in the same memory as the data. EDSAC (Electronic Delay Storage Automatic Calculator), built by Maurice Wilkes at Cambridge and first run in May 1949, was the first full-scale practical machine to work this way. ENIAC (1946) was electronic but was programmed by re-plugging cables and setting switches, so it was not a stored-program machine at that time. UNIVAC-I (1951) was the first commercially sold computer but came two years after EDSAC. The Harvard Mark I (1944) was electromechanical and read its instructions from punched paper tape, not from memory. The Atanasoff-Berry Computer (1942) was electronic but neither programmable nor general purpose. Hence option B.

14. Hollerith built an electromechanical tabulator that read holes punched in cards, and it cut the processing time of the 1890 United States census from years to months. His Tabulating Machine

Company merged with others in 1911 and was renamed International Business Machines (IBM) in 1924. Option A is wrong because the machine was electromechanical, not electronic, and had no stored program; the stored-program idea came only in 1945. Option C is wrong because the Analytical Engine was Babbage's and was never completed, and Lovelace wrote a program, not hardware. Option D is wrong because integrated circuits appeared in 1958–59, nearly seventy years later. Option E is wrong because the transistor was invented in 1947, long after 1890. Hence option B.

15. Take the list items one at a time. First generation machines had no symbolic language at all; programs were written in binary machine code and main memory was the magnetic drum, so (a) goes with (ii). Second generation machines introduced symbolic assembly language and used magnetic core memory, so (b) goes with (i). Third generation machines were built from integrated circuits and were the first to run operating systems supporting multiprogramming and time-sharing, so (c) goes with (iv). Fourth generation machines use VLSI chips and popularised graphical user interfaces, so (d) goes with (iii). The required combination is a-ii, b-i, c-iv, d-iii. Options B and E wrongly assign assembly language to the first generation, option C swaps the third and fourth generation entries, and option D (a-iii, b-iv, c-i, d-ii) attaches VLSI with a graphical user interface to the first generation and machine language with a magnetic drum to the fourth, so every one of its four pairs is wrong. Hence option A.

16. Attach the year to each item: (ii) Pascaline is 1642; (iv) Analytical Engine design is 1837; (v) Hollerith's census tabulation is 1890; (i) ENIAC is 1946; (iii) Intel 4004 is 1971. Sorting these years gives $1642 < 1837 < 1890 < 1946 < 1971$, that is the order (ii), (iv), (v), (i), (iii). Counting along, the first is (ii), the second is (iv) and the third is (v), Hollerith's tabulating machine. Note that (i) is fourth and (iii) is fifth, so options A and C are wrong; (ii) is first and (iv) is second, so options B and D are wrong. Hence option E.

17. Examine each statement. Statement I is correct: ENIAC (1946) contained about 18,000 vacuum tubes and its "programming" meant physically re-plugging cables and setting switches, which could take days; the stored-program idea came later with EDVAC and EDSAC. Statement II is incorrect: the transistor replaced the vacuum tube in the SECOND generation (1956–1963); the third generation is defined by the integrated circuit, which replaced discrete transistors. Statement III is correct: fifth generation systems are built on ULSI chips carrying millions of components, supporting parallel processing and artificial intelligence. So I and III are correct while II is not, which rules out B, D and E, and A is incomplete because it omits III. Hence option C.

18. Date each machine and place it in the correct generation. ENIAC (1946) used vacuum tubes, so first generation, and D is right. The IBM 1401 (1959) was a transistorised machine, so second generation, and A is right. The IBM System/360 (1964) was the flagship integrated-circuit family, so third generation, and B is right. The Apple Macintosh (1984) was a microprocessor-based personal computer with a graphical user interface, so fourth generation, and C is right. The PDP-8, launched by Digital Equipment Corporation in 1965, was an integrated-circuit minicomputer and therefore belongs to the THIRD generation, not the fourth; it predates the microprocessor by six years. Hence the incorrect pairing is option E.

19. The Difference Engine (1822 onward) was a special-purpose mechanical calculator meant only to tabulate polynomial values by the method of finite differences; it could not be reprogrammed. The Analytical Engine (1837) was a general-purpose design: it had a "store" (memory), a "mill" (arithmetic and logic unit), a control unit reading instructions from punched cards borrowed from the Jacquard loom, and input/output, which is why it is regarded as the first design of a programmable general-purpose computer. Option A is wrong because both were purely mechanical; electronics did not exist then. Option B reverses the two machines. Option D is wrong because neither engine was completed in Babbage's lifetime, chiefly for want of funds and precision engineering. Option E is wrong because vacuum tubes came only in the twentieth century. Hence option C.

20. Test each feature against the fifth generation profile, which is defined by artificial intelligence built on extremely dense circuits. I, ULSI technology, is correct, since fifth generation chips carry millions of components. II, parallel processing, is correct, because AI workloads use many processors working

simultaneously instead of a single sequential unit. IV, natural language understanding and expert systems, is the defining application area of the fifth generation. III is wrong: writing programs directly in binary machine language is the hallmark of the FIRST generation; fifth generation systems move in the opposite direction, towards natural language and declarative languages such as PROLOG and LISP. So exactly I, II and IV are correct. Option A omits IV, option B omits I, option D wrongly includes III while dropping II, and option E wrongly includes III. Hence option C.

21. First gap: from ENIAC to the Intel 4004 is $1971 - 1946 = 25$ years. Second gap: from ENIAC to the start of the third generation is $1964 - 1946 = 18$ years. The excess required is $25 - 18 = 7$ years. (Equivalently, one may simply take $1971 - 1964 = 7$ years, since the common year 1946 cancels.) Since 7 years is available as an option, “None of these” is not correct. Hence option B.

Subtopic 5.1.2

22. Step 1: Recall the Indian supercomputing programmes. The PARAM series (PARAM 8000, PARAM Yuva, PARAM Siddhi-AI, etc.) is the flagship supercomputer family built by C-DAC, Pune. Hence option A is correct. Step 2: Eliminate the others. ISRO’s computing work is tied to launch-vehicle and satellite data processing, not the PARAM line. NAL developed the FLOLSOLVER series, a different machine. BARC developed the ANUPAM series. So B, C and D name real Indian organisations but the wrong ones for PARAM, and since a correct option exists, “None of these” (E) cannot be the answer.

23. Step 1: Fix the classification asked about. By principle of operation there are exactly three types: analog (works on continuously varying physical quantities), digital (works on discrete values, i.e. 0 and 1), and hybrid (combines both). So A, B and C all belong to this classification. Step 2: Place the odd one. “Mainframe” belongs to the classification by size and processing capability (micro, mini, mainframe, super), not by principle of operation. Hence D is the exception. Since a genuine exception exists in the list, option E is wrong.

24. Step 1: Note the key word “continuously varying”. Analog devices represent data by a physical quantity that changes smoothly (voltage, pressure, angular rotation, length of a mercury column). Both examples given measure such quantities directly, so they are analog. Step 2: Eliminate. A digital computer works only on discrete values counted in binary, so A is wrong. A hybrid computer must contain BOTH analog measuring parts and a digital processing part; a plain speedometer or mercury thermometer has no digital processing, so C is wrong. Mainframe and supercomputer are size/capability categories of digital machines, so D and E are wrong.

25. Step 1: Identify the defining feature. A microcomputer is any computer whose entire CPU is contained in a single microprocessor chip, and it is designed to serve one user at a time. A desktop PC fits this exactly. Step 2: Eliminate. A minicomputer (mid-range machine) serves a department of several dozen simultaneous users; a mainframe serves thousands of terminals in a large organisation; a supercomputer is built for very heavy scientific computation. A single-user counter PC is none of these, so A, B and D are wrong, and since C is correct, E is wrong.

26. Step 1: Match the requirement to the category. The system must (i) be centralised, (ii) support thousands of simultaneous users/terminals, and (iii) offer very high reliability and input/output throughput. These are precisely the design goals of a mainframe, which is why core banking solutions run on mainframe-class machines. Step 2: Eliminate. A microcomputer is single-user (A wrong). An analog computer cannot store or process account records, which are discrete data (C wrong). A workstation is a powerful single-user machine meant for engineering or design work, not for thousands of terminals (D wrong). Since B is correct, E is wrong.

27. Step 1: Break the working into stages. Stage one senses a continuously varying physical quantity, which is analog behaviour. Stage two converts it to numeric (discrete) form and processes it, which is digital behaviour. Step 2: A machine that uses an analog front end together with a digital processing section is by definition a hybrid computer, and ICU patient monitors are the standard textbook example. Step 3: Eliminate. It is not purely analog, because numeric processing and display take

place (A wrong). It is not purely digital, because the input is measured as a continuous signal (B wrong). Its computing power is small, nowhere near supercomputer class (D wrong). Since C is correct, E is wrong.

28. Step 1: Recall the standard yardstick. Supercomputers are rated by how many floating point arithmetic operations they complete per second, i.e. FLOPS, quoted today in teraflops (10^{12}) and petaflops (10^{15}). Hence C. Step 2: Eliminate. BPS measures data transmission rate over a channel, not computing speed (A wrong). DPI measures printer or scanner resolution (B wrong). Hertz measures clock frequency of a processor; two machines at the same clock speed can differ enormously in supercomputing throughput, so it is not the measure used for supercomputers (D wrong). Since C is correct, E is wrong.

29. Step 1: Recall the standard hierarchy by size and capability, from smallest to largest: microcomputer (single user) < minicomputer (mid-range, a department) < mainframe (a whole organisation, thousands of terminals) < supercomputer (the fastest machines, built for heavy computation). Step 2: Substitute the given labels: microcomputer is (ii), minicomputer is (iv), mainframe is (i), supercomputer is (iii). So the increasing order is (ii), (iv), (i), (iii), which is option A. Step 3: Eliminate. Option B wrongly puts mainframe below minicomputer. Option C wrongly starts with the minicomputer. Option D is the decreasing order, not increasing. Since A is correct, E is wrong.

30. Step 1: Recall the decimal prefixes used for computing speed: giga = 10^9 , tera = 10^{12} , peta = 10^{15} , exa = 10^{18} . Step 2: Therefore 1 petaflop = 10^{15} floating point operations per second, and 3 petaflops = 3×10^{15} operations per second, which is option C. Step 3: Eliminate. Option A uses giga, option B uses tera and option D uses exa, so each is off by a factor of 10^6 , 10^3 and 10^3 respectively. Since C is correct, E is wrong.

31. Step 1: Apply the definition. A hybrid computer is one that contains both analog and digital components: the analog part senses a continuously varying quantity, an analog-to-digital converter turns it into numbers, and the digital part computes on those numbers. That is exactly option B. Step 2: Eliminate. Adding storage does not change the principle of operation, so A is wrong. Running two operating systems is dual booting, a software matter with nothing to do with the analog/digital classification, so C is wrong. Time-sharing a mainframe for heavy jobs does not make it hybrid; hybrid refers to data representation, not workload, so D is wrong. Since B is correct, E is wrong.

32. Step 1: Note the two decisive clues: it serves exactly ONE user, yet it is far more powerful than an ordinary desktop and is meant for engineering/design work. That combination defines a workstation. Step 2: Eliminate. A mainframe is a multi-user central machine serving thousands of terminals, not one architect (B wrong). An analog computer handles continuous physical quantities and cannot run 3D design software (C wrong). A minicomputer is a multi-user mid-range machine shared by a department, so it fails the single-user clue (D wrong). Since A is correct, E is wrong.

33. Step 1: Test the purpose. A general purpose computer can be loaded with any application; a special purpose computer is built to do one predetermined job. The washing machine controller runs one fixed program only, so it is special purpose. Step 2: Test the data handling. It works with discrete instructions stored in memory, so it is digital, not analog. Step 3: Test the packaging. It is a microprocessor/microcontroller built inside a larger appliance, which is precisely what “embedded” means. Combining the three, option C is correct. Step 4: Eliminate. A and B both claim “general purpose”, contradicting the fixed single program; A also wrongly claims analog. A minicomputer is a multi-user mid-range machine, far larger than an appliance controller, so D is wrong. Since C is correct, E is wrong.

34. Step 1: Apply the definition. In client-server computing, the server is the machine that holds shared data or resources and responds to requests from client machines. That is exactly option B. Step 2: Eliminate. “Server” is a role, not a size class: servers range from ordinary microcomputer-based machines up to mainframes, so A is wrong. Servers store and process discrete data and are digital, so C is wrong, and the phrase “continuous traffic” has nothing to do with the analog/digital classification.

The whole purpose of a server is to serve many clients concurrently, so D is wrong. Since B is correct, E is wrong.

35. Step 1: List the standard bases of classification. Computers are classified (i) by size and processing capability, giving micro, mini, mainframe and super; (ii) by purpose, giving general purpose and special purpose; and (iii) by principle of operation, giving analog, digital and hybrid. So A, B and C are all valid. Step 2: The brand name is only a commercial label. Two machines of the same brand may be a laptop and a mainframe, and machines of different brands may be identical in class, so brand carries no classificatory meaning. Hence D is the answer, and because a valid exception exists, E is wrong.

36. Step 1: Verify the true statements. Modern supercomputers process discrete binary data, so A is true. The single-chip CPU is the defining feature of a microcomputer, so B is true. The analog-plus-digital construction is the definition of a hybrid, so C is true. Micro, mini, mainframe and super all belong to the size/capability classification, so D is true. Step 2: Examine E. Physical size is not the distinguishing criterion. A mainframe is optimised for very high throughput of many simultaneous transactions with high reliability, whereas a supercomputer is optimised for maximum raw computational speed on one intensive problem. They are different categories, so E is false and is therefore the required answer.

37. Step 1: Check (I). This is the standard definition of the purpose axis: a general purpose machine, such as a desktop PC, accepts any application program, while a special purpose machine has its single job fixed at the time of design. Correct. Step 2: Check (II). There is no such compulsion. Most special purpose computers in use today, for example a washing machine controller, a traffic-signal controller or a calculator chip, work on discrete binary data and are therefore digital. Analog and special purpose are two independent labels, so (II) is incorrect. Step 3: Check (III). The two classifications cut across each other. A special purpose computer may be a microcontroller of a few rupees embedded in an appliance, or it may be a very large dedicated installation such as a machine built solely for numerical weather prediction. Correct. Step 4: Only (I) and (III) hold, which is option C. Option A keeps only the false statement, option B pairs a true one with the false one, option D accepts the false statement (II), and option E denies all three.

38. Step 1: Convert the working period to seconds. 8 hours = $8 \times 60 \times 60 = 28,800$ seconds. Step 2: Multiply by the rate. Total = $12,000 \times 28,800$. Step 3: Compute. $12 \times 288 = 3456$, and counting the zeros, $12,000 \times 28,800 = 345,600,000$. Step 4: Write in standard form. $345,600,000 = 3.456 \times 10^8$, which is option C. Options A, B and D differ from this by factors of 100, 10 and 10 respectively, so they are wrong, and since C matches, E is wrong.

39. Step 1: Express the speed in operations per second. 2 petaflops = 2×10^{15} operations per second. Step 2: Use time = work $\div$ rate, so time = $\frac{10^{17}}{2 \times 10^{15}}$. Step 3: Simplify the powers of ten: $\frac{10^{17}}{10^{15}} = 10^2 = 100$, so time = $\frac{100}{2} = 50$ seconds. Hence option C. Step 4: Eliminate. 5 seconds would need 10^{16} operations, 20 seconds would need 4×10^{16} , and 200 seconds would need 4×10^{17} ; none of these matches the stated 10^{17} operations. Since C is correct, E is wrong.

40. Step 1: Weather prediction demands enormous raw floating point speed on one huge model, which is the classic supercomputer application, so (i)-P. Step 2: A centralised core banking system serves thousands of branch terminals with maximum reliability, the classic mainframe role, so (ii)-Q. Step 3: A departmental system shared by one section of a factory is mid-range multi-user work, i.e. a minicomputer, so (iii)-R. Step 4: A single-user desktop is a microcomputer, so (iv)-S. Step 5: The combination (i)-P, (ii)-Q, (iii)-R, (iv)-S is option A. Option B interchanges the supercomputer and mainframe roles, option C interchanges the mainframe and minicomputer roles, and option D reverses the whole hierarchy. Since A is correct, E is wrong.

41. Step 1: Check (I). By definition, an analog computer represents data by a continuously varying quantity such as voltage or rotation. Correct. Step 2: Check (II). Precision in an analog machine is limited by the accuracy of physical measurement and by drift, noise and calibration error; a digital

machine can be made as precise as desired simply by using more bits. So analog precision is LOWER, and (II) is incorrect. Step 3: Check (III). A hybrid computer senses an analog quantity, passes it through an analog-to-digital converter and then processes the numbers digitally. Correct. Step 4: Only (I) and (III) hold, which is option B. Options A and C each drop a true statement or keep the false one, D keeps the false one, and E denies all three.

42. Step 1: Decide the purpose. The machine performs only a fixed set of banking functions and cannot be loaded with arbitrary applications, so it is special purpose, not general purpose. This rules out A. Step 2: Decide the principle of operation. Account balances, PINs and note counts are all discrete data processed in binary, so the machine is digital. This rules out B. Step 3: Test the hybrid claim. Currency notes are counted, i.e. they are discrete items, not a continuously varying physical quantity, so there is no analog computing section. This rules out D. Step 4: Decide the size class. The processor sits inside the terminal and drives it, which is an embedded microprocessor-based system. Combining all three attributes gives option C, so E is wrong.

Subtopic 5.1.3

43. In the binary system each digit carries a place value that is a power of 2, counted from the right starting at 2^0 . Writing the place values under the digits: 1 0 1 1 0 1 sits over $2^5 = 32$, $2^4 = 16$, $2^3 = 8$, $2^2 = 4$, $2^1 = 2$, $2^0 = 1$. Now add only the place values where the digit is 1: $32 + 0 + 8 + 4 + 0 + 1$. Step by step, $32 + 8 = 40$, $40 + 4 = 44$, $44 + 1 = 45$. Hence $(101101)_2 = (45)_{10}$, which is option B. Option A (43) would need 101011, option C (47) would need 101111, and option D (49) would need 110001, so none of them matches the given digits.

44. Convert by repeated division by 2, writing down the remainders. $58 \div 2 = 29$ remainder 0; $29 \div 2 = 14$ remainder 1; $14 \div 2 = 7$ remainder 0; $7 \div 2 = 3$ remainder 1; $3 \div 2 = 1$ remainder 1; $1 \div 2 = 0$ remainder 1. Reading the remainders from the last one to the first gives 111010. A quick check by the place-value method confirms it: $32 + 16 + 8 + 0 + 2 + 0 = 58$. So the answer is option C. Option A, $(110110)_2 = 32 + 16 + 4 + 2 = 54$; option B, $(101110)_2 = 32 + 8 + 4 + 2 = 46$; option D, $(111100)_2 = 32 + 16 + 8 + 4 = 60$. None of these equals 58.

45. The hexadecimal system has base 16 and uses the digits 0–9 followed by the letters $A = 10$, $B = 11$, $C = 12$, $D = 13$, $E = 14$, $F = 15$. The number $(2F)_{16}$ has two positions, with place values $16^1 = 16$ and $16^0 = 1$. Therefore its value is $2 \times 16 + F \times 1 = 2 \times 16 + 15 \times 1 = 32 + 15 = 47$. Hence option D. A common error is to treat F as 16, giving $32 + 16 = 48$, or to treat it as 14, giving 46; neither of these is even listed. Option A (45) corresponds to $(2D)_{16}$, option B (31) to $(1F)_{16}$ and option C (51) to $(33)_{16}$.

46. The octal system has base 8 and uses only the digits 0 to 7. For a three-digit octal number the place values are $8^2 = 64$, $8^1 = 8$ and $8^0 = 1$. So $(347)_8 = 3 \times 64 + 4 \times 8 + 7 \times 1$. Computing each term, $3 \times 64 = 192$ and $4 \times 8 = 32$. Adding, $192 + 32 = 224$ and $224 + 7 = 231$. Hence $(347)_8 = (231)_{10}$, option A. Option B (213) results from wrongly using $3 \times 64 + 4 \times 5 + 1$ type slips; option C (229) and option D (247) do not correspond to the given digits at all.

47. A number written in base r may use only the digits 0 to $r - 1$. Octal has base 8, so the only permitted digits are 0, 1, 2, 3, 4, 5, 6 and 7; the symbol 8 itself can never appear in an octal number, just as the symbol 2 can never appear in a binary number. Checking each option: $(345)_8$ uses 3, 4, 5 – valid; $(706)_8$ uses 7, 0, 6 – valid; $(218)_8$ uses 2, 1, 8 and the digit 8 is out of range – invalid; $(177)_8$ uses 1, 7, 7 – valid; $(640)_8$ uses 6, 4, 0 – valid. Hence option C is the number that cannot exist in octal.

48. Convert by repeated division by 16. Dividing, $200 \div 16 = 12$ with remainder 8, and $12 \div 16 = 0$ with remainder 12. Now translate the remainders into hexadecimal symbols: the remainder 12 is written as C and the remainder 8 stays as 8. Reading the remainders from the last division upwards gives $C8$. Verifying, $(C8)_{16} = 12 \times 16 + 8 = 192 + 8 = 200$, which is correct, so option D. Checking the distractors: $(B8)_{16} = 11 \times 16 + 8 = 184$; $(D8)_{16} = 13 \times 16 + 8 = 216$; $(C6)_{16} = 12 \times 16 + 6 = 198$. None of these equals 200.

49. Because $8 = 2^3$, every octal digit corresponds to exactly three binary digits, so a binary number can be converted to octal simply by grouping its bits in threes from the right (padding the leftmost group with zeros if needed). Here 110101 splits neatly as 110 | 101. Now convert each group: 110 means $4 + 2 + 0 = 6$, and 101 means $4 + 0 + 1 = 5$. Writing the octal digits in the same order gives $(65)_8$. A cross-check through decimal confirms it: $(110101)_2 = 32 + 16 + 0 + 4 + 0 + 1 = 53$ and $(65)_8 = 6 \times 8 + 5 = 48 + 5 = 53$. Hence option A. Option B, $(56)_8 = 46$; option C, $(55)_8 = 45$; option D, $(63)_8 = 51$.

50. The safest route is to convert, add in decimal, and convert back. First, $(1011)_2 = 8 + 0 + 2 + 1 = 11$ and $(1101)_2 = 8 + 4 + 0 + 1 = 13$. Their sum in decimal is $11 + 13 = 24$. Now convert 24 to binary: $24 = 16 + 8$, so the bits at place values 16 and 8 are 1 and all lower places are 0, giving 11000. Direct binary addition gives the same result: adding the units column, $1 + 1 = 10$, write 0 carry 1; next column $1 + 0 + 1 = 10$, write 0 carry 1; next column $0 + 1 + 1 = 10$, write 0 carry 1; leftmost column $1 + 1 + 1 = 11$, write 1 carry 1, and the final carry 1 is brought down. This yields 11000. Hence option C.

51. There is no direct hexadecimal-to-octal rule, so pass through binary. Each hexadecimal digit expands into exactly four bits: $3 \rightarrow 0011$ and $A \rightarrow 1010$ (since $A = 10 = 8 + 2$). Joining them, $(3A)_{16} = (00111010)_2$, and dropping the leading zeros this is 111010. Now regroup these bits in threes from the right for octal: 111 | 010. Converting, $111 = 4 + 2 + 1 = 7$ and $010 = 2$, so the octal form is $(72)_8$. Check via decimal: $(3A)_{16} = 3 \times 16 + 10 = 58$ and $(72)_8 = 7 \times 8 + 2 = 58$. They agree, so option B is correct. Option C is a trap for candidates who simply carry the decimal value 58 across without converting.

52. Numbers written in different bases can only be compared after being brought to a common base, and decimal is the convenient choice. Option A: $(10110)_2 = 16 + 0 + 4 + 2 + 0 = 22$. Option B: $(26)_8 = 2 \times 8 + 6 = 16 + 6 = 22$. Option C: $(23)_{10} = 23$ already. Option D: $(1A)_{16} = 1 \times 16 + 10 = 26$. Arranging these, $22 = 22 < 23 < 26$, so the largest is 26, which comes from $(1A)_{16}$. Hence option D. Note the trap: options A and B look different but are equal in value, and a candidate who compares the printed digits rather than the values might wrongly pick $(26)_8$ because 26 looks like the biggest numeral on the page.

53. Convert both numbers to decimal, subtract, and convert the difference back. First, $(11010)_2 = 16 + 8 + 0 + 2 + 0 = 26$. Second, $(1011)_2 = 8 + 0 + 2 + 1 = 11$. The difference is $26 - 11 = 15$. Now write 15 in binary: $15 = 8 + 4 + 2 + 1$, so all four bits are 1, giving 1111. Hence the answer is $(1111)_2$, option C. As a check, add the answer back to the subtrahend: $(1111)_2 + (1011)_2 = 15 + 11 = 26 = (11010)_2$, which matches the original number. Option A, $(10001)_2 = 17$; option B, $(1101)_2 = 13$; option D, $(11110)_2 = 30$. None of these equals 15.

54. In base b the two-digit numeral 24 has place values b^1 and b^0 , so its value is $2 \times b + 4 \times 1 = 2b + 4$. We are told this equals 20 in decimal, so $2b + 4 = 20$. Subtracting 4 from both sides gives $2b = 16$, and dividing by 2 gives $b = 8$. A validity check is essential: the digits used are 2 and 4, and both are less than 8, so the numeral 24 is legitimate in base 8. Confirming, $(24)_8 = 2 \times 8 + 4 = 20$. Hence option B. Testing the other choices quickly: base 9 gives 22, base 7 gives 18 and base 6 gives 16, none of which is 20.

55. A decimal fraction is converted to binary by repeatedly multiplying by 2 and recording the integer part of each product. Start with 0.625: $0.625 \times 2 = 1.25$, so the first bit after the point is 1 and 0.25 carries forward. Next, $0.25 \times 2 = 0.5$, so the second bit is 0 and 0.5 carries forward. Next, $0.5 \times 2 = 1.0$, so the third bit is 1 and the fractional part becomes 0, terminating the process. Reading the bits in the order generated gives $(0.101)_2$. Verifying by place values, $\frac{1}{2} + 0 + \frac{1}{8} = 0.5 + 0.125 = 0.625$, which is correct. Now examine the printed options: $(0.110)_2 = 0.5 + 0.25 = 0.75$; $(0.011)_2 = 0.25 + 0.125 = 0.375$; $(0.111)_2 = 0.5 + 0.25 + 0.125 = 0.875$; $(0.1001)_2 = 0.5 + 0.0625 = 0.5625$. The correct value $(0.101)_2$ is not listed, so the answer is option E.

56. Convert each factor to decimal, multiply, then convert back. Here $(101)_2 = 4 + 0 + 1 = 5$ and $(110)_2 = 4 + 2 + 0 = 6$, so the product in decimal is $5 \times 6 = 30$. Converting 30 to binary, $30 = 16 + 8 + 4 + 2$,

so the bits at place values 16, 8, 4, 2 are 1 and the units bit is 0, giving 11110. Hence option A. The same result follows from direct binary long multiplication: multiplying 101 by the digits of 110 from the right gives partial products 000, 1010 and 10100, and adding these, $0 + 10 + 20 = 30$ in decimal terms, again 11110. Option B, $(11100)_2 = 28$; option C, $(10110)_2 = 22$; option D, $(11010)_2 = 26$.

57. The two's complement of a negative number is found in three steps. Step one: write the magnitude in 8 bits. Since $45 = 32 + 8 + 4 + 1$, the bits at place values 32, 8, 4, 1 are 1, giving $45 = (00101101)_2$. Step two: take the one's complement by inverting every bit, which turns 00101101 into 11010010. Step three: add 1 to the result. Adding 1 to 11010010 changes the last bit 0 into 1 with no carry, giving 11010011. Hence -45 is stored as $(11010011)_2$, option C. Option A is merely the sign-magnitude form (sign bit 1 followed by 0101101), option B is only the one's complement with the final +1 omitted, and option D is not a valid complement of 45. A useful check: adding the answer to +45 should give zero in 8 bits, and indeed $00101101 + 11010011 = 100000000$, whose lower 8 bits are all zero.

58. Work through decimal to stay safe. First, $(A7)_{16} = 10 \times 16 + 7 = 160 + 7 = 167$. Second, $(5B)_{16} = 5 \times 16 + 11 = 80 + 11 = 91$. Their sum is $167 + 91 = 258$. Now convert 258 back to hexadecimal by repeated division by 16: $258 \div 16 = 16$ remainder 2, then $16 \div 16 = 1$ remainder 0, then $1 \div 16 = 0$ remainder 1. Reading the remainders upwards gives 102, so the sum is $(102)_{16}$. Direct hexadecimal addition agrees: the right column is $7 + B = 7 + 11 = 18$, which is $16 + 2$, so write 2 and carry 1; the left column is $A + 5 + 1 = 10 + 5 + 1 = 16$, which is $16 + 0$, so write 0 and carry 1; the final carry gives the leading 1. Hence option A. Checking the distractors: option B, $(1F2)_{16} = 498$; option C, $(FE)_{16} = 254$; option D, $(112)_{16} = 274$. None of these equals 258. The two genuine carry slips lead elsewhere: a candidate who drops the final carry out of the left column would report $(02)_{16}$, while one who forgets to carry the 1 into the left column would report $(F2)_{16}$.

59. Expand the numeral using place values. In base b , the three-digit numeral 144 equals $1 \times b^2 + 4 \times b + 4$. Setting this equal to 49 gives the quadratic $b^2 + 4b + 4 = 49$. The left side is a perfect square, since $b^2 + 4b + 4 = (b + 2)^2$, so $(b + 2)^2 = 49$ and therefore $b + 2 = 7$, taking only the positive root because a base must be positive. This gives $b = 5$. Now check validity: the digits used are 1 and 4, both less than 5, so 144 is a legitimate numeral in base 5. Confirming, $(144)_5 = 1 \times 25 + 4 \times 5 + 4 = 25 + 20 + 4 = 49$. Hence option C. Testing the others: base 7 gives $49 + 28 + 4 = 81$, base 6 gives $36 + 24 + 4 = 64$ and base 8 gives $64 + 32 + 4 = 100$, none of which is 49.

60. Octal and hexadecimal are both powers of 2, so the conversion is done through binary. Expand each octal digit into three bits: $5 \rightarrow 101$, $7 \rightarrow 111$ and, after the point, $4 \rightarrow 100$. This gives $(57.4)_8 = (101111.100)_2$. Now regroup the bits in fours, moving outwards from the binary point in both directions. The integer part 101111 becomes 0010 | 1111 after padding with two leading zeros, and the fractional part 100 becomes 1000 after padding with one trailing zero. Converting each group of four, $0010 = 2$, $1111 = 15 = F$ and $1000 = 8$. So the result is $(2F.8)_{16}$. A decimal cross-check settles it: $(57.4)_8 = 5 \times 8 + 7 + \frac{4}{8} = 47.5$, while $(2F.8)_{16} = 2 \times 16 + 15 + \frac{8}{16} = 47.5$. The two agree, so option B. Option A fails because padding on the fractional side must be done to the right, not the left.

61. First find the binary form of 1000 by subtracting the largest available powers of 2. The powers of 2 up to 1000 are 512, 256, 128, 64, 32, 16, 8, 4, 2, 1. Taking 512 leaves $1000 - 512 = 488$; taking 256 leaves $488 - 256 = 232$; taking 128 leaves $232 - 128 = 104$; taking 64 leaves $104 - 64 = 40$; taking 32 leaves $40 - 32 = 8$; 16 is too large for 8, so its bit is 0; taking 8 leaves 0, and the bits for 4, 2, 1 are all 0. Assembling the bits from 512 down to 1 gives 1111101000. Counting the 1s in 1111101000, they occur at place values 512, 256, 128, 64, 32 and 8, which is six ones. Since 6 does not appear among options A to D, the answer is option E. (Verification of the binary string: $512 + 256 + 128 + 64 + 32 + 8 = 1000$.)

62. Since $16 = 2^4$, each hexadecimal digit corresponds to exactly four bits, so the 16-bit pattern is split into four groups of four, starting from the right. The pattern 1011011000101111 divides as 1011 | 0110 | 0010 | 1111. Now convert each nibble independently. First group: $1011 = 8 + 0 + 2 + 1 = 11 = B$. Second group: $0110 = 0 + 4 + 2 + 0 = 6$. Third group: $0010 = 2$. Fourth group: $1111 = 8 + 4 + 2 + 1 = 15 = F$. Writing the four hexadecimal digits in the same left-to-right order

gives $(B62F)_{16}$, which is option D. The distractors come from typical slips: option A swaps the middle two digits, option B misreads the first nibble as $1010 = A$, and option C misreads the third nibble as $0011 = 3$.

63. Expand every numeral by place values, treating b as an unknown. The two-digit numeral $(23)_b$ equals $2 \times b + 3 = 2b + 3$; likewise $(14)_b = 1 \times b + 4 = b + 4$ and $(42)_b = 4 \times b + 2 = 4b + 2$. The statement that the addition is correct means these values satisfy $(2b + 3) + (b + 4) = 4b + 2$. Simplifying the left side, $2b + 3 + b + 4 = 3b + 7$, so the equation is $3b + 7 = 4b + 2$. Subtracting $3b$ from both sides gives $7 = b + 2$, and subtracting 2 gives $b = 5$. A validity check is essential in base problems: the digits appearing anywhere in the statement are 1, 2, 3 and 4, and every one of them is less than 5, so all three numerals are legitimate in base 5. Confirming numerically, $(23)_5 = 2 \times 5 + 3 = 13$ and $(14)_5 = 1 \times 5 + 4 = 9$, whose sum is $13 + 9 = 22$, while $(42)_5 = 4 \times 5 + 2 = 20 + 2 = 22$. The two sides agree, so option A is correct. Testing the other choices shows each fails: in base 6 the left side is $15 + 10 = 25$ but the right side is 26; in base 7 it is $17 + 11 = 28$ against 30; in base 8 it is $19 + 12 = 31$ against 34.

Subtopic 5.1.4

64. Check each gate against the stated condition “output 1 only when all inputs are 1”. An OR gate gives 1 whenever at least one input is 1, so for inputs 0, 1 it already gives 1; that violates the word “only”. A NOR gate is the complement of OR, so it gives 1 only when all inputs are 0 – exactly the opposite case. A 2-input XOR gate gives 1 when the inputs differ, and for inputs 1, 1 it gives 0, so it fails the requirement. A NAND gate is the complement of AND, so for inputs 1, 1 it gives 0 and for every other combination it gives 1 – again the opposite. Only the AND gate produces 1 for the single combination in which all inputs are 1, and 0 for every other combination. Hence option D.

65. The XOR function is defined as $Y = A \oplus B = A\bar{B} + \bar{A}B$. Substituting the four possible input pairs: for $A = 0, B = 0$ we get $Y = 0$; for $A = 0, B = 1$ we get $Y = 1$; for $A = 1, B = 0$ we get $Y = 1$; for $A = 1, B = 1$ we get $Y = 0$. So the output is 1 exactly for the two rows in which the inputs are unequal. Option A is wrong because 0, 0 gives 0, and option B is wrong because 1, 1 also gives 0. Option D describes the XNOR gate, which is the complement of XOR. Since option C is correct, “None of these” cannot be the answer. Hence option C.

66. AND, OR, NAND and XOR are all combining functions: each needs at least two inputs before the operation has any meaning, and in practice they are supplied as 2-input, 3-input or 4-input devices. The NOT gate performs complementation, $Y = \bar{A}$, which is defined on a single variable. It therefore has exactly one input and one output, and because it converts a 0 into a 1 and a 1 into a 0 it is universally called an inverter. Hence option C.

67. NAND is the complement of AND, so $Y = \overline{A \cdot B}$. The AND output is 1 only for $A = 1, B = 1$; complementing it, the NAND output is 0 only for $A = 1, B = 1$ and 1 for the other three combinations. Testing the choices: for $A = 0, B = 0$ the AND output is 0, so NAND gives 1, ruling out option A. For exactly one input HIGH, say $A = 1, B = 0$, the AND output is 0 and NAND gives 1, ruling out options C and D (different inputs is the same case). Only when both inputs are HIGH does the NAND output fall to 0. Since option B is correct, “None of these” is not the answer. Hence option B.

68. A set of gates is called functionally complete, or universal, if NOT, AND and OR can all be built from it, since every Boolean function can then be realised. A single NAND gate with its two inputs tied together gives $\overline{A \cdot A} = \bar{A}$, which is NOT; feeding two NAND outputs into a third NAND gives AND and OR as well. The same argument works for NOR. Hence NAND and NOR are each universal on their own. AND and OR together cannot produce a complement, so option A fails; NOT with AND, or NOT with OR, is functionally complete only as a pair and neither gate alone is universal, so options C and E do not answer the question as asked about universal gates; XOR and XNOR cannot generate the constant functions needed and are not universal. Hence option B.

69. Each input line can independently take one of two values, 0 or 1. With n independent input lines the number of distinct input combinations, and hence the number of rows in the truth table, is 2^n .

Here $n = 3$, so the number of rows is $2^3 = 8$, namely 000, 001, 010, 011, 100, 101, 110, 111. The wrong options come from common errors: 3 is the number of inputs, 6 is 3×2 , 9 is 3^2 and 16 is 2^4 , which would be right only for a 4-input gate. Hence option C.

70. The variable A can take only the values 0 or 1. If $A = 0$ then $\bar{A} = 1$ and $A + \bar{A} = 0 + 1 = 1$. If $A = 1$ then $\bar{A} = 0$ and $A + \bar{A} = 1 + 0 = 1$. In both possible cases the result is 1, so $A + \bar{A} = 1$ always. Note carefully the companion law $A \cdot \bar{A} = 0$, which is the one that equals 0; option A confuses the two. The expression cannot equal A or $\bar{A}$, since it is a constant independent of A . Since option B is correct, “None of these” is not the answer. Hence option B.

71. Step 1: list the four combinations of (A, B) , namely (0, 0), (0, 1), (1, 0) and (1, 1). Step 2: compute $A \cdot B$ for each, giving 0, 0, 0 and 1 respectively. Step 3: NAND is the complement, $Y = \overline{A \cdot B}$, so the outputs are 1, 1, 1 and 0. Step 4: count the rows where $Y = 1$; there are three such rows, all except (1, 1). So the answer is 3. A count of 1 would correspond to an AND gate and a count of 4 would mean the output is stuck HIGH. Hence option D.

72. Step 1: a multi-input XOR gate is an odd-parity detector; its output is 1 exactly when the number of inputs equal to 1 is odd. Step 2: among the eight combinations of three bits, count those with an odd number of 1s. Combinations with exactly one 1 are 001, 010 and 100, that is 3 of them. Combinations with exactly three 1s number just one, namely 111. Step 3: total = $3 + 1 = 4$. The remaining four combinations, 000, 011, 101 and 110, have an even number of 1s and give output 0. Since 4 appears as an option, “None of these” is not correct. Hence option C.

73. De Morgan’s first theorem states that the complement of a sum equals the product of the complements: $\overline{A + B} = \bar{A} \cdot \bar{B}$. Verify by truth table. For $(A, B) = (0, 0)$: $A + B = 0$ so the left side is 1; and $\bar{A} \cdot \bar{B} = 1 \cdot 1 = 1$, which matches. For (0, 1), (1, 0) and (1, 1) the left side is 0 each time, and the right side is $1 \cdot 0 = 0$, $0 \cdot 1 = 0$ and $0 \cdot 0 = 0$ respectively, again matching in all rows. Option A is the standard trap: $\bar{A} + \bar{B}$ is the second theorem’s result and equals $\overline{A \cdot B}$, not $\overline{A + B}$; for (0, 1) it gives 1 whereas $\overline{A + B}$ gives 0. Option C fails at (1, 1) and option D is the uncomplemented expression itself. Hence option B.

74. Step 1: with both inputs tied to A , the NAND output becomes $Y = \overline{A \cdot A}$. Step 2: apply the idempotent law $A \cdot A = A$, so $Y = \bar{A}$. Step 3: a device whose output is the complement of its single effective input is a NOT gate, or inverter. Confirm numerically: if $A = 0$ then $Y = \overline{0 \cdot 0} = \bar{0} = 1$, and if $A = 1$ then $Y = \overline{1 \cdot 1} = \bar{1} = 0$, which is exactly inversion. It is not an AND or OR gate, since both of those would simply return A itself when the inputs are tied. Hence option C.

75. Step 1: expand the XOR term, $A \oplus B = A\bar{B} + \bar{A}B$. Step 2: multiply by A , giving $Z = A(A\bar{B} + \bar{A}B) = A \cdot A \cdot \bar{B} + A \cdot \bar{A} \cdot B$. Step 3: use $A \cdot A = A$ in the first term and $A \cdot \bar{A} = 0$ in the second term, so $Z = A\bar{B} + 0 = A\bar{B}$. Step 4: check by truth table – (0, 0) gives $0 \cdot 0 = 0$; (0, 1) gives XOR = 1 but $A = 0$, so $Z = 0$; (1, 0) gives XOR = 1 and $A = 1$, so $Z = 1$; (1, 1) gives XOR = 0, so $Z = 0$. The single 1 occurs at $A = 1, B = 0$, which is precisely $A\bar{B}$. Hence option C.

76. Step 1: take A common, $A + AB = A(1 + B)$. Step 2: in Boolean algebra $1 + B = 1$, because an OR with the constant 1 is always 1. Step 3: therefore $A + AB = A \cdot 1 = A$. Verify on all four rows: for $A = 0$ the expression is $0 + 0 \cdot B = 0 = A$; for $A = 1$ it is $1 + B = 1 = A$ whatever B is. Do not confuse this with the closely related law $A + \bar{A}B = A + B$, which is what option D would require; here the term is AB and not $\bar{A}B$, so the answer is simply A . Since option A is correct, “None of these” does not apply. Hence option A.

77. The required behaviour is an equality detector: output 1 when the two bits agree. Step 1: XNOR is defined as $\overline{A \oplus B}$, giving 1 for (0, 0) and (1, 1) and 0 for (0, 1) and (1, 0) – an exact match, which is why XNOR is also called the equivalence or coincidence gate. Step 2: eliminate the others. XOR is the complement of this and glows only when the bits differ. NOR gives 1 only for (0, 0); it stays off for (1, 1), so it fails one required row. NAND gives 1 for (0, 0), (0, 1) and (1, 0) but 0 for (1, 1), so it is wrong on three rows. Since XNOR is listed, “None of these” is not correct. Hence option D.

78. Step 1: the standard NAND-only realisation is built as follows. Gate 1 computes $P = \overline{AB}$. Gate 2 computes $Q = \overline{A} \cdot \overline{P}$ and gate 3 computes $R = \overline{B} \cdot \overline{P}$. Gate 4 computes $Y = \overline{Q} \cdot \overline{R}$. Step 2: verify the algebra. $Q = \overline{A} \cdot \overline{\overline{A} \cdot \overline{B}} = \overline{A} + AB = \overline{A} + B$, and similarly $R = \overline{B} + A$. Then $Y = \overline{Q} \cdot \overline{R} = \overline{\overline{A} + B} \cdot \overline{\overline{B} + A} = AB + \overline{A} \cdot \overline{B} = A \oplus B$, which is XOR. Step 3: this uses 4 gates, and no arrangement of only 3 two-input NAND gates can generate XOR, since XOR requires each input to appear in both true and complemented form and three gates cannot supply both complements together with the final combining stage. Hence the minimum is 4. Hence option B.

79. Step 1: simplify the first term using De Morgan's second theorem, $\overline{X \cdot Y} = \overline{X} + \overline{Y}$ with $X = \overline{A}$ and $Y = \overline{B}$. This gives $\overline{\overline{A} \cdot \overline{B}} = A + B$. Step 2: simplify the second term using De Morgan's first theorem, $\overline{A + B} = \overline{A} \cdot \overline{B}$. Step 3: so $F = (A + B) + \overline{A} \cdot \overline{B}$. But by step 2 the term $\overline{A} \cdot \overline{B}$ is precisely $\overline{A + B}$, so writing $S = A + B$ we have $F = S + \overline{S}$. Step 4: by the complement law $S + \overline{S} = 1$, so $F = 1$ for every input. Cross-check on the four rows: (0, 0) gives $0 + 1 = 1$; (0, 1) gives $1 + 0 = 1$; (1, 0) gives $1 + 0 = 1$; (1, 1) gives $1 + 0 = 1$. The output is stuck HIGH. Hence option B.

80. Step 1: expand the product of sums, $F = (A + B)(\overline{A} + C) = A\overline{A} + AC + \overline{A}B + BC$. Step 2: apply the complement law $A\overline{A} = 0$, so $F = AC + \overline{A}B + BC$. Step 3: apply the consensus theorem, $XY + \overline{X}Z + YZ = XY + \overline{X}Z$, with $X = A$, $Y = C$ and $Z = B$; the consensus term BC is redundant and is absorbed. Hence $F = AC + \overline{A}B$. Step 4: verify by splitting on A . If $A = 0$ the original gives $F = (0 + B)(1 + C) = B$, and the simplified form gives $0 + 1 \cdot B = B$, which matches. If $A = 1$ the original gives $F = (1 + B)(0 + C) = C$, and the simplified form gives $1 \cdot C + 0 = C$, which matches again. Step 5: option B is the standard trap obtained by swapping B and C ; at $(A, B, C) = (0, 1, 0)$ it gives 0 whereas $F = 1$. Option C fails at (0, 0, 1), where $A + B + C = 1$ but $F = 0$, and option D fails at (0, 1, 0). Hence option A.

81. Step 1: group the first two terms, $AB + \overline{A}B = A(B + \overline{B})$. Step 2: by the complement law $B + \overline{B} = 1$, so this reduces to A . Step 3: now $F = A + \overline{A}B$. Step 4: apply the redundancy law $X + \overline{X}Y = X + Y$ with $X = A$ and $Y = B$, giving $F = A + B$. Step 5: verify by truth table – (0, 0) gives $0 + 0 + 0 = 0$; (0, 1) gives $0 + 0 + 1 = 1$; (1, 0) gives $0 + 1 + 0 = 1$; (1, 1) gives $1 + 0 + 0 = 1$. The output is 1 for three rows and 0 only for (0, 0), which is exactly the OR function. It is not XOR, because XOR gives 0 at (1, 1) whereas F gives 1 there. Hence option D.

82. Step 1: it is easier to count the combinations for which $F = 0$. Since F is an OR of two terms, $F = 0$ requires both $C \cdot I = 0$ and $L \cdot \overline{D} = 0$ simultaneously. Step 2: the pair (C, I) has 4 combinations, and $C \cdot I = 1$ for only one of them, namely (1, 1); so $C \cdot I = 0$ for 3 combinations. Step 3: the pair (L, D) has 4 combinations, and $L \cdot \overline{D} = 1$ for only one of them, namely $L = 1, D = 0$; so $L \cdot \overline{D} = 0$ for 3 combinations. Step 4: the two pairs are independent, so the number of combinations with $F = 0$ is $3 \times 3 = 9$. Step 5: therefore the number with $F = 1$ is $16 - 9 = 7$. Since 7 is listed, “None of these” is not correct. Hence option B.

83. Step 1: start from De Morgan, $A + B = \overline{\overline{A} \cdot \overline{B}}$. Step 2: the term $\overline{\overline{A} \cdot \overline{B}}$ is exactly a NAND gate fed with $\overline{A}$ and $\overline{B}$. Step 3: each complement is itself produced by one NAND gate with both inputs tied, since $\overline{A} \cdot \overline{A} = \overline{A}$. So one NAND gate produces $\overline{A}$ and a second produces $\overline{B}$. Step 4: a third NAND gate combines them, giving $\overline{\overline{A} \cdot \overline{B}} = A + B$. Step 5: the total is $1 + 1 + 1 = 3$ NAND gates, and this is minimal, since a single NAND gives NAND or NOT and two NANDs give at best AND, neither of which is OR. The required number is 3, which does not appear among options A to D. Hence option E, “None of these”.

84. Step 1: let $P = \overline{AB}$ and $Q = \overline{A + B}$, so $Y = \overline{P + Q}$. Step 2: by De Morgan, $\overline{P + Q} = \overline{P} \cdot \overline{Q}$. Step 3: $\overline{P} = \overline{\overline{AB}} = AB$ and $\overline{Q} = \overline{\overline{A + B}} = A + B$, by double complementation. Step 4: therefore $Y = AB \cdot (A + B) = AAB + ABB = AB + AB = AB$, using $A \cdot A = A$ and $B \cdot B = B$. Step 5: verify by truth table – (0, 0): $P = 1, Q = 1$, so $Y = \overline{1 + 1} = 0$; (0, 1): $P = 1, Q = 0$, so $Y = \overline{1 + 0} = 0$; (1, 0): $P = 1, Q = 0$, so $Y = 0$; (1, 1): $P = 0, Q = 0$, so $Y = \overline{0 + 0} = 1$. The output is 1 only for $A = B = 1$, which is the AND function. Hence option A.

Subtopic 5.2.1

85. The band of numbers at the bottom of an Indian cheque is printed in magnetic ink and is read by an MICR reader-sorter, so option C is correct. OMR only senses whether a pencil mark is present in a fixed position (used for objective answer sheets), it cannot read the shapes of characters. OCR reads ordinary printed or typed characters by their optical shape, not by magnetism, and is far less reliable when the paper is folded, stamped or soiled – which is exactly why banks chose MICR for cheques. A bar code reader reads only bars and spaces, and no bar code is printed on the MICR band. Since a genuinely correct option exists, “None of these” is wrong.

86. An input device carries data from the user into the CPU. A joystick sends direction and button signals in, a light pen sends the screen position it is pointed at, a trackball sends the rotation of the ball as cursor movement, and a bar code reader sends the decoded number of the scanned bar code. A plotter, by contrast, receives data from the computer and draws large-format line drawings such as maps and engineering diagrams on paper – it is a specialised output device, a cousin of the printer. Hence the odd one out is option C.

87. The function keys are numbered consecutively from $F1$ up to $F12$. Counting them gives $12 - 1 + 1 = 12$ keys, so option C is correct. The value 8 would correspond to $F1$ to $F8$, 10 to $F1$ to $F10$ (the layout of some very old keyboards, where the function keys sat in two columns on the left), and 14 or 16 exceed the highest labelled key $F12$ on a standard keyboard. Note that the numeric keypad keys, the arrow keys and keys such as Esc or Ctrl are not function keys.

88. Scanner resolution states how many separate dots the scanner can sense along one inch of the document, so it is expressed in dots per inch, DPI – option B. Hertz measures frequency, for example the clock speed of a processor or the refresh rate of a monitor. BPS measures the rate of data transfer over a communication link such as a modem or a leased line. PPM measures the speed of a printer or a photocopier, that is, how many pages it delivers in a minute – it is a speed measure, not a quality measure, and it belongs to output devices. As option B is genuinely correct, “None of these” cannot be the answer.

89. An Optical Mark Reader shines light on the sheet at fixed pre-printed positions and measures the light reflected back. A darkened circle reflects much less light than a blank one, so the machine records a mark at that position. It never tries to identify a letter or a digit – it only answers “marked or not marked” – which is precisely what an answer sheet requires. Hence option B. A magnetic ink character reader needs characters printed in magnetic ink, absent here. A digitiser (graphics tablet) is used with a stylus to enter freehand drawings. A web camera captures video images. Since option B is correct, “None of these” is wrong.

90. In a trackball the ball that a mouse hides underneath is brought to the top of the casing. The casing itself does not move; the user spins the ball with the fingers or the palm and the rollers inside translate that rotation into cursor movement, which is exactly the description in option A. Its advantage is that it needs no free desk space, so it suits crowded counters. Option B describes a light pen, option C describes a touchpad of the kind built into laptops, option D describes a magnetic stripe card reader, and option E describes an OCR system. Hence option A.

91. A microphone picks up sound waves and passes the resulting electrical signal into the computer, so it is an input device – option B. A speaker and a woofer both convert electrical signals coming out of the computer back into sound, and a headphone is simply a pair of miniature speakers worn on the ears; all three are output devices. A monitor is a visual output device. Only the microphone carries data inward, so option B is correct.

92. Two MICR fonts exist worldwide. CMC-7, developed in France, is used in much of Europe and Latin America, while E-13B is used in India, the USA, the UK and Australia. Indian cheques issued under the CTS-2010 standard carry the E-13B font, so option C is correct. In E-13B each of the 10 digits and the 4 special symbols is shaped so that, when passed under a read head, it induces a unique voltage pattern – this is why the reader is so accurate. OCR-A is an optical font meant for character

recognition by shape, not by magnetism. Courier New is an ordinary typewriter-style screen font with no magnetic significance. As option C is genuinely correct, “None of these” is wrong.

93. Work backwards from the requirement: the output must be editable, searchable text, not a picture. A scanner alone (option A) or a digital camera (option E) produces only a bitmap image; the words in it cannot be edited or searched because the computer stores dots, not letters. OCR software examines that bitmap, recognises the shape of each character and converts it into the corresponding character code, giving genuine text – so a scanner plus OCR, option B, meets the requirement. Option C fails because OMR only detects marks at fixed positions and cannot read typed words. Option D fails because MICR can read only the 14 characters of the E-13B set printed in magnetic ink, whereas these forms carry ordinary typewriter ink and full sentences. Hence option B.

94. The square pattern is a QR code, a two-dimensional bar code. An ordinary bar code encodes data only in the varying widths of vertical bars, that is, along one axis, so it can hold roughly 20 to 25 characters. A QR code encodes data in both directions of the square, so its capacity runs into thousands of characters – ample for the payee’s UPI identifier, name and amount. Hence option B. Option A reverses the fact. Option C is false because the premise of the question itself is that a mobile phone camera reads it. Option D is false: a QR code carries Reed-Solomon error correction, which is why it still scans when partly smudged. As option B is correct, “None of these” is wrong.

95. A fingerprint scanner captures the ridge pattern of the thumb, converts it into a digital template and sends that template into the system for matching – data therefore flows from the user into the computer, which is the definition of an input device. Because the data captured is a physical characteristic of the human body, it is classed as a biometric input device, so option B is correct. Option A confuses the small display of the micro-ATM with the scanner itself. Option C is wrong because the scanner does not retain the impression; the reference template lies in the central Aadhaar database, and the device only transmits the freshly captured one. Option D is wrong because no magnetic stripe, and indeed no card at all, is used in AEPS. Since option B is correct, “None of these” is wrong.

96. A resistive touch screen has two thin conductive layers separated by a tiny gap. Any object that presses hard enough – a bare finger, a gloved finger, a fingernail or a plastic stylus – pushes the layers into contact at that point, and the resulting change in resistance fixes the coordinates. That matches the observed behaviour, so option B is correct. A capacitive screen (option A) works by sensing the charge drawn away by a conductive object, and wool and plastic are insulators, so an ordinary glove or plastic pen would not register – this is why option A contradicts the given facts. Option C misstates infrared screens, which detect the interruption of a grid of light beams and depend on opacity, not on warmth. Option D names a text-recognition technique, not a touch technology. Hence option B.

97. Test each key against the definition. Caps Lock pressed once turns capitals on, pressed again turns them off, and an indicator lamp shows the current state – a toggle. Num Lock switches the numeric keypad between digits and cursor movement – a toggle. Scroll Lock switches the scrolling behaviour in applications that support it – a toggle. Insert switches between insert mode and overwrite mode while typing – a toggle. Shift, however, has effect only while it is held down; releasing it immediately restores normal typing, so it changes nothing permanently and is classified as a modifier key, together with Ctrl and Alt. Hence the key that is not a toggle key is option E.

98. Resolution in DPI tells how many dots the scanner records along each inch, and it applies to both directions. Step 1: dots along the 8-inch side = $8 \times 300 = 2400$. Step 2: dots along the 10-inch side = $10 \times 300 = 3000$. Step 3: the image is a rectangular grid, so the total number of pixels is the product $2400 \times 3000 = 72,00,000$, that is 7.2 megapixels. Hence option D. Option A is the error of multiplying $8 \times 10 \times 300$, applying the resolution only once. Options B and C are the correct value divided by ten and by three respectively, and follow from no valid step; a candidate who reaches either of them has slipped in the arithmetic rather than in the method. Since a correct value is listed, “None of these” is wrong.

99. Step 1: count the pixels in one frame, $640 \times 480 = 3,07,200$ pixels. Step 2: convert to bytes per frame. A 24-bit colour pixel needs $\frac{24}{8} = 3$ bytes, so one frame occupies $3,07,200 \times 3 = 9,21,600$ bytes.

Step 3: multiply by the frame rate, since 15 such frames arrive every second: $9,21,600 \times 15 = 1,38,24,000$ bytes, roughly 13 MB for a single second. Hence option D, and this is precisely why a live video feed must be compressed before it is sent over a branch link. Option A stops at the pixel count and forgets that each pixel needs 3 bytes. Option B is the size of one frame only, forgetting the frame rate. Option C assumes 1 byte per pixel, that is 256-level grayscale instead of 24-bit colour. Since a correct value is listed, “None of these” is wrong.

100. Step 1: sum the odd-position digits, that is the 1st, 3rd, 5th, 7th, 9th and 11th, which are 8, 0, 2, 4, 6, 8. Their sum is $8 + 0 + 2 + 4 + 6 + 8 = 28$. Step 2: sum the even-position digits, that is the 2nd, 4th, 6th, 8th, 10th and 12th, which are 9, 1, 3, 5, 7, 9. Their sum is $9 + 1 + 3 + 5 + 7 + 9 = 34$. Step 3: weight the even-position sum by three, $34 \times 3 = 102$. Step 4: grand total of the twelve data digits $= 28 + 102 = 130$. Step 5: the check digit c must make $130 + c$ a multiple of 10. Since 130 is already a multiple of 10, we need $c = 0$. Hence option A.

101. Step 1: find the combined rate. Since the three scanners work at the same time on different sheets, their rates add: $3 \times 40 = 120$ sheets per minute. Step 2: divide the work by the combined rate. $\text{Time} = \frac{7200}{120} = 60$ minutes. Hence option C, that is one hour. Option E, 180 minutes, is the time a single scanner would need ($7200 \div 40$), and forgets that three machines share the load. Option A would require a combined rate of 240 sheets per minute, that is six machines. Options B and D correspond to no consistent arrangement of the given figures.

102. Step 1: find the actual working time. The shift is 7 hours, of which 30 minutes, that is $\frac{1}{2}$ hour, is a break, so the operator works for $7 - \frac{1}{2} = 6\frac{1}{2} = 6.5$ hours. Step 2: find the total keystrokes delivered, $6.5 \times 12,000 = 78,000$ keystrokes. Step 3: divide by the keystrokes needed per form, $\frac{78,000}{250} = 312$. As this is a whole number, exactly 312 complete forms are finished. Hence option C. Option E, 336, comes from ignoring the break ($7 \times 12,000 \div 250$), and option A, 288, from wrongly deducting a full hour instead of half an hour.

103. Statement (i) is correct: the E-13B set used in MICR contains only the ten digits and four special symbols, a total of 14 characters, yet within that narrow set the magnetic reading is extremely accurate even on soiled or stamped cheques. Statement (ii) is correct: an OMR reader measures reflected light at fixed pre-printed coordinates and reports simply whether that spot is dark, which is why the marking instructions on an answer sheet insist on the correct position rather than a legible symbol. Statement (iii) is incorrect: a bar code reader only captures the code and sends it into the computer, and it is the computer that then looks up the price and sends it to the monitor or the printer – so the reader itself is an input device, and the display is done by a separate output device. Therefore only (i) and (ii) hold, giving option B.

104. Examine each unit for two-way traffic. A light pen only reports the screen position at which it is held, so data flows only inward; the picture it points at is produced by the monitor, a separate unit. A flat-bed scanner only sends the captured image inward. A joystick only sends direction and button signals inward. A plotter only receives drawing commands and puts ink on paper, so data flows only outward. A touch screen, however, is a single unit that displays the menu, the balance or the keypad to the customer – an output function – and at the same time senses where the customer touches it – an input function. This is why ATMs and kiosks use it. Hence option C.

105. Take the three requirements one at a time. For (i) a live photograph of a person seated at the counter, the natural device is a web camera, which converts the optical image into a digital one. For (ii) the signature must be captured as it is written, so a signature pad, that is a digitiser or graphics tablet with a stylus, is used; it records the pen’s coordinates on a pressure-sensitive surface. For (iii) the number already exists as printing on paper, so it must first be scanned into a bitmap and then passed through OCR software, which recognises the shape of each digit and returns an editable character – a scanner alone would leave only a picture. That gives the order in option B. Option A fails twice, since a plotter is an output device and MICR can read only magnetic-ink characters in the E-13B set.

Option C puts the scanner and the camera in the wrong roles and offers an OMR reader, which can only sense marks at fixed positions and cannot read printed digits. Option D reverses the first two devices and ends with a bar code reader, but a printed Aadhaar number is not a bar code. Since option B is correct, “None of these” is wrong.

Subtopic 5.2.2

106. An output device takes data that the CPU has already processed and presents it to the user; an input device does the opposite, feeding raw data into the computer. The monitor displays the processed result on screen, so it is an output device. The keyboard sends typed characters into the computer (input); the mouse sends pointer coordinates and click signals into the computer (input); the scanner converts a printed page into a digital image and passes it in (input); the joystick sends directional signals in (input). Only one of the five sends information outward, so the answer is option B.

107. The test is whether the output survives after the power is cut. A monitor paints the output with light on a screen; nothing physical remains, so it gives a soft copy only. Every other option puts ink, toner or pigment on paper and therefore gives a hard copy: the laser printer fuses toner powder onto the sheet, the plotter draws with pens or ink on large sheets, the dot-matrix printer strikes an inked ribbon against the paper, and the inkjet printer sprays droplets of liquid ink. Hence only the monitor qualifies, and the answer is option C.

108. VDU is the standard hardware term for the monitor or screen and expands to Visual Display Unit – “visual” because the output is seen, “display” because it is shown on a screen, and “unit” because it is a separate peripheral. “Video Data Unit”, “Visual Data Utility” and “Virtual Display Unit” are not recognised expansions and are only distractors built by swapping one word. Since the correct expansion is present in the list, “None of these” cannot be chosen. Hence option A.

109. A plotter is designed specifically for vector graphics – it moves a pen or an ink head along continuous paths across very wide, long sheets, which is exactly what maps, layouts and blueprints require. The other devices are limited to ordinary cut-sheet or continuous stationery sizes: a laser printer and an inkjet printer normally handle up to A4 or A3 office paper, a thermal printer prints on narrow heat-sensitive rolls used for receipts and slips, and a line printer prints a whole line of characters at a time on continuous stationery meant for text reports, not drawings. Hence option D.

110. An audio output device converts electrical signals produced by the sound card into sound waves that the user can hear. The speaker does exactly this, so it is an audio output device. The microphone works in reverse – it converts sound into electrical signals for the computer, making it an audio input device. The webcam captures video and feeds it in (input), the light pen sends screen-position signals in (input), and the MICR reader reads the magnetic ink characters printed at the bottom of a cheque and feeds them in (input). Hence option D.

111. The word pixel is short for “picture element” and denotes one addressable dot of the screen; the display controller sets the colour of each pixel and the whole picture is built out of them. The other terms belong elsewhere: a byte is a storage unit of 8 bits, a bit is a single binary digit (0 or 1) and neither is a physical dot on the screen; a font is a particular design of the character set used while displaying or printing text; a sector is the smallest storage division of a track on a magnetic disk. Hence option C.

112. A passbook printer must print onto a thick, bound booklet and, at many counters, onto multi-part carbon stationery as well. Only an impact printer can do this, because its print head physically strikes an inked ribbon against the paper and the pressure of the strike carries the impression through. Hence bank passbook printers are dot-matrix impact printers. The other options are all non-impact: inkjet sprays ink and cannot handle a bound booklet reliably, laser needs a flat sheet to pass through a heated fuser and a curved drum, thermal printing needs special heat-sensitive paper (a passbook is ordinary paper), and a plotter draws large graphics, not text lines in a booklet. Hence option B.

113. Printer speed for a page printer such as a laser printer is quoted in pages per minute (ppm). Time required = $\frac{\text{total pages}}{\text{pages per minute}}$. Substituting, time = $\frac{1250}{25} = 50$ minutes. A quick check: in 10 minutes the printer does $25 \times 10 = 250$ pages, and $1250 \div 250 = 5$, so $5 \times 10 = 50$ minutes. Since 50 minutes is listed, “None of these” is not the answer. Hence option C.

114. The common property of the group is that the device receives processed data from the CPU and presents it to the user. The plotter presents it as a large drawing on paper, the speaker as sound, the projector as an enlarged image on a screen or wall, and the monitor as a display. An OMR (Optical Mark Recognition) reader, however, scans pencil marks made on answer sheets or survey forms and feeds that data into the computer, so it is an input device and is the odd one out. Hence option B.

115. A touch-screen monitor performs two jobs at once: as a monitor it displays the processed output, and as a touch panel it senses the position of the user’s finger and sends that co-ordinate into the computer as input. It is therefore both an input and an output device – which is why ATM and kiosk screens are described this way. Each of the other four is input only: the light pen senses a position on the screen and reports it inward, the barcode reader converts a printed bar pattern into a code and passes it in, the joystick passes direction and button signals in, and the flatbed scanner passes a digitised image in. None of them displays or prints anything on its own. Hence option D.

116. Resolution is written as (number of pixels along the width) $\times$ (number of pixels along the height), so the screen is a rectangular grid of pixels and the total is simply the product of the two numbers. Total pixels = 1920×1080 . Compute stepwise: $1920 \times 1000 = 1,920,000$ and $1920 \times 80 = 153,600$. Adding, $1,920,000 + 153,600 = 2,073,600$ pixels. Option A is exactly half of this (a common error of using 1920×540), and options C and D do not arise from the given numbers. Hence option B.

117. Printers are graded by the unit of output they produce in one operation. A dot-matrix printer is a character printer – its head forms and prints a single character at a time – so its speed is measured in characters per second (CPS). LPM (lines per minute) is used for line printers such as drum and chain printers, which compose a whole line at one go. PPM (pages per minute) is used for page printers such as laser printers, which image an entire page at a time. DPI (dots per inch) measures print resolution or sharpness, not speed. BPS (bits per second) measures data transmission speed on a communication line. Hence option C.

118. The device described is a laser printer, and its consumable is toner – a dry powder of pigment and plastic resin held in a cartridge. The powder is attracted to the electrostatically charged image on the drum, transferred to the paper, and then melted by the hot fuser so that it bonds permanently, which is exactly the sequence stated in the question. Liquid ink is the consumable of an inkjet printer, which sprays droplets rather than using a drum. Ribbon ink belongs to impact printers such as dot-matrix and daisy-wheel, where the head strikes an inked ribbon. Thermal dye is used by thermal and dye-sublimation printers, which work on heat-sensitive media without any laser or drum. Since the correct term is listed, “None of these” is wrong. Hence option A.

119. Refresh rate in hertz means redraws per second, so first convert the given time to seconds. 4 minutes = $4 \times 60 = 240$ seconds. Number of redraws = refresh rate $\times$ time in seconds = 75×240 . Compute: $75 \times 240 = 75 \times 24 \times 10 = 1800 \times 10 = 18,000$. Option A (4500) comes from wrongly multiplying 75 by 60, and option B (9000) from multiplying 75 by 120, i.e. taking only 2 minutes. Hence option C.

120. Resolution of 300 dpi means 300 dots are printed along every one inch, so each side must be converted from inches to dots separately. Along the 8-inch side: $8 \times 300 = 2400$ dots. Along the 10-inch side: $10 \times 300 = 3000$ dots. The printed area is a grid of these dots, so the total = $2400 \times 3000 = 7,200,000$ dots. A common trap is to multiply the area in square inches by 300 once only, giving $8 \times 10 \times 300 = 24,000$, or by 300 instead of 300^2 ; the correct relation is total dots = area $\times$ (dpi) ^{2} = $80 \times 90000 = 7,200,000$, which confirms the same figure. Hence option C.

121. The job has two separate parts – the time spent actually printing characters and the time lost in line feeds – so compute each and add. Step 1 – total characters to be printed: $750 \times 96 = 72,000$

characters. Step 2 – printing time at 120 characters per second: $\frac{72000}{120} = 600$ seconds. Step 3 – feed time: there are 750 lines and each costs 0.2 second, so $750 \times 0.2 = 150$ seconds. Step 4 – total time: $600 + 150 = 750$ seconds, and $\frac{750}{60} = 12.5$ minutes. Option A (10 minutes) is what you get by ignoring the feed pauses altogether, i.e. taking only the 600 seconds. Since 12.5 minutes is listed, “None of these” is not the answer. Hence option C.

122. Each bit can independently take one of 2 values, so n bits can represent 2^n different patterns, and each distinct pattern is one colour. With a colour depth of 24 bits the count is 2^{24} . Evaluate in steps: $2^{10} = 1024$, so $2^{20} = 1024 \times 1024 = 1,048,576$, and $2^{24} = 2^{20} \times 2^4 = 1,048,576 \times 16 = 16,777,216$. The distractors are the counts for smaller depths: $2^8 = 256$ (8-bit colour), $2^{16} = 65,536$ (16-bit or High Colour) and $2^{20} = 1,048,576$. Hence option D.

123. Step 1 – count the pixels: $1024 \times 768 = 786,432$ pixels. Step 2 – convert the colour depth to bytes: 16 bits = $\frac{16}{8} = 2$ bytes per pixel. Step 3 – total bytes = $786,432 \times 2 = 1,572,864$ bytes. Step 4 – convert to MB: $\frac{1,572,864}{1024} = 1536$ KB, and $\frac{1536}{1024} = 1.5$ MB. Option A is what you get by forgetting to double for 2 bytes per pixel, and option D by using 32 bits per pixel. Hence option C.

124. Step 1 – pages done by Printer A alone in the first 20 minutes: $30 \times 20 = 600$ pages. Step 2 – pages still pending: $4000 - 600 = 3400$ pages. Step 3 – combined speed once both run: $30 + 20 = 50$ pages per minute. Step 4 – time for the remaining pages: $\frac{3400}{50} = 68$ minutes. Step 5 – total time from the start: $20 + 68 = 88$ minutes. Note that the answer is not $4000 \div 50 = 80$ minutes, because for the first 20 minutes only Printer A was working. Hence option A.

125. Statement (i) is correct: the defining feature of an impact printer is physical contact of the head with an inked ribbon and the paper, and it is precisely this striking pressure that carries the impression through several carbon copies, which is why banks still use dot-matrix printers for multi-part vouchers. Statement (ii) is incorrect: a laser printer forms the image electrostatically on a drum and fuses toner with heat, with no part striking the paper, so it is a non-impact printer. Statement (iii) is correct: dpi counts how many dots the printer places per inch, and a higher dpi means finer detail, so it is the standard measure of print quality (speed, by contrast, is measured in CPS, LPM or PPM). Since (i) and (iii) are correct and (ii) is not, options B, D and E are ruled out and A is incomplete. Hence option C.

126. Step 1 – find the combined speed the centre must achieve: required speed = $\frac{18000 \text{ pages}}{150 \text{ minutes}} = 120$ pages per minute. Step 2 – find how many printers give that speed: each printer contributes 24 pages per minute, so number needed = $\frac{120}{24} = 5$ printers. Step 3 – verify: 5 printers give $5 \times 24 = 120$ ppm, and in 150 minutes they produce $120 \times 150 = 18,000$ pages, exactly meeting the deadline. With only 4 printers the speed is 96 ppm, giving $96 \times 150 = 14,400$ pages, which falls short. Hence the minimum is 5, option B.

Subtopic 5.2.3

127. The CPU has three parts: the Arithmetic Logic Unit (ALU), the Control Unit (CU) and a set of registers. All actual computation – arithmetic operations such as addition and subtraction, and logical operations such as AND, OR, NOT and magnitude comparison – is done inside the ALU. Comparing a balance with Rs. 5,000 is a subtraction followed by an examination of the sign, so it is an ALU job. The Control Unit only fetches, decodes and sequences instructions; it issues the signal that tells the ALU to compare, but it does not do the comparing. The Main Memory Unit only stores data and is not even part of the CPU. The Input Unit merely accepts data from the keyboard or other devices. Since the Arithmetic Logic Unit is listed, “None of these” is not correct. Hence option B.

128. The Control Unit (CU) is the managing part of the CPU. Its duties are: fetch the next instruction from memory, decode the instruction to find out what operation is wanted, and then generate the

sequence of timing and control signals that make the ALU, the registers, memory and the I/O devices act at the right moment. The CU is often described as the “nerve centre” of the computer because it directs but does not compute. The ALU is wrong because the ALU is precisely the part that does compute. The Accumulator is only a single register that holds an operand or a result; it neither fetches nor decodes. Cache memory is a fast buffer store between the CPU and main memory and has no decoding role. Hence option D.

129. A register is one of the three parts of the CPU, along with the Control Unit and the Arithmetic Logic Unit. Registers are built out of flip-flops on the processor chip itself, which makes them the fastest storage in the machine, and each one holds only a word or two of information – an operand for the ALU, the address of a memory location, the instruction being decoded, or a result just produced. They are working scratchpads used for the duration of an instruction and they lose their contents when power is removed. The second option describes a disk area such as a swap or page file, which is secondary storage outside the CPU. The third option describes a software listing, not a hardware component at all. The fourth option describes ROM or flash memory holding the BIOS, which is non-volatile and slow, the exact opposite of a register. Since a correct description is present, “None of these” is not correct. Hence option A.

130. The Accumulator (AC) is the register wired directly to the output of the ALU. In a single-accumulator machine an instruction such as ADD X means “add the contents of memory location X to the accumulator and leave the sum in the accumulator”, so the accumulator supplies one operand and then receives the result. The Program Counter holds the address of the next instruction, not data. The Memory Address Register holds the address of the memory location currently being read or written. The Instruction Register holds the instruction currently being decoded. The Stack Pointer holds the address of the top of the stack, used for subroutine calls. Hence option D.

131. The Program Counter, also called the Instruction Pointer, is a register that stores the memory address of the next instruction the CPU will fetch. At the start of the fetch phase its contents are copied into the Memory Address Register, and it is then incremented so that it points to the following instruction; a jump or branch instruction works simply by loading a new value into it. It stores an address, not the instruction itself – the instruction, once fetched, is held in the Instruction Register, which rules out the first option. The result of an arithmetic operation goes to the accumulator or a general purpose register, ruling out the third. The count of running programs is maintained by the operating system in memory, not in a CPU register, ruling out the fourth. Since a correct option exists, “None of these” is wrong. Hence option B.

132. By definition the CPU consists of exactly three things: the Control Unit, which fetches and decodes instructions and issues control signals; the Arithmetic Logic Unit, which performs arithmetic and logical operations; and a set of high speed registers, which hold addresses, instructions, operands and results while the instruction is being processed. Monitor, keyboard and mouse are input and output peripherals sitting outside the CPU. RAM and ROM are primary memory; although they are on the motherboard and are essential, they are not inside the CPU. Hard disks and optical drives are secondary storage. Hence option B.

133. The CPU comprises the ALU, the Control Unit and the registers, and the Instruction Register is one of those registers, so the first three options are all genuine components of the CPU. A hard disk drive is a secondary storage device: it is non-volatile, it lies outside the processor chip, and it is reached over an interface such as SATA. Data on a disk must first be brought into main memory and then into a register before the CPU can work on it, which proves the disk is external to the CPU. Because a correct answer exists among the options, “None of these” cannot be chosen. Hence option D.

134. Trace the read cycle in two steps. Step 1: the CPU must tell memory which location it wants, so the address is loaded into the Memory Address Register (MAR), whose output is connected to the address bus. Step 2: memory responds by putting the contents of that location on the data bus, and the CPU latches that value into the Memory Data Register (MDR), also called the Memory Buffer Register. So the order is MAR first, MDR second. The first option reverses this order and is therefore

wrong. The Program Counter and Instruction Register are involved in instruction sequencing, not in supplying an arbitrary address and catching arbitrary data. The Accumulator receives data only later, from the MDR, and never drives the address bus. Hence option B.

135. Follow the fetch–decode sequence. The address in the Program Counter goes to the MAR; memory returns the instruction into the MDR; the instruction is then transferred from the MDR into the Instruction Register (IR). The decoder of the Control Unit is permanently wired to the outputs of the IR, so the instruction must sit in the IR for its opcode field to be decoded. The Program Counter is wrong because by this time it has already been incremented and holds the address of the following instruction, not the current instruction. The MAR holds only an address. The Accumulator holds data operands, never instructions. The Stack Pointer holds the top-of-stack address. Hence option C.

136. Reason about what each phase needs before it can begin. An instruction cannot be decoded until it has been brought inside the CPU, so Fetch must come before Decode. It cannot be executed until the Control Unit knows what operation is meant, so Decode must come before Execute. The result cannot be stored until it has been produced, so Store comes last. This gives the fixed order Fetch, Decode, Execute, Store, often abbreviated as the F–D–E–S or simply the fetch–execute cycle. Every other listed order violates one of these dependencies: the first begins decoding an instruction that has not been fetched, the second tries to execute before knowing the operation, and the fourth executes before anything has been fetched. Hence option C.

137. The “bitness” of a processor is defined by its word length, that is, the width of its general purpose registers and of the internal data paths feeding the ALU. A 64-bit processor therefore holds 64-bit operands in its registers and its ALU adds, subtracts or compares 64 bits in one operation; it also normally uses 64-bit wide addresses, which is why such machines can address far more than 4 GB. The number of peripherals is decided by the I/O buses and slots, not by word length. Clock speed is an independent specification measured in GHz. The count of registers is a separate design choice – an *x86-64* CPU has 16 general purpose registers, not 64. Maximum memory is limited by the address width, and 64-bit addressing permits an enormous amount, certainly not merely 64 MB. Hence option D.

138. Every ALU operation produces two outputs: the numerical result, and a set of condition bits describing that result. The condition bits are stored in the flag register, also called the status register or Program Status Word. Typical flags are Zero (set when the result is all zeros), Carry (set on a carry out of the most significant bit), Sign (a copy of the sign bit) and Overflow (set when a signed result is out of range). A conditional branch instruction such as “jump if equal” works by testing the Zero flag. The Accumulator holds the numerical difference itself, which is zero, but it does not tell the Control Unit anything on its own – the CU tests the flag bit, not the whole word. The Program Counter holds an address, the MDR holds data in transit to or from memory, and the Stack Pointer tracks the stack. Hence option D.

139. There are two standard ways of building a Control Unit. In the hardwired design the control signals are produced by a fixed network of gates, flip-flops and counters; it is fast but the logic must be physically redesigned if the instruction set changes, and it is typical of RISC processors. In the micro-programmed design each machine instruction is implemented by a small routine of micro-instructions stored in a read-only control memory; a micro-program counter steps through them and each micro-instruction directly supplies the control signals. This is slower but flexible, since altering the instruction set means only rewriting the control memory, and it is typical of CISC processors. The description given – micro-instructions in a control memory – matches the second design exactly, and the first option describes the opposite technique. “Associative” refers to a type of memory and “cascaded” to counter connection; neither names a control unit design. Hence option D.

140. Test each option against the definition of the Control Unit as the directing, non-computing part of the CPU. Fetching an instruction is a control activity: the CU drives the PC to MAR transfer and asserts the memory read line, so the first option is a genuine CU function. Decoding the opcode is the CU’s central task, so the second is genuine. Generating the timing pulses that synchronise all units is

the classic CU role, so the fourth is genuine. Routing data between registers, memory and I/O ports by enabling the right bus gates is also the CU's work, so the fifth is genuine. Adding and subtracting operands, however, is done by the adder circuits of the Arithmetic Logic Unit; the CU only tells the ALU which operation to perform and when. Hence the one that is not a CU function is option C.

141. Work in two steps. Step 1 – number of locations. The MAR drives the address bus, so the number of distinct addresses is $2^{20} = 1,048,576$, that is 1 M locations. Step 2 – size of each location. The MDR is 16 bits wide and memory is word organised, so each addressable location holds 16 bits = 2 bytes. Therefore the total capacity is $1,048,576 \times 2 = 2,097,152$ bytes = 2 MB. The trap is option A: 1 MB would be right only if each location held a single byte, but here the word is two bytes wide. 16 MB corresponds to a 24-bit MAR, and 20 MB confuses the bit count 20 with a capacity in megabytes – memory sizes from a binary address bus are always powers of two. Hence option B.

142. Step 1 – decode the operands. $01100100_2 = 64 + 32 + 4 = 100$ and $00101101_2 = 32 + 8 + 4 + 1 = 45$; both are positive since their sign bits are 0. Step 2 – add the bit patterns. $01100100 + 00101101 = 10010001$, and the true sum is $100 + 45 = 145$. Step 3 – examine the flags. There is a carry into the most significant bit position but no carry out of it, so the carry flag is 0 while the overflow flag, which equals carry-in XOR carry-out of the sign position, is 1. Step 4 – interpret the stored pattern. An 8-bit two's complement register spans only -128 to $+127$, so 145 cannot be represented; the pattern 10010001 has sign bit 1 and is read as $-(01101111_2) = -111$. Thus positive plus positive has wrongly produced a negative reading, which is exactly what the overflow flag is warning about. Option A ignores the range limit, option B reverses the carry and overflow flags, and option D is impossible since two positive numbers cannot give a negative true sum. Hence option C.

143. Step 1 – the first instruction. It must pass through all 5 stages, so it finishes at the end of cycle 5. Step 2 – the remaining instructions. Once the pipeline is full, one instruction is completed at the end of every subsequent cycle, so the other 99 instructions need 99 more cycles. Step 3 – total cycles. Using the standard formula, total cycles = $k + (n - 1)$ where $k = 5$ stages and $n = 100$ instructions, giving $5 + 99 = 104$ cycles. Step 4 – convert to time: $104 \times 1 = 104$ nanoseconds. Option A forgets the 4 cycles needed to fill the pipeline. Option B wrongly uses $k + n$ instead of $k + n - 1$. Option D, 500 ns, is the time a non-pipelined processor would take at 5 cycles per instruction, and comparing it with 104 ns gives a speed-up of about 4.81. Hence option C.

144. Step 1 – count the patterns. A register of 16 bits can take $2^{16} = 65,536$ distinct bit patterns. Step 2 – map them to unsigned values. For unsigned storage the patterns represent the consecutive integers from 0 up to $2^{16} - 1$. Step 3 – take the largest: $65,536 - 1 = 65,535$, corresponding to the pattern 1111111111111111. So the register can hold at most Rs. 65,535. Option B is the count of values, not the largest value, and forgetting to subtract 1 for the zero pattern is the commonest error here. Options A and D belong to signed two's complement storage, whose range is $-32,768$ to $+32,767$; the question explicitly says unsigned, so the sign bit is available as an ordinary magnitude bit and the range doubles. Hence option C.

145. Establish the dependencies one by one. Micro-operation (iii) reads memory at the address held in the MAR, so the MAR must already contain a valid address; therefore (ii), which loads the MAR from the Program Counter, must come before (iii). Micro-operation (i) copies the MDR into the Instruction Register, so the MDR must already hold the fetched instruction; therefore (iii), which fills the MDR from memory, must come before (i). Chaining the two constraints gives (ii) before (iii) before (i), that is the order (ii), (iii), (i). Option A puts the copy into the IR first, when the MDR still holds stale data. Option B reads memory before any address has been placed in the MAR. Option C copies the MDR to the IR before memory has been read. Hence option D.

146. The memory hierarchy obeys one governing rule: as one moves nearer to the CPU, access time falls, cost per bit rises and total capacity falls. Ordering the four levels from the CPU outward gives registers, then cache, then main memory, then magnetic disk, so registers are the fastest and the disk the slowest, while cost per bit runs the other way – registers, built from flip-flops inside the processor, are the most expensive per bit and disk storage the cheapest. Option A states exactly this and is

correct. Option B contradicts the rule by pairing the fastest level with the lowest cost; being few in number is a consequence of high cost, not evidence of low cost. Option C is false because registers are inside the CPU and are accessed faster than cache; cache lies between the CPU and main memory. Option D reverses both facts about main memory, which is dearer per bit and far faster than a disk. Hence option A.

147. Add the fields one at a time. Step 1 – opcode: given as 6 bits. Step 2 – register fields: to name one out of 16 registers a field needs $\log_2 16 = 4$ bits, and there are two such fields, contributing $2 \times 4 = 8$ bits. Step 3 – memory address field: to select one out of 2^{16} locations requires $\log_2 2^{16} = 16$ bits. Step 4 – total: $6 + 8 + 16 = 30$ bits. Option A results from counting only one register field, option B from allowing just 3 bits per register field, and option D from rounding the answer up to a convenient word boundary, which the question does not ask for. Since 30 bits is available as an option, “None of these” is not correct. Hence option C.

Subtopic 5.2.4

148. RAM (Random Access Memory) is the primary read/write working memory of the computer and it is volatile, that is, it holds data only as long as electrical power is supplied. An unsaved document lives in RAM, so a power cut erases it. Every other option is non-volatile storage: ROM keeps its contents permanently and is only read from; a hard disk drive stores data magnetically and retains it without power (which is why a saved copy would have survived); a DVD-ROM stores data optically and permanently; a pen drive uses flash memory, which also retains data without power. Hence option B.

149. In the memory hierarchy, speed increases and capacity decreases as we move closer to the CPU. Among the five memories listed, cache memory sits closest to the processor (often on the same chip), is built from fast static RAM, and has the smallest access time, typically a few nanoseconds. Main memory (RAM) is slower than cache, typically tens of nanoseconds. A hard disk drive is an electro-mechanical secondary storage device with access times in milliseconds, roughly a million times slower than cache. An optical disk is slower still, and magnetic tape is the slowest of all because it is a sequential-access medium in which the tape must be wound to reach the required record. Hence option A.

150. Storage capacities are counted in powers of 2. The standard ladder is 8 bits = 1 byte, 1024 bytes = 1 KB (kilobyte), 1024 KB = 1 MB (megabyte), 1024 MB = 1 GB (gigabyte) and 1024 GB = 1 TB (terabyte). Therefore 1 GB = 1024 MB, which is option C. Option A is wrong because the multiplier is 1024 and not 1000, and in any case that step relates KB to bytes. Option B states the value of 1 MB, not 1 GB. Option D reverses the relation, since 1 TB = 1024 GB and not the other way round. Because a correct value is present, “None of these” is not the answer. Hence option C.

151. Primary memory is the internal memory that the CPU can address directly, and it consists of registers, cache and main memory (RAM and ROM). Secondary memory is external, non-volatile, cheaper per bit, much larger and cannot be processed directly by the CPU; its data must first be copied into primary memory. Registers are inside the processor, cache lies between the processor and RAM, and RAM is the main working memory, so options A, B and C are all primary. A hard disk drive is a permanent magnetic storage device used to hold the operating system, application software and customer data files, and it is the classic example of secondary storage. Since a correct option exists, “None of these” is wrong. Hence option D.

152. ROM (Read Only Memory) is non-volatile primary memory whose contents are written at the time of manufacture (or by special programming) and are retained permanently even when the power is off. The BIOS and the bootstrap loader must be available the instant the machine is powered on, before any disk has been read, so they are kept in ROM. RAM is volatile and empty at power-on, so it cannot hold the boot program. Cache is only a fast temporary copy area for data already in main memory. Virtual memory is not a physical chip at all; it is an area of the hard disk used as an extension of RAM while programs are running. Magnetic tape is a slow sequential backup medium, never used for booting. Hence option D.

153. Virtual memory is a memory-management technique in which a portion of secondary storage (called the swap file or page file) is treated as an extension of main memory. Pages of a program that are not currently required are kept on the disk and are swapped into RAM only when referenced, so a program larger than the physical RAM can still be executed. Cache memory is the opposite idea, a very small and very fast buffer between CPU and RAM, and it does not increase the apparent memory size. Flash memory is a non-volatile storage technology used in pen drives and SSDs, not a technique for extending RAM. Registers are a handful of tiny storage cells inside the CPU. Since a correct option is listed, “None of these” is wrong. Hence option B.

154. DRAM (Dynamic RAM) stores each bit as a charge on a tiny capacitor. Because the capacitor leaks its charge within a few milliseconds, the stored charge has to be read and rewritten periodically; this operation is called refreshing. DRAM is cheap and dense, so it is used for main memory. SRAM (Static RAM) stores each bit in a flip-flop made of transistors, which holds its state as long as power is on and needs no refreshing; it is faster and costlier and is used for cache. ROM, PROM and EEPROM are all non-volatile read-only type memories that retain data permanently without any refresh cycle. Hence option E.

155. Step 1: Convert the capacity of the pen drive into megabytes. $16 \text{ GB} = 16 \times 1024 \text{ MB} = 16384 \text{ MB}$. Step 2: Divide by the size of one file. $\frac{16384}{250} = 65.536$. Step 3: Interpret the result. A file can be stored only if it fits completely, so the fractional part is discarded; only 65 complete files can be copied. (After 65 files, $65 \times 250 = 16250 \text{ MB}$ is used and only $16384 - 16250 = 134 \text{ MB}$ remains, which is less than 250 MB.) Option A arises from using the decimal convention $1 \text{ GB} = 1000 \text{ MB}$, which gives $16 \text{ GB} = 16000 \text{ MB}$ and $\frac{16000}{250} = 64$; the question, however, specifies $1 \text{ GB} = 1024 \text{ MB}$. Options C and D wrongly round the quotient upward, which would require more space than the drive has. Hence option B.

156. Step 1: Write down the hit and miss probabilities. Hit ratio $h = 0.90$, so miss ratio $= 1 - 0.90 = 0.10$. Step 2: Note the time for each case. A hit costs 10 ns and a miss costs 100 ns in total. Step 3: Take the weighted average. Average access time $= h \times (\text{hit time}) + (1 - h) \times (\text{miss time}) = 0.90 \times 10 + 0.10 \times 100 = 9 + 10 = 19 \text{ ns}$. Option A is the hit time alone and ignores the misses. Option C is the plain arithmetic mean of 10 and 100, which wrongly assumes equal probabilities. Option D reverses the weights, using 0.10 for hits and 0.90 for misses. Hence option B.

157. Step 1: Recall that in the memory hierarchy, the nearer a memory is to the CPU, the faster, costlier per bit and smaller it is. Step 2: Place the electronic memories. CPU registers are inside the processor and are the fastest of all. Cache memory comes next, being fast SRAM placed between the CPU and RAM. Main memory (DRAM) is slower than cache. Step 3: Place the mechanical memories. Magnetic disk has access time in milliseconds, far slower than any semiconductor memory, and magnetic tape is slowest because it is sequential access, requiring the tape to be wound to the required position. Step 4: The order is register, cache, main memory, magnetic disk, magnetic tape, that is (ii), (iv), (i), (v), (iii). Option B wrongly puts cache ahead of registers and also reverses disk and tape; option C wrongly puts main memory ahead of cache; option D wrongly puts main memory ahead of registers. Hence option A.

158. SRAM stores each bit in a flip-flop built from several transistors, so the bit stays as it is while power is supplied and no refresh circuitry is needed. This makes SRAM fast but bulky and expensive per bit, which is exactly why it is used only for the small cache memory. DRAM stores each bit as charge on a capacitor, needs periodic refreshing, is slower but very cheap and dense, and is therefore used for the large main memory. Option A reverses the speeds and the usage. Option B interchanges the storage cells of the two. Option D is false because both are types of RAM and both are volatile, losing their contents when power goes off; only ROM-type memories are non-volatile. Since C is fully correct, “None of these” is wrong. Hence option C.

159. In a virtual memory system, a reference to a page that is not currently in RAM causes a page fault, and the required page must be brought in from disk, usually by removing another page. If too

many processes compete for too little physical memory, the pages that are removed are needed again almost immediately, so the system continuously swaps pages in and out. This state, in which the CPU utilisation collapses because nearly all time goes into paging, is called thrashing. Fragmentation is the scattering of free or file space into non-contiguous pieces, a storage-allocation issue, not a swapping loop. Spooling is queuing jobs (typically print jobs) on disk for a slow device. Caching is the technique of keeping frequently used data in fast memory, which improves rather than degrades speed. Defragmentation is the corrective utility that rearranges disk files contiguously. Hence option E.

160. Step 1: The number of address lines fixes the number of distinct locations that can be addressed. With n address lines the chip has 2^n locations, so here the number of locations $= 2^{16} = 65536$. Step 2: The number of data lines fixes the size of each location. With 8 data lines each location holds 8 bits $= 1$ byte. Step 3: Capacity $= 65536 \times 1$ byte $= 65536$ bytes. Step 4: Convert to kilobytes: $\frac{65536}{1024} = 64$ KB. Option A would need 8 data lines with 14 address lines, option B corresponds to 15 address lines and option D to 17 address lines. Hence option C.

161. EPROM stands for Erasable Programmable Read Only Memory. Its chip carries a quartz window above the silicon die; shining ultraviolet light through this window for some minutes discharges the floating gates and erases the entire chip, after which it can be reprogrammed with a special programmer. PROM (Programmable ROM) can be written by the user only once, by blowing internal fuses, and can never be erased. EEPROM (Electrically Erasable PROM) is erased by applying electrical signals, byte by byte, and needs no UV light or window. Mask ROM has its contents fixed by the manufacturer during fabrication and can never be altered. Flash memory is a fast, block-erasable descendant of EEPROM and is also erased electrically. Hence option D.

162. Step 1: Every reference pays the L1 search time of 1 ns. Step 2: A fraction $1 - 0.90 = 0.10$ of the references miss in L1 and go on to L2, paying an extra 10 ns. Step 3: Of the references that reach L2, a fraction $1 - 0.80 = 0.20$ miss there also and pay a further 100 ns from main memory. Step 4: Combine these, working from the innermost level outward. Extra cost after reaching L2 $= 10 + 0.20 \times 100 = 10 + 20 = 30$ ns. Step 5: Average access time $= 1 + 0.10 \times 30 = 1 + 3 = 4$ ns. Option A forgets the main memory term, option B is only the additional part 0.10×30 without the compulsory L1 time, and option D comes from ignoring the L2 hit ratio, that is, from assuming that every L1 miss also goes all the way to main memory: $1 + 0.10 \times 10 + 0.10 \times 100 = 1 + 1 + 10 = 12$ ns. Hence option C.

163. Step 1: Express the virtual address space in bytes as a power of 2. $4 \text{ GB} = 2^2 \times 2^{30} = 2^{32}$ bytes. Step 2: Express the page size in bytes as a power of 2. $4 \text{ KB} = 2^2 \times 2^{10} = 2^{12}$ bytes. Step 3: The number of pages is the total space divided by the page size, that is $\frac{2^{32}}{2^{12}} = 2^{32-12} = 2^{20}$. Step 4: Evaluate $2^{20} = 1\,048\,576$, that is 1 M pages, so the page number field of a virtual address is 20 bits wide and the offset field is 12 bits wide. Option A is 2^{10} , option B is 2^{16} and option D is 2^{22} , all obtained by mishandling the powers of two. Hence option C.

164. Step 1: Find the number of locations. $4 \text{ M} = 4 \times 1024 \times 1024 = 4\,194\,304 = 2^{22}$ locations. Step 2: Find the size of one word in bytes. One word is 16 bits and 8 bits make 1 byte, so each word is $\frac{16}{8} = 2$ bytes. Step 3: Multiply. Capacity $= 2^{22} \times 2 = 2^{23}$ bytes. Step 4: Convert to megabytes. 2^{23} bytes $= \frac{2^{23}}{2^{20}} \text{ MB} = 2^3 = 8 \text{ MB}$. Option A is obtained by forgetting that each word occupies two bytes and simply reading off “4 M”. Option C confuses the word length 16 with the unit of capacity, and option D multiplies 4 by 16 while forgetting to divide by 8. Hence option B.

165. Step 1: Find the total data to be stored. 30 days at 4.5 GB per day gives $30 \times 4.5 = 135$ GB. Step 2: Find how many cartridges of 25 GB are needed. $\frac{135}{25} = 5.4$ cartridges. Step 3: Since a fraction of a cartridge cannot be bought, round upward: 6 cartridges are required (5 cartridges hold only $5 \times 25 = 125$ GB, leaving 10 GB unstored). Step 4: Find the cost. $6 \times 850 = \text{Rs. } 5100$. Option A corresponds to buying only 5 cartridges, which is insufficient. Option B is 5.4×850 , treating a

cartridge as divisible. Option D corresponds to 7 cartridges, which is more than the minimum needed. Hence option C.

166. Step 1: Convert the free space into kilobytes, the unit of one image. $60 \text{ GB} = 60 \times 1024 \text{ MB} = 61\,440 \text{ MB}$, and $61\,440 \text{ MB} = 61\,440 \times 1024 \text{ KB} = 62\,914\,560 \text{ KB}$. Step 2: Divide by the size of a single image. $\frac{62\,914\,560}{240} = 262\,144$. Step 3: The division is exact, so exactly 262 144 images fit with no space wasted. (As a check, $262\,144 = 2^{18}$, and indeed $62\,914\,560 = 60 \times 2^{20}$ while $240 = 15 \times 16$, giving $\frac{60 \times 2^{20}}{240} = \frac{2^{20}}{4} = 2^{18}$.) Option B is half the correct value, obtained by taking the image size as 480 KB, and option D is double it. Option A results from converting only one step, from GB to MB, and then dividing as though the image size were 240 MB: $\frac{61\,440}{240} = 256$. Hence option C.

167. Step 1: Bring both times to the same unit. $8 \text{ ms} = 8 \times 10^{-3} \text{ s} = 8 \times 10^6 \text{ ns} = 8\,000\,000 \text{ ns}$. Step 2: Write the two cases with their probabilities. With probability $1 - 0.001 = 0.999$ the page is already in memory and the access costs 100 ns; with probability 0.001 a fault occurs and the access costs 8 000 000 ns. Step 3: Take the weighted average. Effective access time $= 0.999 \times 100 + 0.001 \times 8\,000\,000 = 99.9 + 8000 = 8099.9 \text{ ns}$. Step 4: Note the lesson: although faults occur in only 0.1% of accesses, the system runs about 81 times slower than the fault-free 100 ns, because disk service is about 80 000 times slower than memory. Option A ignores the fault term, option B and option C use wrong conversions of 8 ms. Hence option D.

168. Statement C is false and is therefore the answer. The CPU can operate only on data held in registers and main memory; anything stored on secondary storage such as a hard disk must first be read into main memory by the input/output system before the ALU can process it, and results must be written back to disk to be preserved. This is the defining difference between primary and secondary memory. The other four statements are all true: cache is built from fast SRAM and costs far more per bit than the DRAM of main memory, which is why it is kept small; virtual memory keeps inactive pages on disk and swaps them in on demand, so a program need not fit entirely into RAM; DRAM stores bits as capacitor charge that leaks and must be refreshed, while SRAM uses flip-flops that hold their state as long as power is on; and ROM is non-volatile, which is exactly why the bootstrap program is stored there. Hence option C.

Subtopic 5.2.5

169. The VGA connector is formally called a DE-15 connector. Its pins are arranged in three rows of five, so the total is $3 \times 5 = 15$ pins. Hence option B is correct. Option A (9 pins) describes the DB-9 RS-232 serial port. Option C (19 pins) describes the standard HDMI Type-A connector. Option D (25 pins) describes the DB-25 parallel (printer) port. Since the correct value 15 is present in the list, option E cannot be chosen.

170. USB stands for Universal Serial Bus. The word “Universal” indicates that a single standard connector replaces many earlier device-specific ports; “Serial” indicates that data travels one bit after another over the data lines; “Bus” indicates that many devices share the same pathway to the host controller. Option A is wrong because the first word is “Universal”, not “Uniform”. Option B is wrong because the middle word is “Serial”, not “Storage” – USB is not restricted to storage devices. Option D is wrong on two counts: “Unified” and “Buffer” are both incorrect. Therefore option C is the only accurate expansion.

171. Wired Ethernet networking uses the 8-position, 8-contact modular plug known as RJ-45, which terminates twisted-pair cables such as Cat-5e and Cat-6. Hence option B is correct. Option A, RJ-11, is the smaller 6-position modular jack used for ordinary telephone and dial-up modem lines, and it will not fit an Ethernet socket. Option C, DB-9, is the legacy serial port used for devices such as older modems and console cables. Option D, PS/2, is the round 6-pin mini-DIN connector for legacy keyboards and mice. Only RJ-45 terminates a LAN cable.

172. The PC-99 colour convention assigns purple to the PS/2 keyboard port and green to the PS/2

mouse port, precisely so that a user cannot interchange two physically identical mini-DIN sockets. Since the question asks about the green socket, the answer is the mouse, option B. Option A is wrong because the keyboard uses the purple socket. Option C is wrong because printers used the DB-25 parallel port or, later, USB, never PS/2. Option D is wrong because speakers use a 3.5 mm audio jack, which is lime green but is a jack and not a 6-pin mini-DIN. Hence option B alone is correct.

173. HDMI is the accepted abbreviation of High-Definition Multimedia Interface. Each word matters: “High-Definition” refers to the resolutions it supports, “Multimedia” signals that it carries both video and audio on one cable, and “Interface” describes the standardised connection. Option A replaces “Definition” with “Density” and “Interface” with “Interconnect”. Option C invents “Hybrid Digital Monitor Input”, which is not a standard at all. Option D again substitutes “Modular Interconnect” for “Multimedia Interface”. Only option B is the recognised expansion.

174. RJ-11 is a small modular connector, normally 6-position with two or four contacts wired, and it is the standard plug used on telephone handset and dial-up modem cables. So option B is correct. Option A is wrong because printers used the DB-25 parallel port or USB. Option C is wrong because monitors use VGA, DVI, HDMI or DisplayPort. Option D is wrong because external hard disks use USB or eSATA. Because a genuinely correct choice exists in the list, option E is not the answer.

175. HDMI was designed specifically to carry uncompressed digital video together with digital audio over a single cable, so option C is correct. Option A, VGA, carries an analogue video signal only and has no audio channel at all, which is why VGA setups always need a separate audio lead. Option B, PS/2, is a low-speed input port for a keyboard or mouse and carries no audio or video. Option D, RJ-45, is a network port; although audio and video can be streamed over a network, RJ-45 is not a display connector and does not itself carry a video signal to a monitor. Hence only HDMI satisfies the requirement.

176. Two facts must be combined. First, the identification: the 25-pin D-shaped female connector on a PC is the parallel port, historically used with dot-matrix and line printers, and this eliminates options A and C. Second, the mode of transmission: a parallel port has eight separate data lines, so it sends a whole byte, that is 8 bits, at the same instant across those lines. This eliminates option D, which correctly names the port but wrongly describes it as sending one bit at a time – that description belongs to a serial port. Combining both facts, option B is the only choice that is right on both counts.

177. The USB generations must be separated carefully. USB 1.1 (Full Speed) reaches 12 Mbps, which is option A. USB 2.0 (Hi-Speed) reaches 480 Mbps, which is option B. USB 3.0, branded SuperSpeed, reaches 5 Gbps, which is option C and is the value asked for. The figure of 10 Gbps in option D belongs to the later USB 3.1 Gen 2 (SuperSpeed+) standard, not to USB 3.0. Note also that 5 Gbps is roughly 10 times the USB 2.0 figure, since $5000 \div 480 \approx 10.4$, a useful cross-check. Hence option C.

178. Hot-swapping means connecting or disconnecting a device while the system is powered on and having it recognised automatically. USB was designed from the start for hot-swapping, so option A is excluded. The letter “e” in eSATA stands for external, and the standard explicitly supports hot-plugging, so option C is excluded. SD card slots are routinely used to insert and remove cards on a running machine, so option D is excluded. The PS/2 port, however, is enumerated by the system only at boot time and carries no hot-plug detection circuit; connecting a PS/2 keyboard or mouse to a running machine usually leaves the device unrecognised and can damage the port. Hence option B is the port that is not hot-swappable.

179. Thunderbolt 1 and Thunderbolt 2 used the Mini DisplayPort connector, but from Thunderbolt 3 onward the standard adopted the USB Type-C physical connector, which is small, oval and reversible. The word “reversible” in the question is itself the clue, since among all listed connectors only Type-C can be inserted either way up. Hence option A is correct. Option B is wrong because USB Type-A is the familiar flat rectangular plug that fits only one way. Option C describes the VGA DE-15 connector, which is a display port of an entirely different family. Option D describes an Ethernet jack. Therefore option A alone is right.

180. Take the two cables one at a time. VGA is the oldest of the PC display standards and transmits red, green and blue as continuously varying voltages, that is, a purely analogue signal; it has no digital video capability. This immediately rules out options A and C. DVI comes in three variants: DVI-D carries digital only, DVI-A carries analogue only, and DVI-I is the integrated version carrying both digital and analogue on the same connector, which is why a DVI-I socket can feed a VGA monitor through a simple passive adapter. This rules out option D, which wrongly calls DVI-I analogue only. Combining the two findings, option B is the accurate comparison.

181. The USB specification assigns each attached device a 7-bit address. A 7-bit field can hold $2^7 = 128$ distinct values, numbered 0 to 127. However, address 0 is reserved: it is the default address a newly attached device uses only until the host assigns it a permanent one, so no device may keep it. The usable addresses are therefore 1 to 127, giving $128 - 1 = 127$ devices. Hence option C. Option D, 128, is the raw count of addresses before removing the reserved one. Options A and B, 63 and 64, would follow from a 6-bit address field, which USB does not use.

182. RS-232 is the classical serial communication standard, and on a PC it is implemented as the DB-9 connector. In serial transmission the bits of each byte are sent one after another over a single data line, together with start, stop and optional parity bits. Hence option A is correct. Option B is wrong because a parallel port is the 25-pin connector, not the 9-pin one, and it is the parallel port that sends eight bits at once. Option C is wrong because a 1 Gbps network port uses RJ-45; RS-232 speeds are measured in kilobits per second, typically up to about 115.2 kbps. Option D is wrong because DB-9 carries no video signal.

183. Step 1: convert the port speed from bits to bytes. The rate is 480 megabits per second, and since 1 byte = 8 bits, the byte rate is $480 \div 8 = 60$ megabytes per second. Step 2: convert the file size to megabytes. Since 1 GB = 1024 MB, the backup is $1.5 \times 1024 = 1536$ MB. Step 3: divide size by rate. Time = $\frac{1536}{60} = 25.6$ seconds. So option B is correct. The distractors all arise from using a wrong byte rate in Step 3 while keeping the size 1536 MB. Option A, 12.8 s, follows from taking the rate as 120 MB/s, that is, dividing 480 by 4 instead of by 8. Option C, 51.2 s, follows from taking the rate as 30 MB/s, and option D, 102.4 s, from taking it as 15 MB/s, since $1536 \div 30 = 51.2$ and $1536 \div 15 = 102.4$. Note that omitting the bit-to-byte division altogether would give $1536 \div 480 = 3.2$ s, a value that is deliberately not offered. Since 25.6 is present, option E is not chosen.

184. Step 1: express the currents in amperes. $500 \text{ mA} = 0.5 \text{ A}$ and $900 \text{ mA} = 0.9 \text{ A}$. Step 2: find the USB 2.0 power. $P_2 = 5 \times 0.5 = 2.5 \text{ W}$. Step 3: find the USB 3.0 power. $P_3 = 5 \times 0.9 = 4.5 \text{ W}$. Step 4: take the difference asked for. $P_3 - P_2 = 4.5 - 2.5 = 2.0 \text{ W}$. Hence option B. The distractors are the intermediate values themselves: option C is P_2 alone and option D is P_3 alone, both of which answer a question that was not asked, while option A, 1.5 W, corresponds to 5×0.3 , that is, to an incorrect current difference of 300 mA. The actual current difference is $900 - 500 = 400 \text{ mA}$, and $5 \times 0.4 = 2.0 \text{ W}$, which confirms option B by a second route.

185. Step 1: convert the file size from bytes to bits, because the link rate is quoted in bits per second. $750 \text{ MB} = 750 \times 8 = 6000$ megabits. Step 2: divide by the link rate. Time = $\frac{6000}{1000} = 6$ seconds. Hence option B. An equally correct alternative is to convert the rate instead of the size: $1000 \text{ Mbps} = 1000 \div 8 = 125 \text{ MB/s}$, so the time is $750 \div 125 = 6$ seconds. The two methods are algebraically identical, since $\frac{750 \times 8}{1000} = \frac{750}{1000 \div 8}$, and either may be used. By contrast, a student who omits the conversion altogether computes $750 \div 1000 = 0.75 \text{ s}$, a value that is not offered. Option C, 7.5 s, is that erroneous 0.75 s scaled by ten; options A and D do not follow from any correct step.

186. Examine each statement separately. Statement I: VGA sends red, green and blue as varying voltages, that is, an analogue signal, and the DE-15 pinout contains no audio lines, so I is correct. Statement II: HDMI was designed to carry uncompressed digital video along with digital audio on one cable, so II is correct. Statement III: RJ-11 is a 6-position connector normally wired with 2 or 4 contacts, whereas RJ-45 is an 8-position connector with 8 contacts; therefore RJ-11 has fewer, not

more, positions, and III is incorrect. Since exactly I and II hold, option A is the answer, and options B, C and D each wrongly include or exclude a statement.

187. Step 1: count the total wires. A Cat-5e cable carries 4 twisted pairs, and each pair contains 2 wires, so the total is $4 \times 2 = 8$ wires, matching the 8 contacts of an RJ-45 plug. Step 2: count the wires actually used. 100BASE-TX uses 2 pairs, one for transmitting and one for receiving, which is $2 \times 2 = 4$ wires. Step 3: subtract. Unused wires = $8 - 4 = 4$. Hence option B. Option D, 8, is the total wire count rather than the unused count; option A, 2, is the number of unused pairs rather than wires, a very common slip; option C, 6, would follow from assuming only one pair is used.

188. Write down each maximum rate in a common unit. USB 2.0 Hi-Speed is 480 Mbps. Gigabit Ethernet is 1000 Mbps, that is 1 Gbps. USB 3.0 SuperSpeed is 5 Gbps, that is 5000 Mbps. Thunderbolt 3 is 40 Gbps, that is 40000 Mbps. Now order these numbers from smallest to largest: $480 < 1000 < 5000 < 40000$, which corresponds to (i), then (iii), then (ii), then (iv). Hence option B. Option A wrongly places USB 3.0 below Gigabit Ethernet, option C wrongly makes Gigabit Ethernet the slowest, and option D wrongly makes USB 3.0 slower than USB 2.0.

189. Take the connectors one by one. The VGA connector is a DE-15 with pins in three rows of five, giving $3 \times 5 = 15$ pins. The RS-232 serial connector on a PC is a DB-9, giving 9 pins. The parallel printer connector is a DB-25, giving 25 pins. Now add: $15 + 9 = 24$, and $24 + 25 = 49$. Hence the total is 49 pins, option D. Option A, 34, would result from adding the HDMI Type-A count of 19 to the VGA count of 15 instead of the given three. Option B, 40, and option C, 45, do not correspond to any correct combination of the three stated pin counts.

Subtopic 5.3.1

190. System software is the class of programs that operates and controls the computer hardware itself and provides a platform on which other programs run; the operating system is its chief example. Microsoft Windows 11 is an operating system, hence system software. The remaining four are all application software written to do a specific job for an end user: MS Word is a word processor, Tally ERP 9 is an accounting package, Adobe Photoshop is an image-editing package and Google Chrome is a web browser. None of these four controls the machine's resources; each of them in fact runs on top of Windows. Hence option C.

191. MS Excel is a spreadsheet package written to help a user perform a particular task, namely calculation and tabulation of data. Programs written for the direct benefit of an end user are application software, so option B is correct. It is not an operating system, because it does not manage memory, files, processes or devices; it merely asks Windows to do so. It is not a language translator, since a translator such as a compiler or assembler converts source code into machine code, which Excel does not do. It is not a device driver, which is a small system program that lets the operating system communicate with a hardware device. It is not firmware, since firmware is permanently stored in a ROM chip inside hardware. Hence option B.

192. The defining duty of an operating system is resource management: it allocates main memory, schedules the processor among programs, organises files on disk and controls input-output devices, while presenting the user with a usable interface. That description matches only option D. A word processor, a presentation package and a spreadsheet are all application software; they perform one specific user task each and depend on the operating system for every file access and every print job. Since a correct choice is present in the list, the fallback option E is not to be marked. Hence option D.

193. A device driver is a system program that translates the general commands of the operating system into the specific signals a particular hardware device understands. Because a printer, scanner or network card from each manufacturer behaves differently, a matching driver is supplied with it. Hence option B. A word processor merely creates the document to be printed; a database report is output, not software; and an application package is written for the end user's task, not for hardware control. Since option B is correct, option E is not to be marked. Hence option B.

194. Tally ERP 9 is an accounting and inventory package used by traders and firms to maintain ledgers and file returns; it serves an end user's business need and is therefore application software. The other four are all system software. An assembler translates assembly language into machine code. A linker joins separately compiled object modules into one executable program. The BIOS is the start-up program held in ROM that initialises the hardware. A device driver lets the operating system control a hardware device. None of these four does any work directly useful to a business user. Hence option E.

195. System software includes the operating system, utility programs, device drivers and language translators. A compiler is a language translator, so it belongs to system software, even though a programmer sits and uses it directly. The test is not who touches the software but what job it does: a compiler serves the computer system by preparing programs for execution, rather than solving a user's business problem. Hence option B. It is not application software for the same reason; it is certainly not hardware or an output device, since it is a set of instructions and not a physical component; and because a correct option exists, option E is wrong. Hence option B.

196. A media player plays songs and films for a person, which is a task belonging to the end user and not to the machine, so it is application software rather than system software. Application software in turn has two kinds. A ready-made or general purpose package is produced once and sold off the shelf in identical form to a very large number of buyers, each of whom accepts it as it is; a tailor-made package is instead built to the requirement of one single organisation. The media player described is bought and used unchanged by lakhs of buyers, so it is general purpose application software and option B is correct. It is not system software, because it manages no memory, files, processes or devices and in fact depends on the operating system for every file it opens. It is not a language translator, since it converts no source code into machine code. It is not a device driver, since it does not let the operating system control a hardware unit; it merely asks the existing sound and display drivers to do their work. It is not firmware, because firmware is fixed permanently into a ROM chip at manufacture, whereas the player is installed on and loaded from disk. Hence option B.

197. Test each item by asking whether it serves the machine or the end user. Linux is an operating system, so it is system software. MS PowerPoint is a presentation package for a user, so it is application software. An assembler is a language translator, so it is system software. Google Chrome is a browser used by a person to view web pages, so it is application software. A network device driver lets the operating system control the network card, so it is system software. Tally ERP 9 is an accounting package, so it is application software. An interpreter translates and executes a high-level program statement by statement, so it is system software. The system software items are Linux, assembler, device driver and interpreter, that is 4 items, leaving 3 application items. Hence option D.

198. Take the statements one by one. The bootstrap loader brings the operating system into main memory at start-up, and only then can any application be launched, so the first statement is true. An application does not address the disk or printer directly; it issues a system call and the operating system performs the actual input-output, so the second statement is true. The fourth is true because software is classified by the function it performs, and a translator serves the system, not a business need. The fifth is a standard textbook contrast and is true. The third statement is false: without an operating system there is nothing to load the program into memory, allocate it processor time or give it access to files, so an ordinary application cannot run. Since the question asks for the statement that is not true, hence option C.

199. The layered model of a computer system places the physical machine at the centre. Immediately around the hardware sits the operating system, because it is the only software permitted to control devices, memory and the processor directly. Around the operating system sits the application software, which obtains every hardware service by requesting it from the operating system. Outside all of them stands the user, who deals only with the applications. The order from inside outwards is therefore Hardware, then Operating system, then Application software, then User, which is option C. Option A wrongly places the application closer to the hardware than the operating system; option B simply reverses the true order; option D absurdly puts software inside the hardware. Hence option C.

200. The program described is the BIOS. Because it is stored permanently inside a ROM chip and is not loaded from disk like ordinary software, it is given the special name firmware, the term used for software that is fixed into hardware. In function, however, it initialises devices and loads the operating system, which are system tasks, so firmware is treated as a category of system software. Hence option A. It is not application software of any kind, general or customised, because it does no work for an end user. It is not a language translator, since it does not convert source code into machine code. As a correct option exists, option E must not be marked. Hence option A.

201. Classify each item. An assembler translates assembly language into machine code, an interpreter translates and executes a high-level program line by line, and a compiler translates a whole high-level program into machine code; all three are language translators and hence system software. A loader is the system program that places an executable program into main memory and prepares it for execution, so it too is system software. A spreadsheet package, on the other hand, is used by a clerk or an accountant to enter figures and compute totals, which is a task belonging to the user and not to the machine, so it is application software. The odd item is therefore the spreadsheet package. Hence option D.

202. Statement I is correct. Utility programs are service programs that maintain and tune the computer system itself, for example by scanning for malware, rearranging fragmented files on disk, compressing files or taking backups. Since their beneficiary is the system and not a business task, standard classification places utilities under system software along with the operating system, translators and drivers. Statement II is also correct. MS PowerPoint is sold as a ready-made package to a very large number of buyers who all use the same product to make presentations, which is exactly the definition of general purpose application software, as opposed to a tailor-made package built for one organisation. Both statements being correct, hence option C.

203. Take the four items in turn. An assembler converts assembly language mnemonics into machine code, which is a language-translation service for the machine, so (i) matches Q. Tally ERP 9 maintains ledgers, vouchers and stock for a business user, so (ii) matches P. A device driver allows the operating system to control a specific hardware unit such as a printer or network card, so (iii) matches Q. MS Excel is a spreadsheet used for the user's own calculations, so (iv) matches P. The required matching is therefore (i)-Q, (ii)-P, (iii)-Q, (iv)-P, which is exactly option B. Hence option B.

204. Statement I is correct: the processor alone executes instructions, but an application never touches the disk or the printer itself; it issues a system call and the operating system carries out the transfer on its behalf. Statement II is wrong in its conclusion. The first half is true, a translator does convert source code into machine code, but that job serves the computing system rather than an end user's business task, so a translator is system software, not application software. Statement III is wrong, because with no operating system there is nothing to load the program into main memory, allocate processor time to it or provide it with file and device services, so the word processor could not run at all. Only statement I survives, hence option A.

205. First check (A). A device driver enables the operating system to control a hardware unit, which is squarely a system function, so it is system software no matter which company wrote and shipped it; (A) is therefore true. Next check (R). The accepted basis of classification is functional: a program that operates, controls or maintains the computer system is system software, while a program that solves a problem for an end user is application software. This is why a compiler bought from an independent company is still system software, and why an accounting package written by the operating system vendor itself would still be application software. So (R) is true. Finally, (R) states exactly the principle that makes (A) true, so it is the correct explanation. Hence option A.

206. Examine each item. Windows Server 2022 is an operating system, so it is system software. The Finacle Core Banking package performs the branch's banking transactions for its staff and customers, so it is application software. A disk defragmenter is a utility that rearranges fragmented files so that the storage of the machine itself works efficiently; utilities maintain the system rather than serve a business task, so it is grouped under system software. A PDF reader lets a user read documents,

so it is application software. The network interface card driver lets the operating system control the network card, so it is system software. A C compiler is a language translator, so it is system software. The cheque-printing program does a specific job for the branch, so it is application software, of the customised kind. The application items are Finacle, the PDF reader and the cheque-printing program, that is 3 items. Hence option B.

207. Option A reverses the true position: system software such as an operating system or an assembler is written for a particular processor and machine architecture and is therefore machine-dependent, while application software written in a high-level language is comparatively machine-independent. Option B is false, since solving an end user's day-to-day problem is precisely the role of application software; system software serves the machine. Option D is false, because running several operating systems on one machine at the same time requires an extra software layer called a hypervisor or virtual machine monitor. Option C is a correct description of how a computer starts: the bootstrap loader in ROM loads the kernel, the resident portion of which stays in memory throughout the session, whereas an application is loaded from disk only when the user launches it and is removed when closed. Since a true statement exists, option E is wrong. Hence option C.

208. Neither product manages hardware, memory, files or devices, so neither can be system software; both are application software, and the only question is which sub-class each belongs to. A package produced once and sold in identical form to many buyers, who all accept it as it is, is by definition a general purpose or ready-made package, so the payroll product falls there. A system built to the rules of one single organisation and of no use to anyone else is a customised or tailor-made package, so the loan-recovery system falls there. Option B simply interchanges the two, option A and option D wrongly bring in system software, and a correct option exists so option E is wrong. Hence option C.

209. Check every pair. A linker combines separately translated object modules into a single executable file, a service to the programming system, so it is system software and option A is wrongly matched. MS Access is a desktop database package with which a user creates tables, forms and reports for his own records, so it is application software and option B is wrongly matched. An interpreter translates and executes a high-level program statement by statement, making it a language translator and hence system software, so option C is wrongly matched. The bootstrap loader is the small routine that loads the operating system at start-up, which is a pure system function, so option D is wrongly matched. Since not one of the four pairs is correct, the fallback option is genuinely the answer. Hence option E.

210. Statement I is correct: the operating system loads the program, gives it memory and processor time and provides file and device services, so it literally builds the environment the application lives in. Statement II is correct: a processor executes only machine code, so a program written in C, Java or Python must first be handled by a compiler or interpreter, and such translators are system software. Statement III is not correct: an executable is built for a particular operating system and its system-call interface, which is why a program compiled for Windows will not simply run on Linux or macOS without recompilation, a compatibility layer or a portable runtime such as a virtual machine. Statements I and II alone are correct, hence option B.

Subtopic 5.3.2

211. The description lists exactly the standard duties of an operating system: process management, memory management, file management and device management, plus acting as the interface between the user and the hardware. A word processing package is application software; it is loaded only when the user asks for it and it manages nothing beyond its own documents. An antivirus utility is a utility program that scans files – it runs on top of the operating system, not under it. A language compiler is a translator that converts source code into machine code and is also loaded by the operating system. Since the operating system is present in the list, “None of these” cannot be right. Hence option D.

212. Windows 11 is Microsoft's desktop operating system, Ubuntu Linux is a Linux distribution used widely on servers, Android is the mobile operating system built on a modified Linux kernel, and UNIX is the classic multi-user multitasking operating system from which Linux was derived. MS Excel is a

spreadsheet package – it is application software that is installed on top of an operating system and cannot manage hardware, memory or files of the machine by itself. Therefore MS Excel is the odd one out. Hence option D.

213. Booting is the process of loading the operating system from secondary storage into main memory when the computer is powered on, so that the machine becomes usable. Formatting is the preparation of a disk by creating tracks, sectors and a file system on it – it erases data and has nothing to do with start-up. Debugging is the activity of locating and removing errors from a program. Defragmenting rearranges scattered file blocks on a disk so that files occupy contiguous space; it is a maintenance utility run on a working system. Since “Booting” is available, “None of these” is wrong. Hence option C.

214. The kernel is the core of an operating system. It is loaded into main memory during booting, remains resident there, and directly controls the CPU, the memory and the devices. The shell is the outer layer: it is the command interpreter or graphical interface through which the user talks to the kernel, so it is not the innermost layer. A compiler is a translator program and is not part of the core at all. The boot sector is only a small area of the disk that holds the bootstrap loader; it is a place on the disk, not a layer of the operating system. Hence option B.

215. Multitasking is the ability of an operating system to keep several programs of the same user active at the same time and to switch the CPU rapidly among them, so that all of them appear to run together. Batch processing is the opposite: jobs are collected and executed one after another with no interaction from the user while they run. Multiprocessing means the computer has two or more physical CPUs executing instructions simultaneously – here there is only one desktop CPU, and the question is about several programs, not several processors. Booting is only the start-up process. Hence option C.

216. An interface in which the user must type text commands at a prompt and the machine responds with text is a command line interface; MS-DOS is the classic example, and the `C:\>` prompt with commands like `DIR` and `COPY` is its signature. A graphical user interface works through windows, icons, menus and a pointing device – the question explicitly says there are none of these. A touch interface needs a touch-sensitive screen and a voice interface needs speech input; neither is mentioned, and neither matches a typed prompt. Hence option A.

217. Memory management (allocating and freeing main memory), process scheduling (deciding which process gets the CPU and for how long), file and directory management (creating, storing, retrieving and protecting files) and input/output device management (controlling printers, disks and keyboards through device drivers) are all standard operating system functions. Calculating the interest payable on a savings account is a business computation carried out by the bank’s application software, such as the core banking package; the operating system merely provides the memory, CPU time and file access that the application needs, but it has no knowledge of interest rates or account rules. Hence option E.

218. SPOOL stands for Simultaneous Peripheral Operations On-Line. Because a printer is far slower than the CPU and can serve only one job at a time, the operating system writes each print job into a queue (the spool) on disk, tells the requesting program that the job is accepted, and then feeds the jobs to the printer one after another. This is exactly what is described. Compiling is translating source code into machine code. Formatting prepares a disk for use. Defragmentation rearranges file blocks on a disk to make them contiguous. None of these three has anything to do with queueing printer output, and since spooling is listed, “None of these” is also wrong. Hence option A.

219. The key phrase is “four physical CPUs executing at the same instant”. Multiprocessing is defined as the use of two or more processors within one computer system under the control of a single operating system; increased throughput and graceful degradation when one processor fails are its standard advantages, and both are mentioned. Multiprogramming means keeping several jobs in main memory and switching a single CPU among them whenever one job waits for input or output – only one instruction is executed at any instant. Multitasking is the user-level view of the same single-CPU switching.

Multithreading is the splitting of one process into several threads of control, again not a statement about the number of processors. Hence option C.

220. Virtual memory is the memory-management technique in which the operating system keeps only the currently needed pages of a program in RAM and holds the rest in a reserved disk area (called the swap space or page file), moving pages in and out as required. This lets a program larger than physical RAM execute, at the cost of slower speed because disk access is far slower than RAM access – exactly the behaviour described. Cache is a small very fast memory between CPU and RAM; it speeds access up but does not enlarge the address space. ROM is a small permanent chip holding start-up firmware and cannot be written to by user programs. Registers are a few storage locations inside the CPU itself, measured in bytes. Hence option D.

221. In UNIX and Linux the operating system is layered: hardware at the centre, then the kernel, then the shell, then the user. The shell is the command interpreter – it reads the line typed by the user, parses it, and requests the kernel to perform the corresponding system calls. The kernel is the layer that actually carries out the work, but the user's typed text does not reach it directly; therefore the kernel is not the interpreter. A device driver is a small program that lets the kernel talk to one particular piece of hardware such as a printer. Firmware in ROM (the BIOS/UEFI) runs only at power-on, before the operating system is loaded. Hence option B.

222. In batch processing, similar jobs are collected into a batch and executed one after another with no interaction between the user and the job while it is running; end-of-day clearing, payroll and interest-application runs in banks are the standard examples. A real-time operating system must respond to each event within a strict deadline, which is not the requirement here – the work is deliberately deferred to the night. A time-sharing system divides CPU time among many users sitting at terminals and interacting continuously, but the question states that no operator interacts during the run. A distributed operating system links several autonomous computers to look like one machine; the question says nothing about several networked machines acting as one. Hence option A.

223. A hard real-time system guarantees that a task will be completed within a fixed deadline, and a missed deadline is treated as a system failure with possibly catastrophic consequences. An anti-lock braking controller must release and re-apply brake pressure within a few milliseconds of detecting wheel lock; being late is not merely inconvenient, it causes an accident. The payroll batch run is classic batch work with no per-event deadline at all. Video-on-demand is a soft real-time application: a delayed frame degrades quality but the system still works. Auto-save is a background convenience with no deadline whatever. Since a genuine hard real-time example is present, "None of these" is wrong. Hence option C.

224. Statement I is false: multiprogramming was invented precisely for single-CPU machines. Several jobs are kept ready and the one CPU is handed from job to job; needing more than one CPU describes multiprocessing, not multiprogramming. Statement II is true and is the very purpose of multiprogramming – input/output is thousands of times slower than the processor, so instead of letting the CPU idle while a job waits for a disk read, the operating system gives the CPU to another resident job, raising CPU utilisation. Statement III is also true: for the CPU to be handed instantly to another job, that job must already be in main memory, so memory has to be partitioned among several jobs simultaneously. Hence only II and III are correct, option C.

225. Work forward from the power switch. At power-on the only code available is the firmware permanently stored in ROM (BIOS or UEFI), because RAM is empty; its first duty is the Power-On Self Test, so P must come first. The firmware then locates the boot device and reads the small bootstrap loader from the boot sector of the hard disk into RAM and transfers control to it, so Q is second. The bootstrap loader's only job is to find and load the much larger kernel of the operating system, so R follows Q – the kernel cannot load before the loader that fetches it, which rules out the order P, R, Q. Only after the kernel is running can it start the login service and display the login screen, so S is last. The sequence is therefore P, Q, R, S. Hence option A.

226. Thrashing occurs in a virtual-memory system when the degree of multiprogramming is pushed

so high that each process gets too few page frames. Every process then generates page faults almost immediately after being scheduled, so the system spends nearly all its time swapping pages instead of executing instructions – the classic symptoms being very low CPU utilisation together with continuous disk activity, exactly as described. Deadlock is different: there the processes are permanently blocked in a circular wait for resources held by one another, and no swapping storm occurs. External fragmentation is free memory scattered into unusable small holes; it wastes space but does not by itself cause continuous paging. Starvation is one low-priority process being indefinitely postponed while others run, not a system-wide collapse. Spooling is a printer queueing technique. Hence option D.

227. Deadlock requires four conditions to hold simultaneously: mutual exclusion (at least one resource is usable by only one process at a time), hold and wait (a process holding one resource requests another), no pre-emption (a resource cannot be forcibly taken away from the process holding it; it must be released voluntarily), and circular wait (a closed chain of processes each waiting for a resource held by the next). Options A, B, C and E are precisely these four. Option D states the exact opposite of the “no pre-emption” condition – if the operating system could snatch a resource whenever it wished, the deadlock would be broken rather than created. Being the negation of a necessary condition, it is not itself a necessary condition. Hence option D.

228. Step 1: Convert the logical address space to bytes. $64 \text{ KB} = 64 \times 1024 = 65536$ bytes. Step 2: Convert the page size to bytes. $2 \text{ KB} = 2 \times 1024 = 2048$ bytes. Step 3: In paging the logical address space is cut into equal-sized pages, so the number of pages is the total size divided by the page size, that is $\frac{65536}{2048} = 32$. A quicker route is to note that the units cancel: $\frac{64 \text{ KB}}{2 \text{ KB}} = 32$, so the conversion to bytes was not even necessary. The answer 16 would follow from wrongly assuming a 4 KB page, and 128 from wrongly assuming a 512-byte page; both come from mishandling the sizes rather than from the method. Hence option B.

229. In Round Robin each request gets the CPU for at most one quantum (2 ms) and, if unfinished, goes to the back of the queue. Step 1: J1 runs from 0 to 2 ms; it needed 4 ms, so 2 ms remain and it rejoins the queue behind J2 and J3. Step 2: J2 runs from 2 to 4 ms; it needed 3 ms, so 1 ms remains and it rejoins the queue. Step 3: J3 runs from 4 to 6 ms; its requirement was exactly 2 ms, which equals one quantum, so it completes at 6 ms. This is the required answer. (For completeness, J1 then runs 6 to 8 ms and finishes at 8 ms, and J2 runs 8 to 9 ms and finishes at 9 ms, so the whole set is done at 9 ms – which is why 9 ms is offered as a trap, and 8 ms, J1’s finishing time, is another. The value 4 ms is merely the instant at which J3 *begins* its turn on the CPU, after J1 and J2 have each used one quantum; mistaking the start of J3’s slice for its completion gives 4 ms.) Hence option B.

230. The block of code that reads, modifies and writes the shared balance is a critical section, and allowing two processes into it together produces the lost-update problem. A semaphore is the operating system’s synchronisation variable, operated by the wait and signal primitives, that enforces mutual exclusion: the first process passes the semaphore and the second is blocked until the first signals that it has left the critical section. A print spooler only queues output for a slow printer and enforces nothing about shared variables. A page table maps logical page numbers to physical frame numbers in virtual memory – it is about address translation, not synchronisation. An interrupt vector table holds the addresses of interrupt service routines. Since a correct mechanism is listed, “None of these” is wrong. Hence option A.

231. Statement I is correct: UNIX was designed from the start to let many users work simultaneously at different terminals, each running several processes. Statement II is correct and is the textbook definition of a distributed operating system – the network of autonomous machines is hidden from the user, who sees one system. Statement III is false: MS-DOS is a single-user, single-tasking operating system; only one user program can be active at a time, and it has no pre-emptive scheduler at all (TSR programs are a limited exception, not general multitasking). Statement IV is correct: Android runs on a modified Linux kernel with its own runtime and application framework above it. So I, II and IV are correct while III is not. Any option containing III must therefore be rejected, which eliminates C, D and E, and option A wrongly drops the correct statement IV. Hence option B.

Subtopic 5.3.3

232. Step 1: A simple Delete on a hard-disk file moves it to the Recycle Bin, from where it can be restored. Step 2: To bypass the Recycle Bin, Windows provides the Shift + Delete combination, which shows a confirmation box reading “Are you sure you want to permanently delete this file?” Hence option (B) is correct. Why the others fail: Ctrl + Delete has no delete-related function in File Explorer (in a text editor it deletes a word). Alt + Delete is not a standard Explorer shortcut. Ctrl + Shift + Delete opens the “Clear browsing data” box in web browsers and does nothing in Explorer. Since a correct choice exists, “None of these” is wrong.

233. Step 1: From MS Office 2007 onwards, Excel uses the Open XML workbook format as its default. Step 2: The extension for that default format is .xlsx, so option (D) is correct. Why the others fail: .xls is the pre-2007 binary format, chosen only if the user deliberately selects “Excel 97–2003 Workbook”. .xlsm is used only when the workbook contains macros and is saved as “Macro-Enabled Workbook”. .xlt is an old template format. .csv is a plain-text comma-separated format that stores only values and must be selected manually.

234. Step 1: Windows reserves nine characters that cannot appear in a file or folder name, because they have special meaning to the file system: backslash, forward slash, colon, asterisk, question mark, double quote, less-than, greater-than and the pipe symbol. Step 2: Of the five choices, only the colon (:) belongs to that reserved list – it is used to denote a drive letter, as in C:. Hence (E). Why the others fail: hyphen, underscore, ampersand and the blank space are all ordinary characters and are perfectly legal, e.g. KYC_Form-Anita & Co.pdf is a valid name.

235. Step 1: The Recycle Bin is maintained as a hidden folder on each fixed (internal) disk volume. Step 2: Windows does not maintain a Recycle Bin for removable media such as pen drives and memory cards; therefore a delete performed on such media is carried out immediately, and Windows warns “Are you sure you want to permanently delete this file?” Hence (C). Why the others fail: the file never travels to the C: drive’s bin (A), no bin is created on the removable drive (B), and deletion never relocates a file to Documents (D). A correct option exists, so (E) is wrong.

236. Step 1: Recall the standard Windows-key shortcuts. Step 2: Windows key + E is the dedicated shortcut that launches File Explorer, so (D) is correct. Why the others fail: Windows key + D shows the desktop by minimising all open windows; Windows key + R opens the Run dialog box; Windows key + L locks the computer and returns to the sign-in screen. Since a correct option is present, “None of these” is wrong.

237. Step 1: F2 is the standard rename key in Windows: the file name is highlighted in an edit box and the user can type a new name and press Enter. Hence (C). Why the others fail: refreshing the folder is done by F5; F1 opens Help; copying to the clipboard is Ctrl + C; sending to the Recycle Bin is the Delete key. None of these actions is performed by F2.

238. Step 1: A full (absolute) path is read from left to right: drive letter, then root, then the chain of folders, then the file. Step 2: C:\ denotes the topmost level of drive C, i.e. the root directory from which every other folder branches out. Hence (D). Why the others fail: Users and Documents are ordinary folders sitting below the root (Documents is a sub-folder of Anita), and loan.docx is the file itself, identified by its .docx extension.

239. Step 1: Identify the drives. Source D:\Reports and destination D:\Archive lie on the same drive, D. Step 2: Apply the Windows drag-and-drop rule: a plain left-button drag within the same drive performs a MOVE, while a plain left-button drag to a different drive performs a COPY. Step 3: Since both folders are on drive D, the file is moved and disappears from D:\Reports. Hence (B). Why the others fail: to force a copy on the same drive one must hold Ctrl while dragging (A); a shortcut is created only by dragging with Alt held down or with the right mouse button and choosing “Create shortcuts here” (C); dragging never deletes a file to the Recycle Bin unless it is dropped on the Bin itself (D).

240. Step 1: The wildcard ? stands for exactly one character – no more, no less. So the pattern demands the four letters **Loan**, then one single character, then **.xlsx**. Step 2: Test each file. **Loan.xlsx**: zero characters between **Loan** and the dot, so it fails. **Loan1.xlsx**: exactly one character ('1'), extension **.xlsx** – it matches. **Loan12.xlsx**: two characters ('12'), fails. **Loans.docx**: correct single character 's' but wrong extension, fails. **Loan1.docx**: correct single character but wrong extension, fails. Step 3: Exactly 1 file matches, so (A). Note that **Loan*.xlsx** would have matched three files, because * stands for any number of characters including none.

241. Step 1: Convert capacity to MB: $2 \times 1024 = 2048$ MB. Step 2: Divide by the size of one file: $\frac{2048}{250} = 8.192$. Step 3: A file cannot be stored partly, so only the whole-number part counts, i.e. 8 files, occupying $8 \times 250 = 2000$ MB and leaving $2048 - 2000 = 48$ MB free – not enough for a ninth file. Hence (A). Choosing 9 (B) is the trap of rounding 8.192 up; 10 (C) arises only if the file size is misread as 200 MB, giving $2048/200 = 10.24$; 7 (D) is an under-count. Note that even the wrong conversion 1 GB = 1000 MB would still give $2000/250 = 8$ here, so the answer is unaffected by that error.

242. Step 1: Ctrl + X marks **report1.docx** for a move and places that instruction on the clipboard; the file is not removed yet – removal happens only at the moment of pasting. Step 2: The clipboard holds only one item at a time. The subsequent Ctrl + C on **report2.docx** overwrites the pending cut instruction, so the cut of **report1.docx** is cancelled and it stays where it is. Step 3: Ctrl + V in Folder B therefore executes the last clipboard operation, a COPY of **report2.docx**. A copy appears in Folder B while the original stays in Folder A. Step 4: Net position – Folder A still has both files, Folder B has a copy of **report2.docx**. Hence (C). Option (D) is wrong because a copy, not a move, was the last operation.

243. Step 1: The question asks for the combination that opens Task Manager directly. Ctrl + Shift + Esc launches Task Manager immediately, so (E) is correct. Step 2: Why (A) is not the answer – Ctrl + Alt + Del does not open Task Manager directly in modern Windows; it displays the security options screen (Lock, Switch user, Sign out, Change a password, Task Manager), from which Task Manager must still be clicked. That is two steps, not one. Step 3: The remaining options do other things: Alt + F4 closes the active window (or opens the Shut Down box on the desktop); Ctrl + Esc opens the Start menu; Windows key + Tab opens Task View for virtual desktops.

244. Step 1: Besides the nine forbidden characters, Windows also blocks a short list of RESERVED DEVICE NAMES inherited from MS-DOS, where these words addressed hardware rather than files: CON, PRN, AUX, NUL, COM1–COM9 and LPT1–LPT9. Such a name is rejected on its own and also with any extension, e.g. PRN.txt. Step 2: PRN (the old printer device) is exactly on that list, so Windows refuses it. Hence (A). Step 3: Why the others are accepted – the restriction applies only to an exact match of the reserved word. PRINT is a longer word and is not reserved; Print_2024 is an ordinary name; COM10 is allowed because only COM1 to COM9 are reserved (there is no COM10 device name); and LPT without a digit from 1 to 9 is likewise not reserved.

245. Step 1: When a file is deleted from a fixed disk, the Recycle Bin stores not only the data but also a record of its original full path – here D:\Audit\Report.docx. Step 2: The Restore command always sends the file back to that stored path. It has no knowledge of the later rename, because renaming the folder does not update the Recycle Bin's record. Step 3: Since D:\Audit no longer exists, Windows simply re-creates that folder and places the file inside it. Priya then sees two folders, Audit (with the restored file) and Audit2024. Hence (D). Options (A) and (B) assume a redirection that does not happen, and (C) is wrong because a missing parent folder does not block a restore.

246. Step 1: Space taken by the scanned forms = $1250 \times 1.6 = 2000$ MB. Step 2: Add the database backup: total used = $2000 + 350 = 2350$ MB. Step 3: Convert the drive capacity: $4 \times 1024 = 4096$ MB. Step 4: Free space = $4096 - 2350 = 1746$ MB. Hence (A). Option (B) comes from taking 1 GB = 1000 MB, i.e. $4000 - 2350 = 1650$; option (C) arises if the backup is misread as 250 MB instead of 350 MB, giving $4096 - (2000 + 250) = 1846$; option (D) arises if the backup is left out altogether, giving $4096 - 2000 = 2096$. Since 1746 MB is present, "None of these" is wrong.

247. Step 1: Break the pattern into conditions. The name must begin with `Loan`; somewhere after that it must contain `2024`; the extension must be `.pdf`. The wildcard `*` may stand for any string, including an empty one. Step 2: Test each file. (i) `Loan_Report_2024.pdf`: begins with `Loan`, contains `2024`, extension `pdf` – MATCH. (ii) `LoanSummary2024Q1.pdf`: begins with `Loan`, contains `2024`, the trailing `*` absorbs `Q1`, extension `pdf` – MATCH. (iii) `Loan2023_2024.pdf`: begins with `Loan`, the first `*` absorbs `2023_`, then `2024` appears, extension `pdf` – MATCH. (iv) `Loans2024.docx`: extension is `docx` – NO MATCH. (v) `Report_Loan_2024.pdf`: does not BEGIN with `Loan` – NO MATCH. (vi) `Loan2024.pdf`: both wildcards stand for empty strings – MATCH. Step 3: Matches = 4, so (B).

248. Step 1: A plain click on file 3 selects that one file. Step 2: Shift + click on file 9 selects the whole continuous block from 3 to 9, i.e. $9 - 3 + 1 = 7$ files (3, 4, 5, 6, 7, 8, 9). Step 3: Ctrl + click TOGGLES an item. File 5 is already inside the block, so this click DESELECTS it, leaving $7 - 1 = 6$ files (3, 4, 6, 7, 8, 9). Step 4: Ctrl + click on file 11 – it was not selected, so it is added: $6 + 1 = 7$ files (3, 4, 6, 7, 8, 9, 11). Hence (B). The common error is to treat the Ctrl + click on file 5 as an addition and answer 8.

249. Step 1: Free space is not the only constraint; the file system itself sets a ceiling on the size of one file. Step 2: FAT32 records file size in a 32-bit field, so the largest single file it can store is 4 GB minus one byte. Step 3: The backup is 6.2 GB, which exceeds that ceiling, so Windows refuses with the message “The file is too large for the destination file system” even though 12 GB is free. Hence (D). The remedy is to re-format the pen drive as NTFS or exFAT, or to split the backup. Why the others fail: (A) ignores the file-system limit; (B) misstates the limit – FAT32 volumes in Windows can be far larger than 2 GB (the 2 GB volume limit belonged to FAT16); (C) is wrong because Windows never splits a file automatically during a copy.

250. Step 1: The symbol `..` means “go up one level to the parent folder”. Step 2: Start at `C:\Bank\Chennai\Reports`. The first `..` moves up to `C:\Bank\Chennai`. Step 3: The second `..` moves up once more to `C:\Bank`. Step 4: From there the remaining part of the path descends: `Mumbai`, then `KYC`, then the file `form.pdf`. Step 5: The absolute path is therefore `C:\Bank\Mumbai\KYC\form.pdf`, i.e. (B). Option (A) uses only one level up, (C) uses three, and (D) ignores the `..` symbols altogether.

251. Step 1: Convert the data size to MB: $3.5 \times 1024 = 3584$ MB. Step 2: $\text{Time} = \frac{\text{size}}{\text{rate}} = \frac{3584}{25} = 143.36$ seconds. Step 3: Convert to minutes and seconds: $143.36 = 120 + 23.36$, i.e. 2 minutes and about 23 seconds. Hence (D). Option (A) comes from taking 1 GB = 1000 MB, which gives $3500/25 = 140$ s = 2 min 20 s – the wrong conversion for this question. Options (B) and (C) do not follow from either conversion.

252. Step 1: With hidden items off, only visible items are counted: 15 visible items. Step 2: With hidden items on the count is 19, so the number of hidden items is $19 - 15 = 4$. Step 3: Shift + Delete removes 3 hidden files permanently, so hidden items fall to $4 - 3 = 1$; the visible count is untouched at 15. Step 4: Creating 2 new folders adds 2 VISIBLE items, since newly created folders carry no hidden attribute: $\text{visible} = 15 + 2 = 17$. Step 5: With “Hidden items” unticked, only the 17 visible items are shown. Hence (B). Answering 18 or 19 wrongly counts the surviving hidden item or ignores the deletions.

Subtopic 5.3.4

253. The key phrase is “reads the entire source program in one go and produces an equivalent machine-language program”. That is the definition of a compiler: it performs whole-program translation before any execution begins, and leaves behind an object/executable file. An interpreter is wrong because an interpreter takes one statement at a time, translates it and immediately executes it, never handling the whole program at once and never producing a separate machine-language file. An assembler is wrong because its input is assembly language (mnemonics such as `ADD`, `MOV`), not a high-level language. A loader is wrong because it does no translation at all; it merely copies an already-prepared executable file from disk into main memory. Since “Compiler” is present in the list, “None of these” cannot be correct. Hence option A.

254. The CPU's circuitry responds only to patterns of binary digits, i.e. strings of 0s and 1s. A program written in that binary form is called machine language, and it is the only form that needs no translation before execution. Assembly language is wrong: although it is very close to machine language, it uses symbolic mnemonics and must first be converted by an assembler. High-level languages such as C, COBOL or Python are wrong because they are English-like and require a compiler or an interpreter. A fourth-generation query language such as SQL is even further from the hardware and is processed by a database engine, so it too needs translation. As the correct choice is listed, "None of these" is not applicable. Hence option B.

255. Trace the described behaviour. Statements are translated and executed one at a time, in sequence, and execution actually takes place *before* the whole program has been checked – lines 1 to 22 have already run when the error on line 23 surfaces. Only an interpreter behaves this way. A compiler is ruled out because a compiler checks the complete source first and reports its diagnostics before any line is executed; nothing would have run at all. A linker is ruled out because it does not translate or execute source code; it only joins already-compiled object modules with library routines. An assembler is ruled out because it translates assembly mnemonics into machine code as a whole-file operation and does not execute anything. Hence option D.

256. Mnemonic codes such as ADD, SUB, MOV are the vocabulary of assembly language, a low-level language. The translator dedicated to assembly language is the assembler, and its output is machine code. A compiler is wrong because a compiler's input is a high-level language such as C or COBOL, not assembly mnemonics. An interpreter is wrong for the same reason, and additionally because an interpreter executes as it translates rather than producing a machine-code file. A debugger is wrong because it is a testing aid used to trace a program, set breakpoints and examine variable values; it performs no translation at all. Hence option C.

257. The program as written by the human being, in the high-level language and before any translation, is called the source code (or source program). Object code is wrong: that name is reserved for the machine-level output produced *by* the compiler from the source code. Machine code is wrong because the typed C statements are English-like text, not binary instructions the CPU can run. Executable code is wrong because an executable is what emerges only after compiling and then linking; the saved .c file cannot be run. Since the correct term is listed, "None of these" does not apply. Hence option C.

258. Programming languages are graded by how close they are to the hardware. Only machine language and assembly language are classed as low-level, because their instructions map directly onto the operations of the CPU. Now examine the options. Python is a modern high-level, interpreted language. COBOL is a high-level, English-like language designed for business data processing. Java is a high-level object-oriented language. BASIC is a high-level beginners' language. Thus all four named languages are high-level, and not one low-level language such as assembly appears in the list. Therefore the genuinely correct response is "None of these". Hence option E.

259. Read the two halves of the description. "Symbolic names and mnemonics instead of binary opcodes" rules out machine language, which is pure binary with no symbols. "Machine-dependent and works at the level of individual CPU instructions" rules out the high-level options: COBOL is machine-independent and business-oriented, and SQL is a machine-independent, non-procedural query language that has nothing to do with CPU instructions. The only language that is symbolic yet still tied to a particular processor's instruction set is assembly language. Hence option B.

260. Work through the two translation models. A compiler makes one complete pass over the source, emits an object program, and after linking, an executable file remains on disk; the customer can run that executable a thousand times and the compiler need never be invoked again. An interpreter emits no such file: every time the program is run, the interpreter must be present and must translate the statements once more. That is exactly option A. Option B reverses the two, so it is false. Option C is false because an interpreter does not generate an object file at all, so the files cannot be identical. Option D is false on both counts: compilers work on high-level languages, and the translator for the low-level assembly language is the assembler, not the interpreter. Since a true statement exists in the list, option E is not correct. Hence option A.

261. Separate the total time into translation time and execution time. In the compiled version the translation is a one-time cost paid before the run; during the actual processing of the 5 lakh records the CPU executes ready-made machine instructions with zero translation work. In the interpreted version, translation is interleaved with execution, so every statement inside the record-processing loop must be re-examined and re-translated on each of the 5 lakh iterations. That repeated overhead makes the interpreted run substantially slower, so option B is correct. Option A confuses per-line translation with speed; translating a line is cheap individually but is repeated enormously often. Option C is wrong because identical logic does not imply identical run time when the execution mechanisms differ. Option D is wrong because skipping the creation of an object file saves a trivial amount of disk work and does nothing to reduce the far larger repeated translation cost. Hence option B.

262. There are two distinct translation steps described. First, the .java source is translated in its entirety into intermediate bytecode – a whole-program translation, hence the work of a compiler. Second, that bytecode is taken up by the Java Virtual Machine and processed instruction by instruction at run time – statement-at-a-time translation and execution, hence the work of an interpreter. Because both steps genuinely occur, Java uses a compiler as well as an interpreter, and option D is right. Options A and B each capture only one of the two steps and so are incomplete. Option C is wrong because an assembler translates assembly mnemonics, and no assembly stage appears anywhere in the Java model. Hence option D.

263. Ask what the compiler actually checks. A compiler verifies that the statements obey the grammar of the language; violations such as a missing semicolon or an unbalanced bracket are syntax errors and are duly reported. Here the statement $\frac{P \times R \times T}{50}$ is perfectly legal C grammar, so nothing is reported – this rules out option A, since there is no syntax violation for the compiler to have missed. The fault is that the programmer's intention and the coded formula disagree; the machine faithfully computes the wrong thing. Such a mistake in reasoning is a logical error, and no translator can detect it because the translator has no knowledge of what the programmer meant. Option B is wrong: the linker only resolves references between object modules and libraries, and nothing is unresolved here. Option C is wrong because the program did not abort; it ran to completion and printed a result. Hence option D.

264. Recall the generations. The first generation is machine language, written in binary. The second generation is assembly language, using mnemonics. The third generation comprises the procedural high-level languages – C, COBOL, FORTRAN, BASIC – in which the programmer must spell out the step-by-step procedure. The fourth generation consists of non-procedural languages, typically query and report generators such as SQL, in which the user states only the desired result and the system works out the retrieval strategy. The stem explicitly says the officer specifies *what* is wanted and not *how* it is to be fetched, which is precisely the non-procedural, fourth-generation characteristic. Hence option D.

265. Follow the build sequence for a compiled language: source code goes to the compiler, which yields object modules; the linker then binds those modules to one another and to library routines such as the input/output and mathematical functions, resolving all external references and producing one executable file; finally the loader copies that executable from disk into main memory so the CPU can begin execution. The task described in the question – combining object modules with libraries to form an executable – is squarely the linker's job, so option B is right. The loader in option A comes afterwards and does no combining. An interpreter is irrelevant because it produces no object modules to combine. An assembler is irrelevant because its role is translating assembly source, which has already been passed in the sequence. Hence option B.

266. The requirement stated is immediate, statement-level feedback with a fast edit-and-retry cycle. An interpreter provides exactly this: because it translates and executes one statement at a time, it stops at the offending statement and identifies it, and after the trainee edits that statement she simply runs again – there is no compile-and-link rebuild to sit through. Option A is wrong on its stated reason: a compiler does not hide errors, it reports all syntax errors together, but it does force a full re-compilation and re-linking after every correction, which is precisely what she wants to avoid. Option C is wrong because a linker reports only unresolved-reference problems between object modules, not

ordinary programming errors. Option D is wrong because a loader performs no error checking of program logic at all; it only places an executable into memory. Hence option B.

267. Reason from what each phase needs as input. Lexical analysis must come first: it scans the raw character stream and groups characters into tokens such as keywords, identifiers, constants and operators. Syntax analysis (parsing) comes next, because it can only check grammatical structure once tokens exist – it arranges the tokens into a parse tree. Semantic analysis follows syntax analysis, since meaning-related checks such as type compatibility and declaration of variables presuppose a valid parse tree. Only after the program has been found lexically, grammatically and semantically sound does code generation emit the machine or intermediate code. So the order is Lexical, Syntax, Semantic, Code generation, which is option C. Option A wrongly parses before tokenising, option B wrongly checks meaning before tokens even exist, and option D wrongly checks meaning before grammar. Hence option C.

268. The question turns on what each compiler emits. A C compiler produces native machine code packaged in the executable format of one particular operating system and instruction set; move that file to a different operating system and both the instruction encoding and the file format are foreign, so it will not run – a fresh compilation on the target platform is required. A Java compiler instead emits bytecode, an intermediate code targeted at no real processor; every platform supplies its own Java Virtual Machine, and that JVM executes the same bytecode file. This makes option D correct. Option A is false, since C source is portable and can certainly be compiled on Linux. Option B is false, because Java programs are compiled – into bytecode. Option C is false, as Linux routinely runs compiled native executables. Hence option D.

269. Test each statement separately. Statement (i) is correct: whole-program translation before execution is the defining property of a compiler. Statement (ii) is correct: an interpreter translates and executes statement by statement and leaves behind no object file, which is why the interpreter must be present on every run. Statement (iii) is incorrect: an assembler's input is assembly language, a low-level language; the translator whose input is a high-level language is the compiler or the interpreter. Statement (iv) is correct: the compiler's object code is machine-level code, readable and executable by the machine rather than convenient for humans. So statements (i), (ii) and (iv) are correct and only (iii) is wrong, giving a count of three. Hence option C.

270. Check each statement against the working of the two translators. Option A is true: because the compiler examines the entire source in its passes, it can accumulate and list many syntax errors at once. Option B is true: an interpreter reaches an error only when execution arrives at that statement, so it stops there and reports it, later errors remaining undiscovered until earlier ones are fixed. Option C is true: the executable is self-contained machine code, so re-running it needs no further translation and not even the presence of the compiler. Option D is false, and is in fact a description of a compiler wrongly attached to an interpreter – an interpreter never converts and stores the complete program as machine code; it translates and executes one statement at a time. Since a false statement has been found, option E is not applicable. Hence option D.

271. Identify the stage described. The input to the Java compiler is the .java file, which is the source code – so option A names the wrong end of the process. The output is deliberately not tied to any real processor, which excludes option B, since object code of the host processor would be native and hence platform-dependent, defeating Java's portability. Option D is excluded because assembly code is the symbolic form of a specific processor's instruction set and is likewise machine-dependent; moreover no assembler appears in the Java toolchain. The processor-independent intermediate form executed by the JVM is called bytecode. Hence option C.

272. Assembly language is simply a symbolic rendering of the machine's own instruction set, so one mnemonic such as ADD or MOV maps to essentially one machine instruction – this is the well-known one-to-one correspondence of low-level languages. A high-level language such as C is designed around the problem rather than the hardware, so one statement – say a single line that computes and stores an EMI, or a loop header – must be expanded by the compiler into a whole group of machine instructions

for loading, arithmetic, testing and storing. That expansion is precisely why 40 C statements can do the work of 250 assembly mnemonics, and it makes option A correct. Option B reverses the relationship. Option C is wrong because it denies the expansion that gives high-level languages their compactness, and would leave the given counts unexplainable. Option D is absurd, since every program must ultimately reach machine instructions to run. Hence option A.

273. The distinguishing feature here is that the machine on which the translator runs and the machine for which code is generated are different. A translator with exactly that property is called a cross-compiler, and it is the standard tool for building software for embedded targets such as ATMs from an ordinary development desktop. Option B is wrong because a decompiler works in the opposite direction, attempting to reconstruct high-level source from machine or object code. Option C is wrong because an assembler is defined by its *input* being assembly language, and it normally targets the machine it runs on; the stem says nothing about assembly source and everything about differing target hardware. Option D is wrong because an interpreter generates no machine-code file at all – it executes statements directly on the machine it is running on, which cannot serve a different target processor. Hence option A.

Subtopic 5.4.1

274. In MS Word the alignment shortcuts are *Ctrl + L* for left, *Ctrl + E* for centre, *Ctrl + R* for right and *Ctrl + J* for justify. So *Ctrl + E* centres the selected heading, making option B correct. Bold is *Ctrl + B*, not *Ctrl + E*, so option A is wrong. Nothing is deleted by an alignment command, so option C is wrong. *Ctrl + E* has no connection with e-mail – the letter E here stands for “centre” only by convention because *Ctrl + C* was already taken by Copy – so option D is wrong. Since option B is genuinely correct, “None of these” is wrong.

275. From MS Word 2007 onwards the default save format is the XML-based Word Document, whose extension is .docx; hence option C. The older .doc extension belonged to Word 2003 and earlier, and .wrd (option B) is not a Word extension at all – it does not exist. A .txt file (option A) is plain text produced by Notepad and would lose every bit of formatting, so Word never chooses it by default. .pdf (option D) and .rtf (option E) are both available in Word’s “Save as type” list, but they must be selected deliberately; neither is the default.

276. *F7* launches the Spelling and Grammar checker in MS Word, so option C is correct. *F1* opens the Help pane. *F5* opens the Find and Replace box on its Go To tab, used for jumping to a particular page, section or bookmark. *F9* updates a selected field, such as refreshing a table of contents or a date field. *F12* opens the Save As dialog box. None of these four performs a spelling check, so C is the only correct choice.

277. *Ctrl + Home* takes the cursor to the very start of the document – page 1, line 1 – so option A is correct. The plain *Home* key alone moves only to the beginning of the current line, which is why option B is wrong. There is no standard single shortcut that jumps merely to the top of the page you happen to be on, so option C is wrong. Moving to the very end of the document is done by *Ctrl + End*, the mirror image of this shortcut, so option D is wrong. A correct option exists, so “None of these” is wrong.

278. Mail Merge – including Start Mail Merge, Select Recipients, Insert Merge Field and Finish & Merge – lives on the Mailings tab, so option D is correct. The Insert tab holds objects placed into the page such as tables, pictures, headers and page numbers. The References tab holds scholarly apparatus: table of contents, footnotes, citations and index. The Review tab holds spelling, thesaurus, comments, Track Changes and Compare. The Design tab holds document themes, style sets, page colour and watermark. None of these four contains Mail Merge.

279. *Ctrl + K* is the shortcut for Insert Hyperlink, which lets the selected text be linked to a web address, another file or a bookmark inside the same document; hence option A. Inserting a table is done from the Insert tab and has no single Ctrl shortcut of this kind, so option B is wrong. Keyboard customisation is reached through File > Options > Customize Ribbon > Customize, not by *Ctrl + K*,

so option C is wrong. The Paragraph dialog is opened from the Home or Layout tab's dialog launcher, so option D is wrong. Since option A is correct, "None of these" is wrong.

280. *Ctrl + Enter* inserts a hard page break, so the annexure is anchored to the top of a new page permanently; hence option B. Pressing *Enter* repeatedly (option A) only adds empty paragraphs – adding a single line above them would push the annexure down and spoil the layout, which is exactly what Kavita wants to avoid. *Shift + Enter* inserts a line break within the same paragraph, not a page break. *Alt + Enter* is not a page-break shortcut in Word. *Ctrl + Shift + Enter* inserts a column break, which starts a new column in a multi-column layout, not a new page.

281. MS Word offers two different "grow font" shortcuts, and they behave differently. *Ctrl +]* increases the font size by exactly one point, so 12 pt becomes 13 pt – option A. *Ctrl + Shift + >* instead moves to the next size available in the font-size drop-down list, and that list runs ... 10, 11, 12, 14, 16 ..., so from 12 pt it jumps to 14 pt – overshooting the required 13 pt, which is why option B is wrong. Note that 13 pt is not on the list at all and therefore can never be reached by option B. *Ctrl + Shift + P* merely places the cursor in the Font Size box, from where he would still have to type a number, so it is not by itself the size change asked for. *Ctrl + D* opens the full Font dialog box – again only a dialog, not a one-point increase. A correct option exists, so E is wrong.

282. MS Word separates character formatting (font, size, colour, bold, italic, underline) from paragraph formatting (alignment, indents, spacing). *Ctrl + Spacebar* clears the character formatting of the selection and returns it to the underlying style, which is exactly what is wanted – option E. *Ctrl + Q* clears paragraph formatting, but the paragraph settings are already correct, so it would attack the wrong half of the problem. *Ctrl + Z* undoes the last action, which would remove the paste itself and lose the text. *Ctrl + Shift + N* applies the Normal style, which resets paragraph formatting as well and would therefore disturb the alignment and indents she wants to keep. *Ctrl + U* toggles underline only, leaving the colour, the bold and the Verdana font untouched.

283. *Enter* ends the paragraph, and since every paragraph in a numbered list gets its own number, it would produce condition 6 – so option B defeats the purpose. *Shift + Enter* inserts a manual line break: the text moves to the next line but remains part of the same paragraph, so no new number is generated – option D is correct. *Ctrl + Enter* inserts a page break and would throw the rest of the list onto a fresh page. *Tab* pressed at the start of a list item demotes it to a lower list level, and pressed at the end of a line it simply inserts a tab stop; either way it does not start a new line. A correct option exists, so E is wrong.

284. Because the file has already been saved once, pressing an ordinary Save command would silently overwrite *Audit_Note.docx* and destroy the original. What is needed is the Save As dialog, where a new name can be typed. *F12* opens Save As – option A. *Shift + F12* is equivalent to *Ctrl + S*, that is plain Save, which would overwrite the original. *Ctrl + F12* is equivalent to *Ctrl + O*, the Open dialog, which loads a file rather than saving one. *Alt + F12* has no such standard assignment in Word. *F11* jumps to the next field in the document and has nothing to do with saving.

285. *Ctrl + Shift + C* is Copy Formatting – the keyboard version of the Format Painter: it lifts the formatting but not the text. *Ctrl + Shift + V* then pastes that formatting onto whatever is selected. Repeating the paste on each of the three sub-headings reproduces the look exactly, so option D is correct. Option A copies the text itself, so the other sub-headings would be replaced by the words of the model heading – their own wording would be lost. *Ctrl + Shift + D* applies double underline, which is not the formatting described. *Ctrl + Y* repeats the last action, but the last action here is a selection, not a formatting command, so it cannot reliably transfer a combination of size, weight, small caps and paragraph spacing. Since option D works, "None of these" is wrong.

286. Inside a Word table, *Tab* moves to the next cell and *Shift + Tab* to the previous one. When the cursor is already in the very last cell, *Tab* has no next cell to move to, so Word creates one: it appends a fresh row of the same structure and places the cursor in its first cell – option C. The cursor does not leave the table (option A). To insert an actual tab character inside a table cell one must press

Ctrl + Tab, not *Tab*, so option B is wrong. Columns are never added by *Tab* (option D). Option E is wrong because Word's designed behaviour is precisely to extend the table rather than do nothing.

287. The line-spacing shortcuts in Word are *Ctrl + 1* for single spacing, *Ctrl + 2* for double spacing and *Ctrl + 5* for 1.5-line spacing. The 5 is easy to mistake, but it refers to the .5 in 1.5 – so option C is correct. *Ctrl + 1* would give single spacing and *Ctrl + 2* double spacing, neither of which is what head office asked for. *Ctrl + 1.5* (option D) is not a valid keystroke at all, since a shortcut cannot contain a decimal point. *Ctrl + Shift + 2* has no line-spacing function in Word.

288. In MS Word, page orientation is a property of a section, not of an individual page. To give one page a different orientation it must be isolated in a section of its own, and that requires Next Page section breaks – one before it and one after it. Once the cursor is inside that middle section, changing orientation to landscape affects that section alone. Hence option B. Option A fails because an ordinary page break does not create a new section, so the orientation change would spread to the whole document. Option C fails for the same reason: selecting a table does not create a section boundary, and Word would apply the change to the entire section containing it. Option D is absurd as a document design and text rotation does not change the printed paper orientation. Since option B is correct, “None of these” is wrong.

289. *Shift + F5* is the Go Back command. Within a session it cycles through the last three editing locations, and immediately after a document is reopened its first use returns the cursor to the position where editing last stopped before the file was closed – exactly Ravi's need, so option D. *Ctrl + F5* restores the document window size and does not move the cursor. *Alt + F5* likewise affects the program window, not the cursor. *Ctrl + End* moves to the physical end of the document, which is the last page, not necessarily page 23 where he was working. *F5* opens the Go To dialog, but pressing *Enter* there merely repeats the last Go To target, which need not be his last edit point.

290. *F8* drives Word's Extend Selection mode and each further press widens the selection by one grammatical unit. The first press only switches Extend mode on and selects nothing. The second press selects the word containing the cursor. The third press extends the selection to the whole sentence. A fourth press would take it to the paragraph and a fifth to the entire document. Since exactly three presses are made, the selection stands at the sentence level – option C. Option A describes the state after one press, option B after two, option D after four and option E after five, so none of them matches three presses.

291. The feature that records each insertion and deletion with the reviewer's name, and lets the author accept or reject them one by one, is Track Changes, toggled by *Ctrl + Shift + E* – option B. *Alt + Ctrl + M* inserts a comment: a comment is a remark in the margin, it does not record the actual edits made to the text, so option A does not meet the requirement. *Ctrl + Shift + C* copies formatting, unrelated to reviewing. *Alt + Shift + C* closes a split document window, again unrelated. A correct option exists, so “None of these” is wrong.

292. *Ctrl + Shift + Spacebar* inserts a non-breaking space. Word treats the characters on either side of it as one unbreakable unit, so the whole designation moves together to the next line instead of splitting – option C. *Ctrl + Spacebar* clears character formatting from the selection; it inserts nothing and would not stop the break. *Shift + Spacebar* simply types an ordinary space, which is precisely the character that is allowing the break. *Alt + Spacebar* opens the window control menu of the application, not a Word text command. *Ctrl + Hyphen* inserts an optional hyphen, which does the opposite of what is wanted – it offers Word an extra place to break a word.

293. Holding the *Alt* key while dragging the mouse turns on Word's column (vertical block) selection, which highlights a rectangular region of text irrespective of line boundaries – exactly what is needed to catch only the balances column, so option C is correct. Holding *Shift* and dragging extends an ordinary linear selection, which sweeps up the account numbers and names lying between the balances. Holding *Ctrl* and dragging selected text moves a copy of it, and *Ctrl*-clicking selects whole sentences – neither produces a vertical block. *Ctrl + A* selects the entire document, so deleting would wipe out the whole statement. Since option C works, “None of these” is wrong.

294. *Ctrl + T* creates a hanging indent: it pushes every line except the first to the right by one default tab stop of 0.5 inch, which is precisely the described layout – option E. *Ctrl + M* increases the indent of the entire paragraph, first line included, so the first line would not remain at the margin. *Ctrl + Shift + M* is the reverse of *Ctrl + M* and decreases the paragraph indent. *Ctrl + Shift + T* is the reverse of *Ctrl + T* and reduces an existing hanging indent, so it would undo the effect rather than create it. *Ctrl + Tab* inserts a tab character inside a table cell and does not set any indent for the paragraph.

Subtopic 5.4.2

295. The **SUM** function adds every numeric value in the stated range, and **B2:B4** covers the three cells B2, B3 and B4. Adding them step by step: $12500 + 8750 = 21250$, and then $21250 + 4250 = 25500$. So B5 shows Rs. 25,500. Option (A) is the total of only the first two receipts, i.e. the student stopped at B3. Option (C) is a rounded figure and is not what Excel computes. Option (D) Rs. 20,750 cannot be produced from these three cells by any correct or partial addition; note that omitting B3 would give $12500 + 4250 = 16750$, not 20750, so (D) is simply a trap value. Since Rs. 25,500 is listed, (E) is not correct.

296. The **COUNT** function counts only cells that contain numbers; it ignores text entries and ignores blank cells. In the range there are exactly five numeric cells, so **COUNT** returns 5. Option (A) 8 would be the answer to **=ROWS(A1:A8)**, which counts all cells regardless of content. Option (B) 7 is what **=COUNTA(A1:A8)** returns, because **COUNTA** counts every non-empty cell (5 numbers + 2 text). Option (C) 6 corresponds to no standard function here. Since 5 appears in the list, (E) is not correct.

297. A reference written with dollar signs before both the column letter and the row number, such as **\$A\$1**, is an absolute reference: it never changes when the formula is copied. A reference written without dollar signs, such as **B5**, is relative: it shifts by the same offset as the paste. Copying from C5 to C6 moves the formula down by one row and across by zero columns. Therefore **\$A\$1** stays as **\$A\$1**, while **B5** becomes **B6**. The result is **=\$A\$1+B6**. Options (B) and (D) wrongly shift the absolute part. Option (C) wrongly leaves the relative part unchanged. Option (E) drops the dollar signs altogether, which pasting never does.

298. **AVERAGE** divides the sum of the numeric values by how many numeric values there are. First find the sum: $4200 + 3800 = 8000$; $8000 + 5000 = 13000$; $13000 + 4600 = 17600$; $17600 + 4400 = 22000$. There are 5 values, so the average is $\frac{22000}{5} = 4400$. Hence Excel shows Rs. 4,400. Option (A) is merely the first entry, (B) is the midpoint of 4,000 and 5,000 and not the mean, and (D) is one of the data values. Since Rs. 4,400 is listed, (E) is not correct.

299. A pie chart divides a single circle into sectors whose angles are proportional to the values, so it is designed precisely to show the share of each part in one whole. A line chart (A) is meant for showing a trend of values over time, not parts of a total. A scatter chart (B) is used to display the relationship between two numeric variables. An area chart (D) again plots values over a continuous axis such as time. Since the pie chart is offered and is correct, (E) is not correct.

300. A row of hash symbols is not an error value at all; it is Excel's way of saying that the numeric or date value stored in the cell is too wide to be shown in the current column width. Widening the column, or reducing the font, immediately reveals the number. A circular reference (A) produces a warning message and usually a 0, not hashes. A reference to a deleted cell (B) produces **#REF!**. A protected cell (D) still displays its value normally; protection only blocks editing. Since the correct explanation is listed, (E) is not correct.

301. The ampersand is the text-joining (concatenation) operator in Excel. It joins the pieces exactly as they are given, from left to right. Here the three pieces are the text **IBPS**, a single space enclosed in quotation marks, and the text **Clerk**. Joining them gives **IBPS Clerk** with one space in the middle. Option (A) would be the result of **"IBPS"&"Clerk"**, with no space piece. Option (C) is wrong because the ampersand is an operator and is never printed as a character. Option (D) is wrong

because concatenating text values is a perfectly valid operation and raises no error. Since the true result is listed, (E) is not correct.

302. Work out the two functions separately and then subtract. $\text{MAX}(B2:B7)$ scans the six values and returns the largest, which is 71000. $\text{MIN}(B2:B7)$ returns the smallest; the value 38500 occurs twice, and a repeat makes no difference to MIN, so the minimum is 38500. The formula therefore evaluates $71000 - 38500 = 32500$. Options (A) and (B) give only the MAX part or only the MIN part, ignoring the subtraction. Option (C) Rs. 26,000 does not arise from any correct step; it is a plausible-looking but incorrect difference. Since Rs. 32,500 is listed, (E) is not correct.

303. A nested IF is evaluated from the outside in, and stops at the first test that is TRUE. Step 1: test $C2 \geq 50000$, that is, is $25000 \geq 50000$? No, so the outer test is FALSE and Excel moves to the value-if-false part, which is the inner IF. Step 2: test $C2 \geq 25000$, that is, is $25000 \geq 25000$? Yes, because $\geq$ includes equality. So the inner IF returns its value-if-true, **Silver**. Option (A) would need a balance of at least Rs. 50,000. Option (C) is returned only when the balance is strictly below Rs. 25,000, which is not the case here since the balance equals the boundary. Option (D) is wrong because every branch of this nested IF supplies a text result, so FALSE can never be displayed. Since **Silver** is listed, (E) is not correct.

304. The criterion " >40000 " is a strict inequality, so a value equal to 40000 does NOT qualify. Test each entry in order: 35000 no; 42000 yes (1); 40000 no, it only equals the limit; 58000 yes (2); 39500 no; 40000 no again; 75000 yes (3); 28000 no; 61000 yes (4); 40500 yes (5). The count of qualifying entries is 5. Option (D) 6 is the trap answer obtained by wrongly counting one of the two cells equal to 40000; that would be the answer to " ≥ 40000 " only if both were counted, giving 7. Options (A) and (B) undercount. Since 5 is listed, (E) is not correct.

305. SUMIF checks the first range against the criterion and adds up only the matching cells of the third range (the sum range), matching row by row. Rows where A equals "Chennai" are row 2 (Rs. 12,000), row 4 (Rs. 15,000) and row 6 (Rs. 8,000). Adding these: $12000 + 15000 = 27000$, and $27000 + 8000 = 35000$. So the answer is Rs. 35,000. Option (A) Rs. 27,000 is the trap of stopping after the first two Chennai rows. Option (B) Rs. 32,000 and option (C) Rs. 43,000 are trap values that match no subtotal of this table: the non-Chennai rows (Madurai and Salem) come to $9000 + 7000 + 6000 = 22000$, wrongly including Salem's Rs. 7,000 with the Chennai rows would give $35000 + 7000 = 42000$, and the grand total of all six rows is 57000. Since Rs. 35,000 is listed, (E) is not correct.

306. Relative references move by exactly the same offset as the copy itself, so first measure the offset. Moving from C3 to E6, the column goes $C \rightarrow E$, an increase of 2 columns; the row goes $3 \rightarrow 6$, an increase of 3 rows. Now shift each reference by (+2 columns, +3 rows). For A1: column $A + 2 = C$, row $1 + 3 = 4$, giving C4. For B2: column $B + 2 = D$, row $2 + 3 = 5$, giving D5. The pasted formula is therefore $=C4*D5$. Option (B) is what would appear only if the references were fully absolute. Option (C) shifts the rows by 2 instead of 3. Option (D) wrongly assumes the references become the destination cell itself. Since $=C4*D5$ is listed, (E) is not correct.

307. VLOOKUP searches for the lookup value down the FIRST column of the given table, then returns the value from the column whose position number is given as the third argument, counting that first column as column 1. Here the table starts at column A, so column 1 = A (names), column 2 = B (account numbers), column 3 = C (branches) and column 4 = D (balances). The third argument is 3, so the branch is returned, i.e. **Erode**. Option (A) would need a column index of 2, and option (B) a column index of 4. Option (D) #N/A appears only when the lookup value is not found in the first column, but Kavita is present. Since **Erode** is listed, (E) is not correct.

308. The key rule is that AVERAGE ignores truly blank cells but does include cells containing the number zero, because zero is a genuine numeric entry. So the values actually averaged are 1200, 1800, 2400 and 0: four values, not five and not three. Their sum is $1200 + 1800 = 3000$; $3000 + 2400 = 5400$; $5400 + 0 = 5400$. Dividing, $\frac{5400}{4} = 1350$. Option (A) 1080 is the trap of dividing by 5, i.e. wrongly counting the blank cell. Option (C) 1800 is the trap of dividing by 3, i.e. wrongly discarding the zero

as well. Option (D) does not arise from any correct or common step. Since 1350 is listed, (E) is not correct.

309. Excel applies operator precedence in this order: exponentiation first, then multiplication and division together from left to right, then addition and subtraction together from left to right. Step 1 (exponent): $3^2 = 9$, so the expression becomes $10 + 20 \times 9/6 - 4$. Step 2 (multiply and divide, left to right): $20 \times 9 = 180$, then $180/6 = 30$, giving $10 + 30 - 4$. Step 3 (add and subtract, left to right): $10 + 30 = 40$, then $40 - 4 = 36$. The displayed value is 36. Option (B) 40 is the trap of forgetting the final subtraction. Option (A) 34 is a pure trap value: no evaluation order yields it, since multiplication and division share the same precedence and here commute, $20 \times (9/6) = 30$ giving the same 36. Option (D) 30 is the intermediate result $20 \times 9/6$ before the addition and subtraction are applied. Option (C) 46 matches no step of the calculation. Since 36 is not among the four numeric options, the correct choice is "None of these".

310. SUMPRODUCT multiplies the two arrays element by element, pairing row with row, and then adds all the products. Row by row: $12 \times 250 = 3000$; $8 \times 400 = 3200$; $15 \times 150 = 2250$; $10 \times 320 = 3200$. Now add the four products: $3000 + 3200 = 6200$; $6200 + 2250 = 8450$; $8450 + 3200 = 11650$. The result is Rs. 11,650. Note that this is NOT the same as multiplying the sum of quantities (45) by the sum of rates (1120), which would give a meaningless Rs. 50,400. Options (B), (C) and (D) are arithmetic near-misses of the correct row-wise total. Since Rs. 11,650 is listed, (E) is not correct.

311. These are mixed references: a dollar sign locks only the part it immediately precedes. First measure the copy offset. From D2 to F5 the column goes $D \rightarrow F$, an increase of 2 columns, and the row goes $2 \rightarrow 5$, an increase of 3 rows. Now treat each reference. In B\$1 the column B is free, so it shifts by +2 to become D, while the row is locked by the dollar sign and stays 1; result D\$1. In \$A2 the column A is locked and stays A, while the row is free and shifts by +3 to become 5; result \$A5. Hence F5 contains =D\$1*\$A5. Option (A) wrongly freezes the column of the first reference. Option (C) wrongly shifts the locked row \$1. Option (D) shifts the wrong halves in both references. Since the correct formula is listed, (E) is not correct.

312. SUMIFS adds a cell of the sum range only when EVERY criterion is satisfied in that same row. Check all eight rows against both tests, branch = Coimbatore AND amount ≥ 5000 . Row 2: Coimbatore, $6000 \geq 5000$, both pass, take 300. Row 3: Erode, fails the branch test. Row 4: Coimbatore but $4500 < 5000$, fails the amount test, so its 225 is excluded. Row 5: Coimbatore, $9000 \geq 5000$, take 450. Row 6: Salem, fails. Row 7: Coimbatore, $5000 \geq 5000$ is true because the criterion includes equality, take 250. Row 8: Erode, fails. Row 9: Coimbatore, $12000 \geq 5000$, take 600. Now add: $300 + 450 = 750$; $750 + 250 = 1000$; $1000 + 600 = 1600$. Option (D) Rs. 1,825 is the trap of ignoring the amount criterion altogether and adding every Coimbatore commission, $300 + 225 + 450 + 250 + 600 = 1825$. Option (A) Rs. 1,350 is the trap of reading " ≥ 5000 " as a strict $>$ and so dropping the Rs. 250 row: $300 + 450 + 600 = 1350$. Option (B) Rs. 1,225 matches no valid combination of the rows. Since Rs. 1,600 is listed, (E) is not correct.

313. Evaluate the logical functions one at a time. AND is TRUE only when all its conditions are TRUE. Here $72 \geq 60$ is TRUE but $55 \geq 60$ is FALSE, so AND returns FALSE and the outer IF moves to its value-if-false, which is the inner IF. OR is TRUE when at least one condition is TRUE. Here $72 \geq 60$ is TRUE, so OR returns TRUE and the inner IF gives its value-if-true, namely Reappear. Option (A) would require both marks to be at least 60. Option (B) Fail would require both marks to be below 60, but one mark clears the bar. Option (C) cannot occur because every branch of the nested IF returns a text string. Since Reappear is listed, (E) is not correct.

314. The requirement is to plot two numeric variables against each other, one branch = one point, in order to see a relationship. That is exactly the purpose of a scatter (XY) chart, in which both the horizontal and the vertical axes are numeric value axes. A stacked column chart (A) shows how components build up to a total for each category, which is not the aim here. A line chart (B) joins points in the order of a category axis and implies a sequence such as time; with 40 unordered branches this would produce a meaningless zig-zag. A doughnut chart (D), like a pie chart, shows parts of a

whole, and cannot display two variables at once. Since the scatter chart is offered and correct, (E) is not correct.

315. Evaluate the inner function first. Sum the five values: $41250 + 38700 = 79950$; $79950 + 45900 = 125850$; $125850 + 39400 = 165250$; $165250 + 42150 = 207400$. The average is $\frac{207400}{5} = 41480$. Now apply **ROUND** with the second argument -2 . A negative second argument rounds to the left of the decimal point, and -2 means round to the nearest hundred. The two neighbouring hundreds are 41400 and 41500; since the tens-and-units part is 80, which is 50 or more, the value rounds up to 41500. So the result is Rs. 41,500. Option (A) is the unrounded average, i.e. the trap of ignoring the -2 . Option (C) is the trap of always rounding down. Option (D) would be the result of **ROUND**(... , -3), rounding to the nearest thousand. Since Rs. 41,500 is listed, (E) is not correct.

Subtopic 5.4.3

316. From PowerPoint 2007 onward the default XML-based format for an ordinary presentation is .pptx, so option B is correct. Option A, .docx, is the default format of MS Word documents and option C, .xlsx, is that of MS Excel workbooks – neither is produced by PowerPoint. Option D, .potx, is a PowerPoint design template: it is created only when the user deliberately chooses “PowerPoint Template” in the Save-as-type list, and the question states she changed nothing. Option E, .ppsx, is a PowerPoint Show, again produced only by an explicit choice in the Save-as-type list. Since she used the default setting, the file is a .pptx presentation.

317. In MS PowerPoint *F5* starts the slide show from the beginning of the presentation, so option C is correct. *F1* opens the Help pane. *F2* is used to move into or out of editing the text of a selected placeholder. *F7* launches the spelling check. *F12* opens the “Save As” dialog box. None of these four begins a slide show, so only *F5* satisfies the requirement of a single keystroke starting the show from slide 1.

318. Slide Sorter view displays all the slides as miniature thumbnails in a grid, and slides can be rearranged simply by dragging them, so option C is correct. Normal view shows one large slide for editing with only a narrow thumbnail strip, and is meant for creating content rather than bulk reordering. Reading view plays the presentation inside a window for review and does not permit reordering at all. Notes Page view shows one slide with its speaker-notes area below it, again one slide at a time. Outline view shows only the text of the titles and bullets, not the slides as thumbnails, so it cannot fulfil the requirement of seeing many slides as pictures.

319. *Ctrl + M* inserts a new slide after the current slide in MS PowerPoint, so option B is correct. *Ctrl + N* does not add a slide – it creates an entirely new blank presentation file. *Ctrl + D* duplicates the selected slide or object, which produces a copy of the existing slide rather than a fresh new slide. *Ctrl + K* opens the Insert Hyperlink dialog box. Because a genuinely correct shortcut is listed at option B, “None of these” is wrong.

320. The Slide Master stores the elements common to the whole presentation; anything placed on it – a logo, a footer, a background – is inherited by every slide based on it, including slides created afterwards. Hence option A is correct. Slide Transition only controls the visual effect used when moving from one slide to the next; it places no object on the slide. Custom Animation controls how objects already on a slide appear, but it cannot create an object on all slides. Slide Sorter is merely a view for rearranging slides. Rehearse Timings records how long the speaker spends on each slide. None of these four can place a repeating logo on every slide.

321. A transition is by definition the effect seen while one slide is replaced by the next – fade, wipe, push, morph and so on – so option B is correct. Animation is the closely related but different feature that governs how individual objects within a single slide enter, move, are emphasised or exit; it operates inside a slide, not between slides. Formatting refers to changing fonts, colours and alignment of content and has no motion component. A hyperlink jumps to another slide, file or web page when clicked, but the jump itself is not the visual effect being described. An action button is a ready-made shape that carries such a hyperlink. Only “Transition” names the slide-to-slide effect.

322. Text typed in the Notes pane belongs to the notes page, not to the slide itself. When the show is run, the projected slide carries only the slide content; the notes remain hidden from the audience and are displayed privately to the speaker on his own monitor in Presenter View, and can also be printed as notes pages. Hence option C is correct. Option A is wrong because notes never appear on the projected slide. Option B is wrong because PowerPoint has no such automatic ticker for notes. Option D is wrong because notes are never merged into the slide's bullet placeholders. Option E is wrong because notes are saved permanently with the file and are not deleted when the show begins.

323. Step 1: recall that *F5* always restarts the show from the very first slide, so option A would take her to slide 1 and is wrong. Step 2: the command "From Current Slide" on the Slide Show tab carries the shortcut *Shift + F5*, which starts the full-screen show at whichever slide is currently selected – here slide 18. Hence option B is correct. *Ctrl + F5* is not a slide-show command in PowerPoint (in Windows it relates to window sizing). *Alt + F5* opens Presenter View in recent versions rather than the normal audience full-screen show, so it does not meet the stated requirement. *Esc* ends a running slide show instead of starting one.

324. Step 1: for a presentation to advance by itself, each slide must carry a stored timing; without timings a self-running show would stall on the first slide. Step 2: the Rehearse Timings command on the Slide Show tab runs the presentation with a timer, records how long the speaker spends on each slide and saves those durations as automatic advance timings – exactly what is described. Hence option B is correct. Hide Slide merely prevents a slide from being shown and records no timing. Slide Master controls common layout and design elements, not timing. Compress Pictures reduces the file size of images. Format Painter copies formatting from one object to another. None of these four can record per-slide durations.

325. Step 1: the requirement is that opening the file launches the show directly. Step 2: the "PowerPoint Show" format, extension .ppsx, is designed precisely for this – double-clicking it starts the slide show at once. Hence option C is correct. A .pptx file is the ordinary presentation and opens in Normal editing view, so option A fails the requirement. A .potx file is a template and opens a new presentation based on that design, not a show. A .pptm file is a macro-enabled presentation; it still opens in editing view, and the macro warning makes it unsuitable for circulation. A .pdf file is a fixed document, not a PowerPoint show, and its animations and transitions are lost.

326. Step 1: two things are required – a chosen subset of slides, and a different sequence for them – while the original deck stays intact. Step 2: the Custom Slide Show command (Slide Show tab, Custom Slide Show, Define Custom Show) lets the user name a show, pick exactly the slides wanted and arrange them in any order; the parent presentation is not altered, so both meetings are served from one file. Hence option B is correct. Hide Slide can suppress the other 41 slides but cannot change the order of the four shown, so it fails the sequencing requirement. Deleting slides and relying on Undo is unsafe – Undo history is lost once the file is closed – and still does not give a reusable second sequence. Section Header is only a slide layout for dividing a deck into parts. Saving and reordering a copy does work in a rough sense but creates a second file to maintain and is not the feature PowerPoint provides for this purpose, whereas Custom Slide Show meets every stated condition within the same file.

327. Step 1: during a running slide show PowerPoint accepts a slide number typed on the keyboard followed by *Enter*, and jumps straight to that slide. Typing 7 and pressing *Enter* therefore lands on slide 7 in one action, so option C is correct. Option A does not achieve the goal at all: *Esc* breaks out of the full-screen show, and although slide 7 is then selected in Normal view, *F5* restarts the show from slide 1 rather than from the selected slide – *Shift + F5* would be needed instead, so as written the presenter ends up on slide 1. Option B does move backwards one slide (or one animation step) at a time, but sixteen presses is far from the quickest method and any animations on intervening slides make the count unreliable. Option D is wrong because *Ctrl + G* is not a go-to-slide command in a PowerPoint show. Option E is wrong because *Ctrl + 7* has no navigation function during a slide show.

328. Step 1: PowerPoint provides two screen-blanking keys during a running show – *B* turns the screen black and *W* turns it white; pressing the same key again restores the slide. Step 2: the requirement

is a completely black screen, so *B* is correct and option *A* is the answer. Option *B*, *W*, gives a white screen, which is not what was asked. *Esc* ends the slide show altogether, contrary to the condition that the show must continue. *Ctrl + P* changes the pointer into a pen for annotating the slide and does not blank the screen. *End* jumps to the last slide of the presentation.

329. Step 1: what has to be copied is an animation effect together with its timing settings, not the visual formatting of a shape. Step 2: the Animation Painter, found on the Animations tab, copies all animation effects and their settings from one object to another; double-clicking it keeps it active so that all seven charts can be clicked one after another. Hence option *B* is correct. Format Painter copies only formatting such as fill, outline, font and effects – it does not carry animation. Slide Master governs layout and design elements common to slides and cannot store an animation for individual charts. Copy and Paste Special would paste the object itself in some format rather than transfer an animation to existing charts. Since a correct tool is listed, “None of these” is wrong.

330. Step 1: in Slide Master view the left pane is a hierarchy – the single large thumbnail at the top is the slide master, and the smaller thumbnails indented below it are the individual layouts that inherit from it. Step 2: a change made on the master flows down to every layout beneath it, and therefore to every slide built on those layouts. Step 3: inheritance is overridden by any more specific setting, so a layout or an individual slide on which the font was already changed manually keeps its own font. This is exactly option *C*. Option *A* is wrong because the change is not confined to the Title Slide layout – that would be the result of editing only that one layout thumbnail. Option *B* is wrong because the master is not linked to whichever slide happened to be selected. Option *D* is wrong because the whole purpose of the master is central formatting. Option *E* is wrong because existing slides are updated as well, not only future ones.

331. Step 1: the Reuse Slides pane inserts slides from another file and offers a “Keep source formatting” check box. Step 2: when that box is left unticked – the default – the incoming slides are re-formatted to match the theme, fonts and colours of the presentation they are being placed into. Since the destination carries the blue corporate theme, the five slides become blue, so option *B* is correct. Option *A* describes what would happen only if the box had been ticked. Option *C* is wrong because the slides always adopt some theme, never a themeless blank state. Option *D* is wrong because inserting slides never overwrites the destination theme; the flow of formatting is from destination to the incoming slides, not the reverse. Option *E* is wrong because reused slides remain fully editable text and objects, unlike a pasted picture.

332. Step 1: a font that is not installed on the receiving computer is silently replaced by a substitute, which changes the appearance of every slide. Step 2: PowerPoint solves this by embedding the font data inside the presentation file; the option is at File, Options, Save, “Embed fonts in the file”, and choosing to embed all characters also allows the recipients to edit and type in that font. Hence option *B* is correct. Option *A* preserves appearance but a PDF cannot be edited as a presentation, violating the editing requirement. Option *C* is wrong because substitution depends on whether the font exists on the machine, not on its size. Option *D* preserves appearance but converts text into images, which again destroys editability. Option *E* is wrong because a Slide Master only records which font is to be used; it does not carry the font file itself, so substitution would still occur at the other end.

333. Step 1: with the ordinary “On Click” start, a click anywhere on the slide advances the animation, which is not what is wanted. Step 2: a Trigger (Animations tab, Advanced Animation group, Trigger, On Click of) ties the animation of one object to a click on a specified other object; the animation then fires only when that particular object is clicked. Setting the trigger to the cheque picture makes the text box appear exactly as required, so option *C* is correct. “With Previous” would run the text box animation simultaneously with the preceding effect, needing no click at all. “After Previous” would run it automatically as soon as the previous effect ends, again with no click on the picture. A slide transition applies to the change of slides and cannot control an object on the slide. As a correct feature is listed, “None of these” is wrong.

334. Step 1: the “Browsed at a kiosk (full screen)” show type runs the presentation full screen, loops it automatically and ignores mouse clicks for advancing, which is exactly the unattended behaviour

required. Step 2: because clicking is disabled, the slides can move only on stored timings, so per-slide timings must already exist (set manually or through Rehearse Timings); without them the show would freeze on the first slide. Hence option C, which states both the type and the precondition, is correct. Option A is wrong because the speaker mode is driven by clicks and does not loop by itself. Option B is wrong because it runs in a window with scroll bars and still lets the viewer navigate. Option D is wrong because PowerPoint offers no “disable Esc” setting in that dialog and speaker mode remains click-driven. Option E is wrong because looping alone does not stop the audience clicking through the slides, and in kiosk mode looping is applied automatically in any case.

335. Step 1: distinguish embedding from linking. An embedded object stores its own private copy of the data inside the presentation; later changes in the original workbook do not reach it. A linked object stores only a reference to the source file, so it is refreshed from that file. Step 2: the requirement is automatic updating, which needs a link, and a link is created by Paste Special with “Paste link” (or the Keep Source Formatting and Link Data paste option). Hence option B is correct. Option A embeds a static copy and will not update. Option C produces a picture, which is frozen forever. Option D creates an independent chart with its own retyped data, which not only fails to update but also introduces the risk of typing errors. Option E inserts a fixed PDF, which is likewise static.

336. Step 1: Object P starts on the click, so it runs from $t = 0$ to $t = 0 + 1.5 = 1.5$ s. Step 2: Object Q is “With Previous”, so its clock starts when P starts, that is at $t = 0$; its delay of 2 s makes it begin at $t = 2$ and its duration of 1 s makes it end at $t = 2 + 1 = 3$ s. Step 3: Object R is “After Previous”, so it waits until the previous animation, Q , has finished at $t = 3$; adding the delay of 0.5 s it begins at $t = 3.5$ and with duration 2 s it ends at $t = 3.5 + 2 = 5.5$ s. Step 4: Object S is “With Previous”, so it starts along with R , that is its clock starts at $t = 3.5$; the delay of 1 s makes it begin at $t = 4.5$ and the duration of 1.5 s makes it end at $t = 4.5 + 1.5 = 6.0$ s. Step 5: the last effect to finish is S at $t = 6.0$ s, so the whole sequence takes 6.0 seconds. Hence option B is correct; 5.5 s is only the finishing time of R , and the other values do not correspond to any effect’s end.

Subtopic 5.4.4

337. A primary key must be (i) unique for every record and (ii) never blank. Since the table stores one record per account, Account_Number is generated by the bank so that no two accounts ever share it, hence it satisfies both conditions. Customer_Name fails because two customers may both be named “Anil Kumar”, and also because one customer holding several accounts would occupy several records. Branch_City fails because hundreds of accounts belong to the same city. Date_of_Opening fails because many accounts are opened on the same day. Account_Type fails badly, as it takes only a few repeated values (Savings, Current, RD). Therefore only Account_Number can uniquely identify a record, so the answer is Account_Number.

338. MS Access stores data in tables made of rows and columns and, more importantly, lets those tables be *linked* to one another through primary and foreign keys; software with that ability is called a relational database management system. The spreadsheet package in MS Office is Excel, the word processor is Word, and the presentation package is PowerPoint, so options A, B and D name other Office members, not Access. Access is an application program and cannot manage hardware or run a computer, so it is not an operating system either. Hence option C is correct.

339. From MS Access 2007 onwards the default database format is the Access Database file, whose extension is .accdb (the older format up to Access 2003 was .mdb). Since the question specifies Access 2016, the default is .accdb. The extension .xlsx belongs to an Excel workbook, .docx to a Word document and .pptx to a PowerPoint presentation, those three are files of other Office programs. .dbf is the old dBASE/FoxPro table format, which Access can import but does not use as its own default. Hence option A is correct.

340. In a table, the vertical columns are the *fields* (also called attributes), and each horizontal row, which holds all field values belonging to one entity, is a *record* (also called a tuple). Since the row here holds every detail of one customer, it is a record. The first three options – field, attribute and column

– are synonyms for the vertical column, which is exactly the opposite of what is asked. A data type such as Text or Currency merely describes what kind of value a field may hold, and is not a part of the table structure that stores a customer’s details. Hence option D is correct.

341. A Form is the Access object designed as a data-entry and viewing screen; by default it presents a single record at a time with labelled boxes, which is exactly what is described. A Table does store the data, but it is displayed in Datasheet View as a wide grid of many records, which the question specifically wants to avoid. A Query extracts or filters records; it does not provide a friendly entry screen. A Report is meant for formatted printed output and, in Access, reports are read-only – data cannot be entered through them. A Module contains VBA program code, not a screen layout. Hence option C is correct.

342. The only Access object that physically stores data is the **Table**, and the Table is not listed among options A to D. A Query merely stores the *instructions* for selecting records; its result set is built afresh from the tables every time the query is run. A Form is only an interface through which data is passed to a table. A Report is a formatted printout generated from tables or queries. A Macro stores a list of automated actions. Since the correct object (Table) does not appear in the given options, the answer is “None of these”.

343. The Currency data type is meant exactly for monetary values: it keeps a fixed number of decimal places, prevents rounding errors during calculation, and formats the value with the currency symbol automatically. Short Text would store the amount as characters, so arithmetic such as totalling balances would be impossible and sorting would be alphabetical rather than numerical. Yes/No stores only a two-state value like True/False, which cannot hold Rs. 45,750.50. OLE Object stores embedded files such as pictures or documents. Hyperlink stores a web or file address. Hence option E is correct.

344. An Incrementing AutoNumber field simply remembers the highest value already issued and adds 1 to it; it never reuses a number that has been released by a deletion, because reuse would risk duplicating a key that may still be referenced elsewhere. The highest value issued so far is 40, so the next record gets $40 + 1 = 41$. The choices 15 and 22 wrongly assume Access recycles the gaps left by the deleted records. The choice 39 wrongly assumes the counter drops to the current number of records ($40 - 2 = 38$, giving 39 as the next value); Access does not renumber existing records when rows are deleted. Since 41 is present in the list, “None of these” is not the answer. Hence option D is correct.

345. Identify the two directions separately. From CUSTOMER to ACCOUNT: one customer $\rightarrow$ many accounts. From ACCOUNT to CUSTOMER: one account $\rightarrow$ exactly one customer. A relationship in which one record on the primary side matches many records on the related side is by definition One-to-Many. It is not One-to-One, since that would restrict every customer to a single account, contradicting the given condition. It is not Many-to-Many, since that would require one account to be shared by several customers, which the question expressly rules out. Option D is wrong because Access supports such a link through a foreign key. As option B is genuinely correct, “None of these” is ruled out.

346. A field in one table whose values must match the primary key of another table is called a foreign key; it is the device that creates the link between the two tables. Cust_ID cannot be the primary key of ACCOUNT, because the same customer may own several accounts, so its values repeat within ACCOUNT and are not unique there. A candidate key is a field that *could* serve as the primary key, which again requires uniqueness that Cust_ID lacks in ACCOUNT. A composite key is formed from two or more fields taken together, whereas here a single field is being described. A super key is any set of fields that uniquely identifies a record, which Cust_ID alone does not do in ACCOUNT. Hence option A is correct.

347. Two criteria written on the same row of the query grid are combined with AND, so a record qualifies only if it satisfies *both* conditions. First keep only Coimbatore records: Anil (Rs. 78,500), Chetan (Rs. 45,000), Divya (Rs. 50,000) and Farida (Rs. 1,20,000); Bhavna and Eshan are dropped at once as they belong to Madurai. Now apply Balance > 50000 to these four: Anil $78500 > 50000$ qualifies; Chetan 45000 fails; Divya has exactly 50000, and since the operator is “greater than” and

not “greater than or equal to”, she also fails; Farida 120000 qualifies. So 2 records are returned, and option B is correct. Counting Divya as well would wrongly give 3.

348. The situation described is a Many-to-Many relationship, and Access cannot implement such a relationship directly. The standard solution is to break it into two One-to-Many relationships using an intermediate table, called a junction or linking table, that stores one row per customer–scheme pair. A One-to-One link is wrong because it would allow each customer only a single scheme. Merging the two tables is wrong because every scheme’s details would then be repeated for every subscriber, causing massive redundancy and update anomalies. Packing all scheme codes into one text field violates the very first rule of table design – a field must hold only one value – and would make querying, sorting and counting by scheme impossible. Since option D is genuinely correct, “None of these” does not apply.

349. In an Access query, sorting is applied from the leftmost sorted field towards the right, so Branch is the primary sort and Balance only breaks ties within a branch. Step 1: Branch ascending puts “Coimbatore” before “Madurai” alphabetically, so the whole Coimbatore group comes first and Bhavna and Eshan (Madurai) are pushed to the bottom. Step 2: within the Coimbatore group, Balance descending orders them as Farida Rs. 1,20,000, Anil Rs. 78,500, Divya Rs. 50,000, Chetan Rs. 45,000. The topmost record is therefore Farida Khan. Anil is second, not first; Chetan is last in his group; Bhavna has the second-largest balance overall but her branch sorts later, so she cannot come first. Hence option C is correct.

350. The Input Mask property defines a fixed pattern of characters that data must follow and displays placeholders as the user types, which is precisely what is required for the rigid 11-character IFSC layout (four letters, then the compulsory 0, then six alphanumeric characters). Default Value only supplies a value automatically when a new record is created; it does not control the shape of what is typed afterwards. Caption merely changes the heading displayed for the field, with no effect on the data. Indexed speeds up searching and sorting on the field and can forbid duplicates, but it places no restriction on the format. Description is only an explanatory note that appears on the status bar. Hence option E is correct.

351. The rule is that the **Count** aggregate applied to a *named field* counts only the values that are **not Null**; a Null means “no value was ever entered” and is therefore skipped. A zero-length string is a different thing altogether – it is an actual value, namely a string of length 0, which was deliberately stored – so **Count** does include it. Now tally the 8 records: the 4 ordinary names are counted; the 1 zero-length string is also counted, being non-Null; the 3 Nulls are skipped. The result is $4 + 1 = 5$. The value 4 comes from wrongly treating the zero-length string as if it were Null. The value 8 would arise only from **Count(*)**, which counts rows rather than field values and therefore ignores Nulls’ existence entirely. The value 7 wrongly discards just one of the three Nulls, and 3 counts the very records that are excluded. Hence option C is correct.

352. In a Totals query, “Group By” collapses all rows sharing the same Branch value into a single output row, so the number of rows equals the number of *distinct* branches. The distinct branches are Salem, Erode and Trichy, giving 3 rows – which at once rules out the two choices that keep all 6 original rows. Now compute each sum: Salem = $120000 + 60000 + 20000 = 200000$; Erode = $80000 + 100000 = 180000$; Trichy = 45000. The largest of these is Salem’s Rs. 2,00,000. The choice Rs. 1,80,000 quotes Erode’s total, which is the second largest, not the largest. The figure Rs. 4,25,000 is the grand total of all six loans, which would appear only if there were no grouping field at all. Hence option D is correct.

353. Step 1 – decide which records the criterion **Balance < 10000** selects. Rs. 9,500 is below 10000, so it is updated. Rs. 10,000 is *equal to* 10000, and the operator is strictly “less than”, so it is not updated. Rs. 12,000 is above the limit and is not updated. Step 2 – update the selected record: $9500 \times 1.08 = 9500 + 760 = 10260$. Step 3 – add up the final balances: $10260 + 10000 + 12000 = 32260$. Option B (Rs. 33,060) results from wrongly updating the Rs. 10,000 record as well. Option C (Rs. 34,020) results from updating all three records. Option D (Rs. 31,500) is the original total, i.e. assuming the query changed nothing. Hence option A is correct.

354. Query 1: an inner join produces one row for every ACCOUNT record that finds a matching CUSTOMER. Check each of the 8 account rows – their Cust_ID values 101, 101, 102, 103, 103, 103, 105, 106 all exist in CUSTOMER, so every one of them matches, giving 8 rows. Query 2: a left outer join keeps those same 8 matched rows and, in addition, shows every CUSTOMER record that has no account at all, with blank account fields. The customer IDs appearing in ACCOUNT are 101, 102, 103, 105, 106; the only ID missing is 104. So exactly 1 extra row is added, giving $8 + 1 = 9$ rows. Option B wrongly counts customers rather than joined rows; option C adds the two table sizes ($6 + 8$); option D interchanges the two answers. Hence option A is correct.

355. A primary key must identify each record uniquely. Branch_Code alone fails, since one branch code appears on several rows, one for each product it offers – so it cannot pick out a single record; option A and hence option D are ruled out. Product_Code alone fails for the same reason, as one product code appears once for every branch offering it – ruling out option B. However, the question states that a given branch–product pair never occurs twice, which means the *combination* of the two fields is unique across the table. A key made of two or more fields used together is called a composite (or concatenated) primary key, so the pair (Branch_Code, Product_Code) is the correct choice. Since option C is genuinely correct, “None of these” does not apply.

356. Entries on one row are joined by AND, and separate rows are joined by OR. So the condition is: (Branch = Salem AND Balance > 50000) OR (Branch = Erode), the second row placing no restriction at all on Balance because that cell is left blank. Test each record. (Salem, 80000): Salem and $80000 > 50000$ – qualifies. (Salem, 30000): Salem but 30000 is not > 50000 , and it is not Erode – rejected. (Erode, 15000): the second condition is satisfied by branch alone – qualifies. (Erode, 90000): qualifies. (Trichy, 95000): neither branch matches – rejected. (Salem, 55000): Salem and $55000 > 50000$ – qualifies. Total qualifying records = 4. A common error is to apply > 50000 to the Erode row too, which would drop (Erode, 15000) and give 3.

357. Consider the two settings one by one. Enforce Referential Integrity alone would forbid deleting a parent record while related child records exist, which is the “error message” choice – but that is the behaviour *without* the cascade option. Ticking Cascade Delete Related Records overrides that block: Access instead deletes the parent record and automatically removes every matching child record so that no orphan rows are left behind. Therefore customer 103 plus his 3 account rows are removed, a total of $1 + 3 = 4$ records. Leaving orphan accounts with a blank Cust_ID is wrong because that is exactly the situation referential integrity exists to prevent. Retaining the customer while deleting only his accounts is wrong because the deletion was initiated on the parent record itself, so the customer cannot survive. Hence option A is correct.

Subtopic 5.5.1

358. Networks are classified mainly by the geographical area they cover. Here every device lies inside one building and the cabling belongs to the branch itself, so the spread is only a few tens of metres. A network confined to a single room, building or small campus and owned by one organisation is a Local Area Network (LAN), so option A is correct. A MAN (Metropolitan Area Network) spans a whole city or large town, which is far bigger than one branch building, so B is wrong. A WAN (Wide Area Network) spans states or countries and normally uses a telecom carrier’s links, so C is wrong. SAN stands for Storage Area Network, a specialised network that connects servers to storage devices, not ordinary desktops and printers, so D is wrong. Since a valid classification exists, E is wrong.

359. In the standard classification of networks by size, the three common terms are LAN (Local Area Network), MAN (Metropolitan Area Network) and WAN (Wide Area Network). The letter W stands for Wide, A for Area and N for Network, giving Wide Area Network, so option B is correct. Option A wrongly reads W as Wireless; a WAN may be wired or wireless, and wireless access networks are described by other terms such as WLAN. Options C, D and E are invented expansions with no standing in networking terminology; in particular a WAN is not restricted to analog transmission, and a network is not called a node, since a node is a single device on the network.

360. The offices named are in different states and are separated by well over a thousand kilometres, and the connecting circuits are hired from a public telecom carrier rather than owned by the bank. A network that covers such large distances, typically across cities, states or countries, and that relies on carrier-provided transmission links, is a Wide Area Network, so option D is correct. A PAN (Personal Area Network) covers only a few metres around one person, such as a Bluetooth link, so A is wrong. A LAN is limited to one building or campus, so B is wrong. A MAN is limited to a single city or metropolitan region, and here the offices lie in five different cities, so C is wrong. A correct category exists, hence E is wrong.

361. The deciding factor is again the geographical spread. The network extends beyond a single building, because branches lie in different localities, but it does not go outside the city limits. A network that covers a city or metropolitan area, typically a few kilometres up to about 50 km, is a Metropolitan Area Network, so option B is correct. A LAN would be confined to one building or a small campus, which is smaller than the whole of Pune, so A is wrong. A WAN would extend across cities or states, which is larger than what is described, so C is wrong. A PAN covers only a few metres, so D is wrong. Since MAN fits exactly, E is wrong.

362. Data rate falls as the distance covered increases, because long links are costlier, are shared among many users and suffer greater attenuation and interference. A LAN covers the shortest distance and uses dedicated cabling owned by the organisation, so it commonly runs at 100 Mbps, 1 Gbps or more; hence option C is correct. A MAN covers a city and typically delivers less throughput per user than a LAN, so A is wrong. A WAN covers the largest area and, being built on shared carrier links, normally offers the lowest data rate of the three, so B is wrong. The rates are clearly not equal, so D is wrong, and since a correct choice is present, E is wrong.

363. The Internet spans every continent, crossing national boundaries through undersea cables and satellite links, and it is built by interconnecting a very large number of smaller networks. A network with worldwide geographical reach falls squarely in the Wide Area Network category, and the Internet is the standard textbook example of the largest WAN, so option C is correct. It cannot be a LAN, because a LAN is limited to a building or campus, so A is wrong. It cannot be a MAN, because a MAN stops at the boundary of a city, so B is wrong. A PAN covers only a few metres around one user, so D is wrong. A correct description is available, hence E is wrong.

364. The classification by area places the smallest category first. A Personal Area Network (PAN) is a network formed around a single person, usually within a range of about 10 metres, and Bluetooth is the most common PAN technology. Two devices 2 metres apart linked over Bluetooth therefore form a PAN, so option A is correct. A MAN spans a city and a WAN spans states or countries, both enormously larger than 2 metres, so B and C are wrong. A CAN (Campus Area Network) joins several buildings of one campus, again much larger than a two-device Bluetooth link, so D is wrong. Since PAN fits, E is wrong.

365. Take the statements one at a time. A LAN is by definition limited to a room, building or small campus, so A is a correct statement. A WAN spans large distances that no single company could cable on its own, so organisations hire leased lines or MPLS circuits from carriers such as BSNL or Airtel; B is correct. A MAN is defined as covering a metropolitan area, that is a city or a large town, so C is correct. LANs, being inside the owner's premises, are privately installed, owned and managed, so E is correct. Statement D reverses the true relationship: because a LAN uses short, dedicated, high quality cabling it typically runs at 1 Gbps or more, whereas a WAN link shared over long distances usually delivers far less. Hence D is the incorrect statement and is the required answer.

366. Recall the typical coverage of each category. A PAN reaches about 10 metres around one person. A LAN reaches from a few metres up to roughly 1 km within a building or small campus. A MAN reaches across a city, of the order of 5 km to 50 km. A WAN reaches hundreds or thousands of kilometres across states and countries. Writing these in increasing order gives PAN, then LAN, then MAN, then WAN, that is (ii), (iv), (i), (iii), which is option A. Option B wrongly places LAN before PAN. Option C wrongly places MAN before LAN. Option D is the descending order, not the ascending order asked for. Since a correct sequence is listed, E is wrong.

367. Two features must be checked, the area covered and who owns the network. The fibre ring stays within Hyderabad, so its span is one city, which is exactly the metropolitan scale. In addition, a MAN is characteristically owned by a service provider or a civic body and shared by many subscriber organisations, which matches the description precisely, so option B is correct. Option A fails because a LAN is confined to a single building or campus and is privately owned by one user, whereas this ring crosses the whole city and serves many users. Option C fails because carrier ownership alone does not make a network a WAN; the defining test for a WAN is coverage beyond a city, and this ring never leaves Hyderabad. Option D fails because a PAN spans only a few metres around one person. A correct classification exists, so E is wrong.

368. A MAN must cover a whole city or metropolitan region, more than a single building but less than a state or country. A cable television distribution network runs coaxial and fibre lines across every locality of one city while remaining inside that city, and it is the classic textbook example of a MAN, so option B is correct. Option A describes a network inside one flat, which is a LAN. Option C describes a worldwide network, which is a WAN, not a MAN. Option D describes a link of a few metres around one person, which is a PAN. Option E describes the simplest possible LAN, only two machines in one room. Hence only option B has metropolitan scale.

369. Joining a LAN to a WAN means passing traffic between two different networks that use different addressing and often different transmission technologies, so the device must be able to read network layer addresses and choose a path. A router works at the network layer, examines the destination IP address of each packet and forwards it along the best route towards the remote network, which is exactly what is needed here, so option C is correct. A hub merely repeats incoming electrical signals to all its ports within one LAN segment and has no addressing intelligence, so A is wrong. A repeater only regenerates a weakened signal to extend cable length, again within one network, so B is wrong. A switch forwards frames using MAC addresses inside a single LAN and does not perform routing between separate networks, so D is wrong. A correct device is listed, hence E is wrong.

370. Network categories form a hierarchy by size, and joining smaller networks can only produce a network at least as large, never a smaller one. Statement I says that LANs in different cities, when joined by long distance links, produce a WAN. This is true and is in fact how every bank's core banking network is built, each branch LAN being linked into one nationwide WAN. Statement II claims the reverse, that joining WANs across countries produces a LAN. This is false, because the result of joining networks that already span countries is an even larger WAN, and a LAN by definition cannot extend beyond a building or campus. Therefore only statement I is true, which is option A. Options B, C and D contradict this finding, and since A is available, E is wrong.

371. Check each pairing against the definition. Options A and B are correct, since twisted pair Ethernet cabling and Wi-Fi are the two ordinary ways of building a LAN inside an office or branch. Options C and D are correct, since a WAN spans large distances and therefore relies on satellite hops, undersea and terrestrial fibre and leased circuits taken from carriers. Option E is the faulty pairing on two counts: a LAN is privately owned and does not depend on hired carrier circuits, and more importantly a link between cities takes the network beyond the local scale altogether, so such a link belongs to a WAN and not to a LAN. Hence the incorrect pairing is option E.

372. Match each item from its definition. A PAN surrounds one person and Bluetooth style links reach only about 10 metres, so (a) goes with (ii). A LAN is confined to a building or small campus, a span of a few metres up to about a kilometre, so (b) goes with (iv). A MAN covers a metropolitan area, of the order of 5 km to 50 km within one city, so (c) goes with (iii). A WAN reaches across states and countries, hundreds to thousands of kilometres, so (d) goes with (i). The combination (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i) is option A. Option B interchanges the LAN and MAN ranges. Option C scrambles all four. Option D interchanges PAN and WAN, absurdly giving a personal network a range of thousands of kilometres. Since a fully correct match is listed, E is wrong.

373. Classify each arrangement by its geographical spread. In (i) all terminals lie inside one branch building and the switches belong to the bank, which is the definition of a LAN. In (ii) the network

extends across several localities of Coimbatore but stops at the city boundary, which is precisely metropolitan scale, so it is a MAN. In (iii) the network reaches Mumbai and five other states, distances of well over a thousand kilometres, so it is a WAN. The required order is therefore LAN, MAN, WAN, which is option B. Option A wrongly calls the intra city fibre a WAN and the inter state network a MAN, exactly reversing them. Option C wrongly promotes the single building network to a MAN. Option D wrongly calls the city wide network a LAN and the inter state network a MAN. Hence E is not needed.

374. Classification by category depends on the geographical spread of the network, not on the ownership of the circuits or on the logical view presented to the user. Vijayawada and Chennai are in two different states, several hundred kilometres apart, so whether that distance is bridged by a hired leased line or by a tunnel across the public Internet, the network remains a Wide Area Network; option C is correct. Option A is the main trap: a VPN does make the two sites look like one private network to applications, but this is only a logical view created by encryption and tunnelling, and a LAN is defined by physical confinement to a building or small campus, which is plainly violated here. Option B is wrong because a VPN tunnel has no distance limit at all, and in any case the two cities are far outside one metropolitan area. Option D is wrong because a PAN covers only about 10 metres around a single person, and per-user logins have nothing to do with the size classification. Since C fits, E is wrong.

375. The IEEE 802 series allots a separate working group number to each network scale. IEEE 802.16 is the working group for broadband wireless access over metropolitan distances, and its output is marketed commercially as WiMAX, so option D is correct. IEEE 802.3 is the Ethernet standard used for wired LANs, so A is wrong. IEEE 802.11 is the wireless LAN standard marketed as Wi-Fi, which covers only a building or campus, so B is wrong. IEEE 802.15 is the personal area network group and includes Bluetooth, a range of about 10 metres, so C is wrong. Since the correct standard is listed, E is wrong.

376. Examine the statements one by one. Statement I is true, since a LAN lies wholly within the owner's premises, so the organisation itself buys the cabling and switches and administers the network. Statement II is true, because no ordinary organisation can lay cable across states, so a WAN is built on leased lines, MPLS circuits or satellite capacity bought from carriers. Statement III is false: error rate rises with distance, number of intermediate hops and exposure to noise, so a WAN link, which may traverse thousands of kilometres and many routers, has a distinctly higher bit error rate than a short LAN cable in a clean office environment. Only statements I and II are true, which is option B. Options A, C and D each mis-state this, and since B is available, E is wrong.

377. The point being tested is that networks are classified by geographical spread, not by the number of computers attached. Network P, although large in device count, lies entirely within one building on cabling owned by the bank, which satisfies the definition of a LAN. Network Q, although it has only 12 computers, spans three cities in three different states over leased carrier circuits, which satisfies the definition of a WAN. Hence option B is correct. Option A applies the wrong criterion, namely device count, and reverses the classification. Option C is wrong because common ownership does not shrink a three city network into a LAN. Option D is wrong for the same reason of criterion, and because P plainly never leaves one building. Since B is correct, E is wrong.

378. Two independent classifications apply here and both must be settled. By geographical spread the network links offices all over India over leased lines, so it is a WAN. By access policy the network is private, restricted to the organisation's own employees and used for internal content, which is the definition of an intranet; an extranet would additionally admit outside parties such as vendors or partners, and the Internet is public and open to all. Combining the two, the network is a WAN functioning as the bank's intranet, option C. Option A is wrong on both counts, since the network is not confined to a building and is not public. Option B fails because the network is not limited to one city and outsiders are excluded. Option D fails because a PAN spans only a few metres. As C is accurate, E is wrong.

Subtopic 5.5.2

379. In a star topology every node has a dedicated point-to-point link to one central device (hub or switch); all traffic passes through that centre, so the centre is a single point of failure while an individual node cable failure affects only that node. Both facts given in the question match exactly. Bus topology is ruled out because there is no shared backbone cable and no central device at all. Ring is ruled out because in a ring each node is cabled to exactly two neighbours, not to one common device. Full mesh is ruled out because that would need a cable between every pair of terminals, not one cable per terminal to a centre. Hence option (C).

380. Transmission media are classified as guided (bounded) and unguided (unbounded). Guided media confine the signal inside a physical conductor or glass strand: UTP, STP and coaxial cable carry electrical signals along copper, and optical fibre carries light inside a glass core. So options (A), (B), (C) and (E) are all guided media. An unguided medium propagates the signal through free space with no physical conductor, which is exactly what a terrestrial microwave radio link does. Hence option (D).

381. Category 6 UTP contains 4 twisted pairs, i.e. 8 conductors, and the standard 8-position modular plug for it is the RJ-45. Option (A), the BNC connector, is a bayonet coaxial connector used with thin coaxial Ethernet, not twisted pair. Option (B), RJ-11, is the smaller 6-position telephone connector that uses only one or two pairs and will not terminate 4 pairs. Option (D), the ST connector, is a bayonet connector used for optical fibre. Since RJ-45 is present and correct, option (E) is not needed. Hence option (C).

382. Twisted pair copper suffers attenuation and picks up crosstalk as the run lengthens, so the structured cabling standard caps a single UTP link segment between a station and the switch port at 100 metres (conventionally 90 metres of solid horizontal cable in the wall plus about 10 metres of stranded patch cords at the two ends). Beyond this the signal must be regenerated by a repeater or another switch. The other figures belong to older coaxial Ethernet and not to twisted pair: option (C), 185 metres, is the maximum segment of 10BASE2 thin coaxial cable, and option (D), 500 metres, is the maximum segment of 10BASE5 thick coaxial cable. Option (A), 10 metres, is only the patch cord allowance, not the whole run. Hence option (B).

383. Only optical fibre transmits information as light. Its glass or plastic core is surrounded by cladding of lower refractive index, so a ray striking the boundary beyond the critical angle undergoes total internal reflection and stays trapped in the core; this is the defining description given in the question. Coaxial cable in option (A) carries an electrical signal on a central copper conductor surrounded by a braided shield. Options (C) and (D), STP and UTP, carry electrical signals on twisted copper pairs. None of these three involves light or total internal reflection. Hence option (B).

384. A terminator is simply a resistor matched to the characteristic impedance of the cable. When a signal reaches an unterminated open end it bounces back and the reflected wave collides with fresh signals, corrupting the data; the matched resistor absorbs the energy so no reflection occurs. Option (A) describes a repeater or amplifier, which is an active device; a terminator is passive and cannot amplify. Option (C) describes a modem. Option (D) describes a DHCP server, a software function entirely unrelated to cabling. Hence option (B).

385. Walk around the closed loop: starting from ATM 1 the links are 1–2, 2–3, ..., 8–9 and finally 9–1 to close the ring. That is 8 links along the chain plus 1 closing link = 9 links. In general a closed ring of n nodes has exactly n links, while an open chain of n nodes has $n - 1$ links. Option (A), 8, is the open-chain answer and ignores the closing link. Option (D), 18, counts each link twice, once from each of the two nodes it touches. Hence option (B).

386. Step 1: total lines. Each line joins one pair of branches, so lines = $\frac{n(n-1)}{2} = \frac{12 \times 11}{2} = 66$. Step 2: ports per router. A given branch has a line running to each of the other branches, and there are $12 - 1 = 11$ other branches, so each router needs 11 ports. Option (A) wrongly uses n ports instead

of $n - 1$. Option (C) uses $n(n - 1) = 132$, which double counts every cable. Option (D), 78, is $\frac{13 \times 12}{2}$, the answer for 13 devices. Hence option (B).

387. Step 1: mesh cables $= \frac{n(n - 1)}{2} = \frac{10 \times 9}{2} = 45$. Step 2: star cables $= n = 10$, one dedicated link per computer to the central switch. Step 3: difference $= 45 - 10 = 35$. Option (D), 45, is the mesh count alone and forgets to subtract. Option (B), 30, and option (A), 25, do not follow from either count. Hence option (C).

388. STP means Shielded Twisted Pair. Compared with UTP it adds a conducting foil or braid around the pairs (and sometimes around each pair). This shield, when properly earthed, intercepts external electromagnetic fields such as those radiated by a lift motor and drains the induced current away, and it also cuts crosstalk between pairs, which is precisely the fault described. Option (B) is wrong because only optical fibre carries light; STP is still a copper medium. Option (C) is wrong because STP retains twisted pairs, the twisting itself being an anti-noise measure; a single thick conductor describes coaxial cable. Option (D) is wrong because STP is a physical cable and hence a guided medium. Hence option (A).

389. Check each statement. (A) is correct: the signal is light and not an electric current, so external magnetic and electric fields induce nothing in it. (B) is correct: fibre supports bandwidths in the gigabit and terabit range whereas twisted pair is limited to a few hundred megahertz. (D) is correct: loss in fibre is of the order of a fraction of a dB per kilometre, far below coaxial loss, which is why repeater spacing on fibre is tens of kilometres. (E) is correct and is the standard physical principle of fibre. (C) is false: the core of an optical fibre is ultra-pure glass or plastic and the signal is carried by photons, not electrons in copper. The question asks for the incorrect statement, so the answer is option (C).

390. Count links and per-node ports for $n = 20$. Bus: one backbone with a short drop per node, and each node needs only one connection. Star: $n = 20$ cables to the hub, each node needing one port. Ring: $n = 20$ links, each node needing exactly two ports. Full mesh: $\frac{20 \times 19}{2} = 190$ cables, and each workstation needs $20 - 1 = 19$ ports. Since 190 is far greater than 20, and 19 ports far exceeds 1 or 2, the full mesh is heaviest on both counts. This cabling cost is precisely why full mesh is used only for a few critical backbone nodes. Hence option (D).

391. The description has two levels. At the lower level, each hub with its own group of terminals radiating out on separate cables is a star. At the upper level, those hubs all hang off one common backbone, which is a bus. A layered structure of stars joined by a backbone is by definition a tree or hierarchical topology. Option (A) fails because no closed loop exists. Option (C) fails because terminals of different groups have no direct cable between them. Option (D) fails because a point-to-point topology joins exactly two devices, whereas many devices are involved here. Hence option (B).

392. In a unidirectional ring every station acts as a repeater on the single circulating path, so the loop is broken the moment one station stops repeating; frames can no longer complete the circuit and the entire network halts. That is exactly option (B). Option (A) is the behaviour of a star, where each node has an independent link to the centre. Option (C) is wrong because no topology reconfigures itself physically on its own; a bypass relay or a dual ring must be provided in advance. Option (D) is wrong because a ring has no central hub at all. Hence option (B).

393. Step 1: cables in the original mesh of 8 servers $= \frac{8 \times 7}{2} = 28$. Step 2: total servers after expansion $= 8 + 4 = 12$, so cables in the new mesh $= \frac{12 \times 11}{2} = 66$. Step 3: additional cables $= 66 - 28 = 38$. Option (D), 66, is the new total, not the increase. Option (A), 28, is the old total. Option (B), 32, is 4×8 , which counts only the links from each new server to the 8 old ones and forgets the $\frac{4 \times 3}{2} = 6$ links among the four new servers themselves; note $32 + 6 = 38$, confirming the answer. Hence option (C).

394. Step 1: for n offices in a full mesh, links = $\frac{n(n-1)}{2}$. Set $\frac{n(n-1)}{2} = 78$, so $n(n-1) = 156$. Step 2: find two consecutive integers with product 156. Since $12 \times 13 = 156$, we get $n = 13$. Step 3: verify, $\frac{13 \times 12}{2} = 78$, which matches. Checking the traps: $n = 12$ gives $\frac{12 \times 11}{2} = 66$ links and $n = 14$ gives $\frac{14 \times 13}{2} = 91$ links, so options (A) and (C) are wrong. Option (D), 39, is $\frac{78}{2}$, which has no meaning here. Hence option (B).

395. Step 1: the route must be cut into segments each not longer than 50 km. Minimum number of segments = $\left\lceil \frac{240}{50} \right\rceil = \lceil 4.8 \rceil = 5$ segments. Step 2: to divide a line into 5 segments you need $5 - 1 = 4$ interior cut points, and one repeater sits at each such point, for example at 48, 96, 144 and 192 km, each hop being 48 km which is within the 50 km limit. Step 3: therefore 4 repeaters. Option (B), 5, counts segments instead of interior points. Option (D), 48, is a hop length in km, not a count. Hence option (A).

396. Step 1: convert the file size from bytes to bits. $900 \text{ MB} = 900 \times 10^6 \text{ bytes} = 900 \times 10^6 \times 8 \text{ bits} = 7200 \times 10^6 \text{ bits} = 7200 \text{ Mb}$. Step 2: the link speed is 100 Mbps, that is 100 megabits per second, so time = $\frac{7200}{100} = 72$ seconds. Option (A), 9 seconds, comes from dividing 900 by 100 and forgetting the byte-to-bit factor of 8. Option (D), 720 seconds, is ten times too large. Note also the standard trap of confusing MB (megabytes, the file) with Mb (megabits, the link). Hence option (B).

397. Single-mode fibre has a core of roughly 8 to 10 micrometres, narrow enough that only one propagation mode, essentially a single axial ray, can exist; it is fed by a laser and, since there is no modal dispersion, it carries signals over tens of kilometres. Multimode fibre has a core of about 50 to 62.5 micrometres, allows many ray paths of different lengths, is usually driven by an LED, and modal dispersion smears pulses so its reach is limited to a few hundred metres. Option (A) states this correctly. Option (B) interchanges the two types. Option (C) is false because every fibre must have cladding of lower refractive index, otherwise total internal reflection cannot occur at all. Option (D) is false because both types carry light. Hence option (A).

398. Step 1: hub-to-terminal cables. Each hub has 5 separate cables, and there are 4 hubs, giving $4 \times 5 = 20$ cables. Step 2: backbone segments. Four hubs joined one after another in a line form an open chain, which needs $4 - 1 = 3$ segments (hub1–hub2, hub2–hub3, hub3–hub4). Step 3: total = $20 + 3 = 23$ segments. Option (A), 20, omits the backbone. Option (C), 24, wrongly treats the four hubs as a closed ring needing 4 segments, but the question says they are joined in a single line, not a loop. Option (D), 26, has no basis. Hence option (B).

399. Test each statement. (i) Correct: in a star every node has its own dedicated link to the hub, so one broken link isolates only that node, the hub and all other links being untouched. (ii) Incorrect: a device links to every other device, and there are $n - 1$ others, so it needs $n - 1$ ports, not n . (iii) Correct: coaxial cable has a much wider usable frequency range, which is why it carried cable television and early Ethernet, whereas ordinary UTP telephone cable is far more limited. (iv) Incorrect: radio waves travel through free space with no physical conductor, so they are unguided, not guided. Only (i) and (iii) survive, which is option (B).

Subtopic 5.5.3

400. The OSI (Open Systems Interconnection) reference model, standardised by ISO, is divided into exactly 7 layers: Physical, Data Link, Network, Transport, Session, Presentation and Application. Option (A) 4 is the number of layers in the TCP/IP model, not OSI. Option (B) 5 corresponds to the hybrid/five-layer teaching model sometimes used, not the ISO standard. Option (C) 6 matches no standard model. Since 7 is present as option (D), option (E) cannot be correct. Hence the answer is (D).

401. Routing means choosing a path across interconnected networks using logical (IP) addresses. This is the defining job of the Network layer (Layer 3), where routers operate. The Data Link layer (A)

moves frames only across a single link between directly connected nodes, so it cannot select a path across many networks. The Transport layer (C) provides end-to-end delivery, segmentation and flow control, but hands the routing decision downward. The Session layer (D) only manages dialogue and checkpoints. The Physical layer (E) merely transmits raw bits. Hence the answer is (B).

402. The classical TCP/IP reference model has 4 layers: Network Access (Link), Internet, Transport and Application. Option (A) 3 omits one of these. Option (C) 5 belongs to the hybrid model in which Network Access is split into Physical and Data Link. Option (D) 7 is the OSI model. Since the correct value 4 is listed, option (E) is ruled out. Hence the answer is (B).

403. The Physical layer (Layer 1) deals with the mechanical and electrical specification of the medium: voltage levels, data rate, connectors and the transmission of an unstructured bit stream. The Data Link layer (B) works with frames and adds error detection, not raw signalling. The Network layer (C) works with packets and logical addresses. The Session layer (D) manages dialogue between applications. The Presentation layer (E) handles translation, encryption and compression. Hence the answer is (A).

404. HTTP is a protocol through which user-level software (a browser and a web server) exchanges documents, so it sits at the topmost layer, the Application layer (Layer 7). The Transport layer (A) hosts TCP and UDP, which merely carry HTTP messages. The Network layer (B) hosts IP. The Session layer (D) would manage the dialogue, but HTTP itself is classified as an application protocol. The Data Link layer (E) hosts framing protocols such as Ethernet. Hence the answer is (C).

405. The Presentation layer (Layer 6) is often called the translation layer: it converts data into a common syntax and performs compression and encryption/decryption. The Session layer (A) only opens, manages and closes sessions and inserts synchronisation checkpoints. The Application layer (C) provides the user interface and services such as mail and file transfer. The Transport layer (D) does segmentation, flow control and error recovery. Since the correct layer is listed, option (E) is wrong. Hence the answer is (B).

406. TCP (Transmission Control Protocol) sets up a connection using a three-way handshake, numbers its bytes, acknowledges them and retransmits losses, so it is connection-oriented and reliable. UDP (A) is a Transport layer protocol but is connectionless and unreliable. IP (B) is a connectionless Internet layer protocol. ICMP (D) is an Internet layer protocol used for error and status messages such as ping. ARP (E) resolves IP addresses to MAC addresses at the link level. Hence the answer is (C).

407. Step 1: identify the key words – establishing a dialogue, dialogue control, synchronisation checkpoints and orderly termination. Step 2: these are exactly the services defined for the Session layer (Layer 5), which manages sessions between two communicating processes and inserts checkpoints so that recovery after a failure resumes from the last checkpoint. Step 3: eliminate the rest. The Transport layer (A) provides end-to-end delivery, segmentation and flow control, but it recovers lost segments, not interrupted dialogues. The Presentation layer (C) handles syntax translation, encryption and compression. The Application layer (D) supplies the user-facing service itself. The Network layer (E) performs routing and logical addressing. Hence the answer is (B).

408. Step 1: map the layers. OSI Physical + Data Link correspond to the TCP/IP Network Access layer; OSI Network corresponds to the Internet layer; OSI Transport corresponds to the Transport layer. Step 2: the three remaining OSI layers – Session, Presentation and Application – are all collapsed into the single TCP/IP Application layer. Step 3: since the TCP/IP Application layer keeps the name 'Application', the two layers that lose their separate identity are Session and Presentation. Option (A) is wrong because those two are represented by the Network Access layer. Options (C) and (D) name layers that do exist separately in TCP/IP. Hence the answer is (B).

409. Step 1: the OSI layers numbered 7 down to 1 are Application, Presentation, Session, Transport, Network, Data Link, Physical. Step 2: check each option. (A) interchanges Presentation and Session. (C) interchanges Network and Transport, which would wrongly place routing above end-to-end delivery. (D) lists the layers correctly but from bottom to top, whereas the question asks for top-to-bottom order. (B) matches the standard order exactly, so (E) is ruled out. Hence the answer is (B).

410. Step 1: a router forwards packets between different networks on the basis of logical IP addresses, which is a Network layer job, i.e. Layer 3. Step 2: an ordinary LAN switch forwards frames within one network using MAC addresses, which is a Data Link layer job, i.e. Layer 2. Step 3: option (A) reverses the two. Option (C) puts the switch at Layer 1, which is where a hub or repeater works. Option (D) puts the router at the Transport layer, which handles ports, not routing. Hence the answer is (B).

411. Step 1: ping works by sending Echo Request messages and waiting for Echo Reply messages. Step 2: these messages, along with error reports such as 'destination unreachable' and 'time exceeded', are defined by ICMP (Internet Control Message Protocol), which rides directly on IP at the Internet layer. Option (A) SMTP is an Application layer mail protocol. Option (C) FTP is an Application layer file transfer protocol. Option (D) UDP is a Transport layer protocol and does not itself report network errors. Since ICMP is listed, option (E) is wrong. Hence the answer is (B).

412. Step 1: the 48-bit MAC address is a physical address burnt into the NIC and is used to deliver frames within a single local network, which is the job of the Data Link layer. Step 2: the IP address is a logical, software-assigned address used to deliver packets across interconnected networks, which is the job of the Network layer. Step 3: therefore the required pair is (Data Link, Network). Option (A) reverses them. Option (C) wrongly assigns addressing to the Physical layer, which handles only bits. Option (D) wrongly assigns IP addressing to the Transport layer, which uses port numbers. Hence the answer is (B).

413. Step 1: identify the key words – segmentation, reassembly, end-to-end flow control and error recovery. Step 2: these are the classic duties of the Transport layer (Layer 4), which provides process-to-process delivery between the two end hosts. Option (A) the Network layer performs routing and logical addressing, and is hop-to-hop rather than end-to-end. Option (C) the Session layer only sets up, synchronises and tears down dialogues. Option (D) the Data Link layer performs error control only across one link, not end to end. Since the Transport layer is listed, option (E) is wrong. Hence the answer is (B).

414. Statement (I): OSI has 7 layers and the classical TCP/IP model has 4 – correct. Statement (II): the TCP/IP Network Access (Link) layer indeed absorbs both the OSI Physical layer and the OSI Data Link layer – correct. Statement (III): the TCP/IP Transport layer carries TCP, which is connection-oriented and reliable, and UDP, which is connectionless and unreliable – correct. Since all three statements are true, the options naming only two of them, namely (A), (B) and (C), are incomplete, and (E) is wrong because a valid option exists. Hence the answer is (D).

415. Step 1: the upper three layers (Application, Presentation, Session) simply handle 'data'. Step 2: the Transport layer adds its header and the unit becomes a 'segment'. Step 3: the Network layer adds the IP header and the unit becomes a 'packet' or datagram. Step 4: the Data Link layer adds a header and a trailer, giving a 'frame'. Step 5: the Physical layer transmits it as 'bits'. So the order is Data, Segment, Packet, Frame, Bits. Option (A) puts Packet before Segment, reversing layers 3 and 4. Options (C) and (D) both place Frame above Packet, which contradicts the fact that framing happens below routing. Hence the answer is (B).

416. Check each pair. (A) The Physical layer does transmit an unstructured bit stream over the medium – correct. (B) The Data Link layer adds a trailer carrying a CRC to detect errors over one link – correct. (C) The Network layer performs routing across interconnected networks – correct. (E) The Presentation layer performs syntax translation, encryption/decryption and compression – correct. (D) Choosing the best path between networks is precisely the Network layer's routing function; the Transport layer instead provides end-to-end, process-to-process delivery using port numbers, segmentation and flow control. Therefore the mismatched pair is (D). Hence the answer is (D).

417. Step 1: a port number distinguishes one process from another on the same host, which is how the Transport layer multiplexes and demultiplexes many conversations over one IP address. So port numbers belong to the Transport layer. Step 2: an IP address identifies a host on an internetwork and is used for routing, which is a Network layer function. Step 3: hence the pair is (Transport, Network). Option (A) reverses the two. Option (C) wrongly assigns IP addressing to the Data Link layer, which

uses MAC addresses. Option (D) wrongly assigns port numbers to the Application layer, which uses service names, not ports. Hence the answer is (B).

418. Examine each pair. (A) FTP is a file transfer protocol used directly by user programs, so it belongs to the Application layer, not the Internet layer. (B) UDP is a connectionless Transport layer protocol, not an Application layer protocol. (D) ICMP carries control and error messages for IP and is encapsulated directly inside IP datagrams, so it is an Internet layer protocol, not a Transport layer one. (C) IP is the core protocol of the Internet layer, responsible for logical addressing and routing of datagrams – correctly matched. Since one option is correct, (E) is ruled out. Hence the answer is (C).

419. Step 1: the Transport layer adds a TCP or UDP header only; the Network layer adds an IP header only; the Presentation layer transforms data without appending a trailer; the Physical layer adds nothing at all, as it merely converts the frame into signals. Step 2: the Data Link layer builds a frame by prefixing a header containing source and destination MAC addresses and appending a trailer containing the frame check sequence (CRC) used for error detection. Step 3: therefore the only layer using both a header and a trailer is the Data Link layer. Hence the answer is (B).

420. Step 1: find how much application data one datagram can carry. Each datagram of 1,500 bytes must contain an IP header of 20 bytes and a TCP header of 20 bytes, so the usable payload is $1500 - 20 - 20 = 1460$ bytes. Step 2: divide the total data by the payload per datagram: $\frac{4000}{1460} = 2.74$ approximately. Step 3: since a fraction of a datagram cannot be sent, round up to the next whole number, giving 3 datagrams. Step 4: verify – $1460 + 1460 = 2920$ bytes in the first two datagrams, leaving $4000 - 2920 = 1080$ bytes for the third, which fits comfortably. Two datagrams could carry only 2,920 bytes, so option (A) is too few, while 4 or 5 datagrams are more than the minimum. Hence the answer is (B).

Subtopic 5.5.4

421. Each application-layer protocol has a reserved (well-known) port. Port 21 belongs to FTP (control connection), port 25 to SMTP (sending mail), port 110 to POP3 (retrieving mail) and port 443 to HTTPS (secure HTTP). Plain HTTP is assigned port 80, so when a browser is given a plain `http://` address with no port specified it silently connects to port 80. Hence option C.

422. A URL is the standard address that identifies where a particular resource (page, image, file) is located on the web, e.g. `https://www.rbi.org.in/home.aspx`. The accepted expansion laid down by the W3C is Uniform Resource Locator. "Universal Reference Link", "Unified Retrieval Language" and "Uniform Registry Locator" are invented terms with no standing in networking, and since option A is genuinely correct, "None of these" is ruled out. Hence option A.

423. Work through what each protocol does. SMTP (Simple Mail Transfer Protocol) only carries outgoing e-mail. SNMP (Simple Network Management Protocol) is used by administrators to monitor and manage network devices such as routers and switches. ICMP (Internet Control Message Protocol) carries error and diagnostic messages, and is what the `ping` command uses. FTP (File Transfer Protocol) is the protocol built precisely for uploading and downloading files between a client and a server, which matches the situation described. Hence option B.

424. A browser is the software installed on your machine that fetches and displays web pages; a search engine is a website you visit through a browser in order to look for information. Bing (Microsoft), Yahoo!, Baidu (China) and Ask.com are all search-engine websites – you need a browser to reach any of them. Google Chrome is the application itself, i.e. the browser. Hence option C.

425. An e-mail address is always built as *username@domain*. Here `ramesh.kumar` identifies the individual mailbox and is the user name, so option A describes the part *before* the `@`. A protocol (such as SMTP or POP3) is the set of rules used to move the mail and is not part of the address at all. A hyperlink is a clickable link on a web page. The part `sbi.co.in` identifies the organisation's mail server on the internet and is the domain name. Hence option C.

426. A web hosting server stores the files of a website so that others can view it – it does not give you your connection. A search engine merely indexes and returns web pages. A domain registrar sells and records domain names such as `.in` or `.com`; that is a name-booking service, not a connectivity service. The organisation that actually carries your traffic to the internet backbone and bills you for the link is the Internet Service Provider. Hence option A.

427. An applet is a small program (traditionally Java) that runs inside the browser – it is executable code, not a stored preference file. Spam means unsolicited bulk e-mail. A firewall is hardware or software that filters incoming and outgoing traffic. The tiny text file written by a website onto the visitor's machine to hold session and preference data is, by definition, a cookie. Hence option A.

428. Split the task into two halves. (1) Sending: mail leaves the client and is pushed to the mail server using SMTP (Simple Mail Transfer Protocol) – SMTP is a *push* protocol and cannot fetch mail. (2) Retrieving: the client pulls the stored messages down from the server using POP3 (or IMAP). Therefore the correct order is SMTP first, POP3 second. Option B reverses the order and is therefore wrong; FTP transfers files, not mail, so A fails; HTTP is a web protocol and is not the sending protocol of a desktop mail client, so D fails. Hence option C.

429. Machines route traffic using numeric IP addresses, while humans type names, so a name-to-number lookup is required. DHCP (Dynamic Host Configuration Protocol) only leases an IP address to your own computer when it joins a network. NAT (Network Address Translation) rewrites private addresses into a public one at the router. ARP (Address Resolution Protocol) maps an IP address to a hardware MAC address inside a local network – it never handles domain names. DNS (Domain Name System) is the distributed directory that converts `www.rbi.org.in` into its IP address. Hence option B.

430. Two steps are involved. Step 1: read the scheme at the start of the address – it is **https**, not **http**. Step 2: recall the well-known port for that scheme. Plain HTTP uses 80 (option E, which would be right only if the address began with `http://`), while HTTPS, i.e. HTTP secured by SSL/TLS, uses port 443. Port 21 is FTP, port 25 is SMTP, and port 8080 is only a common alternate/testing port for HTTP, never a default. Hence option C.

431. The requirement has two parts: mail must stay on the server, and the status must stay synchronised across devices. POP3 in its normal configuration downloads mail to one device and removes it from the server, so the other devices see nothing and no synchronisation occurs – A fails. SMTP only sends mail, so it cannot retrieve anything – C fails. SNMP manages network devices and has nothing to do with mail – D fails. IMAP (Internet Message Access Protocol) keeps the master copy on the server and merely mirrors it on each client, so read/deleted flags set on one device appear on all. Hence option B.

432. Identify what actually stores page content. A bookmark list stores only addresses of favourite pages, not the pages themselves, so it can never cause stale content. The address bar merely accepts and displays the URL being typed. The plug-in manager lists add-on components such as PDF viewers. The browser cache is the temporary storage area where recently downloaded pages, images and scripts are kept so that repeat visits load faster – and it is exactly this that must be cleared when an outdated page keeps appearing. Hence option B.

433. The requirement lists three features: connection establishment, sequencing, and retransmission of lost data. UDP is connectionless and gives no acknowledgement or retransmission, which is why it suits live streaming rather than financial files – A fails. ICMP carries only control and error messages such as **ping** replies, and ARP resolves IP addresses to MAC addresses; neither is a data-transport protocol – C and D fail. TCP (Transmission Control Protocol) performs the three-way handshake, assigns sequence numbers and retransmits unacknowledged segments, delivering reliable ordered data. Hence option B.

434. Check each statement. (i) HTTP treats every request independently and retains no memory of earlier requests, which is why cookies were invented – correct. (ii) FTP uses port 21; port 25 belongs

to SMTP – incorrect. (iii) HTTPS is HTTP layered over SSL/TLS, which encrypts the traffic between browser and server – correct. (iv) SMTP only pushes mail outwards; receiving into a client is done by POP3 or IMAP – incorrect. So only (i) and (iii) hold, which eliminates A, C, D and E. Hence option B.

435. Verify each pairing against the standard well-known port assignments. HTTPS is 443 – correct. SMTP is 25 – correct. Telnet is 23 – correct. DNS is 53 – correct. FTP uses 21 for its control connection (and 20 for data), not 23; port 23 is already taken by Telnet, so no two of these can share it. The only wrong pairing is therefore FTP – 23. Hence option E.

436. Break the URL into its standard components. `https` before the colon-slash-slash is the *scheme* or protocol. `www.bankofbaroda.co.in` is the *host* or domain name. The number 8443 written after the colon is the *port number*. `/retail/login.jsp` is the *path* identifying the file on the server. Everything written after the question mark is the *query string*, which carries parameters to the server as name–value pairs. Here that is `acctno=12345`. Hence option E.

437. Take them one at a time. (i) HTTP is what the browser application speaks to the web server, so it sits at the Application layer. (ii) TCP provides end-to-end reliable delivery through ports, sequencing and acknowledgements, which is the definition of the Transport layer. (iii) IP handles logical addressing and routing of packets between networks – the Network layer. (iv) Ethernet defines framing and MAC addressing on the local link – the Data link layer. Only option A gives this order; every other option misplaces at least one of them (for example B swaps HTTP and TCP, and E puts IP at the Network layer only after wrongly moving HTTP there). Hence option A.

438. Test each claim. A is true: TLS encrypts the traffic so that an eavesdropper cannot read it. B is true: the server presents an X.509 certificate signed by a Certifying Authority, which is how the browser verifies the server’s identity. D is true: the default HTTPS port is 443. E is true: HTTPS is simply HTTP carried inside an SSL/TLS session. C is false: HTTPS only protects the data *in transit* and authenticates the server’s identity – a phishing or malware-hosting site can and often does obtain a valid certificate and show the padlock. The padlock says nothing about the honesty of the content. Hence option C is the statement that is not correct.

439. First fix the length. IPv4 uses 32 bits, which allows about 2^{32} addresses and is written in dotted-decimal form such as 192.168.1.1 – that is what option A describes, so A is IPv4, not IPv6. IPv6 was created to enlarge this space and uses 128 bits, i.e. 2^{128} addresses, which eliminates option B immediately. Next fix the notation: 128 bits split into eight groups of 16 bits each, every group written as four hexadecimal digits and the groups separated by colons, e.g. 2001:0db8:0000:0000:0000:ff00:0042:8329. Decimal-and-dots notation is never used for IPv6, so D fails. Hence option C.

440. A search engine is an external website used to find pages; it is not a part of the browser at all. A plug-in is an optional add-on that extends the browser to handle extra content types, but it does not lay out ordinary HTML pages. A web server is the remote machine that supplies the files – it is at the other end of the connection, not inside the browser. The internal module that parses HTML and CSS and paints the resulting layout (for example Blink in Chrome, Gecko in Firefox, WebKit in Safari) is called the rendering engine or layout engine. Hence option A.

441. Reason from what each step needs before it can begin. The browser cannot open a TCP connection until it knows the server’s IP address, so DNS resolution must come first – this rules out option B. The HTTP request is data carried inside a TCP connection, so the connection must already exist before the request can be sent; that rules out options C and D, both of which send the request too early. Finally the browser can render only after the response arrives. The valid order is therefore DNS lookup, TCP three-way handshake, HTTP request, then rendering of the returned page. Since this sequence is present as option A, "None of these" is not required. Hence option A.

Subtopic 5.5.5

442. Bcc stands for “Blind Carbon Copy”. Addresses typed in Bcc do receive the mail, but the Bcc list is stripped out of the copy delivered to every recipient, so nobody can see who else received it.

Addresses in the *To* field are fully visible to everyone, so option A fails. Addresses in *Cc* (Carbon Copy) are also visible to all recipients, so option B fails. The *Subject* field carries only the title line and cannot deliver mail, so option D fails. An *Attachment* is a file rider on the mail, not an address field, so option E fails. Hence only Bcc meets the requirement.

443. SMTP (Simple Mail Transfer Protocol) is the standard protocol used to *push* mail from a client to a mail server and from one mail server to another, so option B is correct. POP3 (Post Office Protocol version 3) only *downloads* incoming mail from the server, so option A is wrong. FTP (File Transfer Protocol) transfers files between hosts and has nothing to do with mail, so option C is wrong. IMAP (Internet Message Access Protocol) also only *retrieves* incoming mail, keeping it on the server, so option D is wrong. Since a correct option exists, “None of these” is not the answer.

444. Every e-mail address has exactly two parts separated by the @ sign: the *user name* (or mailbox name) before @ and the *domain name* after @. Here everything before @ is **ramesh.kumar**, which is the user name, so options A and B name parts of the user id, not the domain. Everything after @ is **sundarambank.co.in**, which identifies the mail server, so option C is correct. Option D straddles the @ sign and is therefore not a valid single part. Option E, **in**, is only the top-level country code inside the domain, not the whole domain name.

445. The vendor is supplying only the bare *infrastructure*, namely computing power, storage and network, while the customer supplies the operating system and everything above it. That is precisely Infrastructure as a Service, so option C is correct. In SaaS the customer merely uses ready-made application software over the Internet and installs nothing, so option A does not fit. In PaaS the vendor also supplies the operating system and development platform and the customer supplies only the application code, so option B does not fit. NaaS covers only network connectivity, not virtual machines and storage, so option D does not fit. A correct option exists, so option E is wrong.

446. A search engine is a service that maintains an index of web pages and returns a ranked list of pages matching a query. Bing is such a service, so option D is correct. Mozilla Firefox and Google Chrome are *web browsers*, that is, programs used to view web pages, so options A and B are wrong even though a browser can be used to reach a search engine. MS Outlook is an e-mail client, so option C is wrong. Windows Explorer (File Explorer) is a file management utility of the operating system and does not search the web at all, so option E is wrong.

447. Unsolicited, unwanted mail sent in bulk to a very large number of addresses is called *spam* (or junk mail), so option A is correct. A *draft* is a message the user has composed but not yet sent, so option B is wrong. To *archive* is to move a mail out of the inbox into long-term storage without deleting it, so option C is wrong. A *signature* is a block of text automatically appended to the bottom of one’s own outgoing mail, so option D is wrong. A *thread* is a chain of replies on the same subject, so option E is wrong.

448. A *private cloud* is cloud infrastructure operated for the exclusive use of a single organisation, which is exactly what is described, so option B is correct. A *public cloud* is open to the general public over the Internet, which contradicts “no outside organisation has access”, so option A is wrong. A *community cloud* is shared by several different organisations having a common interest, but here only one bank uses it, so option C is wrong. A *hybrid cloud* is a combination of private and public clouds, and no public component is mentioned, so option D is wrong. A correct option exists, so option E is wrong.

449. Step 1: The requirement is about *receiving* mail, so SMTP, which only sends mail, is ruled out (option A). Step 2: Compare the two retrieval protocols. POP3 in its normal setting downloads mail to one device and removes it from the server, so a mail read on the laptop would not be marked as read on the phone; hence option B fails. IMAP keeps the master copy of every message on the server and merely synchronises the folder and read/unread flags with each device, so a change made on one device is reflected on all; hence option C satisfies both conditions. Step 3: HTTP is the protocol of the World Wide Web; web-mail uses it as a carrier but it is not itself a mail retrieval protocol, so option D fails. A correct option exists, so option E is wrong.

450. Step 1: To force an exact phrase, the words must be enclosed in double quotation marks; without them the engine may return pages containing the three words scattered anywhere. Step 2: To exclude a word, a minus sign is placed immediately before it with no space. Combining the two rules gives "IBPS Clerk syllabus" -coaching, which is option B. Option A has neither quotes nor exclusion and will actually favour pages about coaching. Option C uses "+", which *requires* the word instead of excluding it, the opposite of what is wanted. Option D uses OR, which widens the search to pages containing any one of the words, and it still permits "coaching". Option E puts "coaching" inside the quoted phrase, so it demands the very word she wants removed.

451. Step 1: Identify what the vendor supplies. Here the vendor supplies the finished *application software* itself, ready to use through a browser. Step 2: Identify what the customer manages. The bank manages nothing but its user accounts and data. Step 3: The model in which complete application software is delivered over the Internet on subscription, with the vendor handling installation, patching and hardware, is Software as a Service, so option C is correct. In IaaS the bank would have to install and patch its own operating systems, which it does not, so option A is wrong. In PaaS the bank would have to write and deploy its own applications, which it does not, so option B is wrong. The service is run by an outside vendor on shared infrastructure, so it is not a private cloud, and option D is wrong.

452. Step 1: "Reply All" addresses the original sender plus every address visible in the To and Cc fields of the mail received, excluding the person replying. Step 2: The original sender Ravi gets the reply, giving 1 person. Step 3: From the To field, Bhavna and Chetan get it; Anjali herself is the one replying and is not counted, giving 2 more, total 3. Step 4: From the Cc field, Deepak and Esha get it, giving 2 more, total 5. Step 5: Farhan was a Bcc recipient; a Bcc address is stripped from the copies delivered to others, so Anjali's mail client never saw it and cannot address him. Hence the count is $1 + 2 + 2 = 5$ persons, which is option B.

453. Step 1: The KYC database on the bank's own dedicated data centre is a *private* cloud component. Step 2: The rented, publicly hosted website running on shared vendor infrastructure is a *public* cloud component. Step 3: When an organisation uses both, bound together so that data and applications can move between them, the combination is called a hybrid cloud, so option C is correct. Because a private part exists, it is not a pure public cloud (option A); because a public part exists, it is not a pure private cloud (option B). A community cloud requires several distinct organisations sharing one cloud for a common purpose, and only one bank is involved here, so option D is wrong.

454. Step 1: A *web browser* is the software installed on the computer that fetches and displays web pages; Firefox is such software, so Firefox is the browser. Step 2: A *search engine* is a website that maintains an index of the web and returns ranked results for a query; www.google.com is reached *through* the browser and answers the query "RTGS timings", so Google is the search engine. Hence option B is correct. Option A reverses the two roles. Option C wrongly calls the display software a search engine. Option D wrongly calls the indexed website a browser. Option E is wrong on both counts, as Firefox is not a mail client and Google is not the operating system running on her machine.

455. Step 1: Monthly charge = $240 \times 3 = \text{Rs. } 720$. Step 2: Charge for 9 months = $720 \times 9 = \text{Rs. } 6,480$. Step 3: Discount = 15% of 6480 = $\frac{15}{100} \times 6480 = \text{Rs. } 972$. Step 4: Amount payable = $6480 - 972 = \text{Rs. } 5,508$, which is option A. Option B is the undiscounted total, option C corresponds to applying a wrong 10% discount and option D to deducting an arbitrary larger amount, so all three are traps. Since a correct value is listed, option E is wrong.

456. Check each part separately. In option A: SMTP is indeed the outgoing-mail protocol; POP3 does download messages and by default deletes the server copy; DNS does translate names such as sundarambank.co.in into numeric IP addresses. All three parts are correct, so option A is the answer. Option B is wrong because SMTP does not download and IMAP does not send; also DNS does not assign addresses (DHCP does). Option C is wrong because POP3 does not send, SMTP does not synchronise mailboxes, and HTTP does not resolve names. Option D reverses IMAP and SMTP and wrongly credits DHCP with name resolution. Since option A is fully correct, "None of these" is not the answer.

457. Step 1: Searching billions of live pages at query time is impossible within a fraction of a second, so the work must be done *beforehand*. Step 2: A search engine therefore has three stages. A *crawler* continuously follows links and fetches pages; an *indexer* builds an inverted index that lists, for every word, the pages containing it; and a *ranking* algorithm orders the matching pages by relevance. Step 3: When a query arrives, only the pre-built index is consulted, which is why the answer is almost instantaneous. This is exactly option B. Option A is the impossible live-scan idea just ruled out. Option C is wrong because an ISP is only a connectivity provider and keeps no searchable copy of the web. Option D is wrong because history and cache hold only the few pages that this one user has already opened, whereas a search engine returns pages the user has never visited. Option E is wrong because websites are passive stores of pages and do not answer queries on request.

458. Test the four conditions one at a time. (i) Exact phrase requires quotation marks, which eliminates option A. (ii) The `site:` operator restricts results to one domain; option C prefixes it with a minus sign, which *excludes* rbi.org.in instead of restricting to it, so option C fails. (iii) The `filetype:` operator must be `pdf`; option D asks for `doc`, so it fails, and it also buries “draft” inside the required phrase. (iv) Exclusion of a word needs a minus sign immediately before it. Only option B satisfies all four: quotes for the phrase, `site:rbi.org.in` for the domain, `filetype:pdf` for the format and `-draft` for the exclusion. Since option B works, “None of these” is not the answer.

459. Step 1: In IaaS the boundary of responsibility lies just above the virtual machine. The vendor owns and manages everything up to and including the virtualisation layer — buildings, physical security, power, cooling, hardware and the hypervisor. Step 2: The customer owns and manages everything from the guest operating system upward — the OS itself, its patches, middleware, applications and data. Step 3: Options A, D and E are all physical data-centre duties belonging to the vendor, and option B is the virtualisation layer, again the vendor’s duty. Option C, patching the guest operating system inside the customer’s own virtual machine, lies above the boundary and is therefore the customer’s responsibility. Hence option C is correct.

460. Step 1: Cost of the machines per hour = $3 \times 2.40 = \text{Rs. } 7.20$. Step 2: Cost per day = $7.20 \times 18 = \text{Rs. } 129.60$. Step 3: Cost for the month = $129.60 \times 25 = \text{Rs. } 3,240$. Step 4: Storage cost = $500 \times 1.80 = \text{Rs. } 900$. Step 5: Total = $3240 + 900 = \text{Rs. } 4,140$, which is option B. Option A, Rs. 3,240, is the machine cost alone with the storage charge omitted. Option C, Rs. 4,320, arises from billing the machines for a full 24 hours a day ($3 \times 2.40 \times 24 \times 25 = 4320$) while also forgetting the storage charge. Option D, Rs. 5,040, arises from adding the storage charge twice ($3240 + 900 + 900$). A correct value is present, so option E is wrong.

461. Step 1: The requirement is to represent binary and non-ASCII content in a form that a 7-bit text channel can transport. Step 2: MIME (Multipurpose Internet Mail Extensions) does exactly this: it labels each body part with a content type and encodes binary data (for example by Base64) into printable ASCII characters, so images, PDFs and Unicode scripts survive transmission. Hence option A is correct. Option B, SMTP, is the transport protocol whose 7-bit limitation created the problem in the first place, so it cannot be the solution. Option C, SNMP, is the Simple Network Management Protocol used to monitor network devices, unrelated to mail content. Option D, TCP, is a transport-layer protocol that delivers bytes reliably but says nothing about content types or encoding. A correct option exists, so option E is wrong.

462. Statement (I): Elasticity is precisely the ability to add or release resources rapidly as workload rises or falls, for example during a festival-season rush; so (I) is correct. Statement (II): Multi-tenancy means one set of physical servers serves many customers (tenants) at once, with logical isolation keeping each tenant’s data private; so (II) is correct. Statement (III): Vendor lock-in is the *opposite* of what is stated — it is the difficulty and cost of migrating away from a provider because of proprietary formats, APIs and data-transfer charges; the ability to move freely is called *portability*. So (III) is incorrect. Hence exactly (I) and (II) are correct, which is option B.

Subtopic 5.6.1

463. DBMS is a standard abbreviation in computer science and expands letter by letter as Data-Base Management System, i.e. Database Management System. It refers to software such as Oracle, MySQL or MS Access that stores data and lets users define, insert, update, delete and retrieve it. Hence option B is correct. Option A wrongly reads the M as Mailing; backup and mailing are unrelated activities. Option C invents a business term and does not match the letters D-B-M-S in the standard sense. Option D is a fabricated banking phrase and is not a recognised computing term. Since the correct expansion is present as option B, option E is wrong.

464. In the relational model a table is called a relation. Its horizontal entries, each holding the complete set of values describing one entity occurrence, are called tuples (informally records or rows). The details of one customer form one such horizontal entry, so it is a tuple and option C is correct. An attribute is a vertical entry, i.e. a column such as Name or Mobile, so option A is wrong. A domain is the permitted set of values an attribute may take, for example ten-digit numbers for Mobile, so option B is wrong. Degree is the number of attributes (columns) in the relation, a count and not a row, so option D is wrong. Schema is the overall logical design or structure of the database, not a single row, so option E is wrong.

465. A primary key is the attribute chosen to identify each tuple of a relation uniquely. Two conditions therefore follow. First, uniqueness: if two accounts carried the same AccountNo, the key could not identify a row uniquely, so duplicates are barred. Second, entity integrity: a NULL means unknown, and an unknown identifier cannot identify anything, so NULLs are barred too. Hence the column allows neither duplicates nor NULLs and option C is correct. Option A allows duplicates and option B allows NULLs, each violating one of the two conditions. Option D violates both. Since a correct statement exists at C, option E is wrong.

466. The requirement is pure retrieval: read some rows and show them, changing nothing. In SQL, retrieval of data from one or more tables is done by the SELECT statement, which returns a result set and leaves the stored data untouched. Hence option A is correct. UPDATE modifies values in existing rows, which is forbidden here, so option B is wrong. INSERT adds new rows, so option C is wrong. DELETE removes rows, so option D is wrong. ALTER is a DDL statement that changes the structure of the table, for example adding a column, and it neither retrieves nor is desired here, so option E is wrong.

467. A foreign key is an attribute in one relation whose values are required to match the values of the primary key of another (or the same) relation, thereby creating the link between the two tables. Here BranchCode in ACCOUNT must match BranchCode in BRANCH, which is exactly that definition, so option C is correct. It is not the primary key of ACCOUNT, since many accounts belong to the same branch and the values repeat, ruling out option A. A candidate key is an attribute set that could serve as primary key, which requires uniqueness that BranchCode does not have inside ACCOUNT, so option B is wrong. A composite key is a key formed of two or more attributes together, whereas this is a single attribute, so option D is wrong. A super key is any attribute set that determines a tuple uniquely, which again fails here, so option E is wrong.

468. Edgar Frank Codd, a researcher at IBM, published the paper A Relational Model of Data for Large Shared Data Banks in 1970, introducing the idea of storing data in tables (relations) linked by common values rather than by physical pointers. He also laid down the twelve rules an RDBMS should satisfy. Hence option B is correct. Charles Babbage designed the Analytical Engine in the nineteenth century and is called the father of the computer, not of databases, so option A is wrong. Tim Berners-Lee invented the World Wide Web, so option C is wrong. Dennis Ritchie created the C language and co-created UNIX, so option D is wrong. James Gosling designed Java, so option E is wrong.

469. Two standard terms apply to a relation. The degree of a relation is the number of attributes, that is the number of columns, which here is 8. The cardinality of a relation is the number of tuples, that is the number of rows, which here is 250. The question asks for degree first and cardinality second,

so the answer is 8 and 250, i.e. option B. Option A reverses the two definitions. Option C wrongly uses the column count for both. Option D wrongly uses the row count for both. Option E multiplies 8×250 to get 2000, which is the number of data cells and is not the degree of the relation.

470. SQL statements are grouped by what they act upon. DDL statements define or change the structure of database objects; the main ones are CREATE, ALTER, DROP, TRUNCATE and RENAME. DML statements manipulate the data held inside those structures; the main ones are INSERT, UPDATE and DELETE, with SELECT treated as the data retrieval (DQL) member of the manipulation family. Testing each statement: (i) CREATE TABLE builds a new structure, so it is DDL. (ii) INSERT INTO adds rows of data, so it is DML. (iii) UPDATE changes values inside rows, so it is DML. (iv) SELECT only reads data, so it is not DDL. Exactly one statement, namely CREATE TABLE, is DDL, so option A is correct and options B, C and D overcount. Since a valid count is available, option E is wrong.

471. Work through the definitions in order. An attribute set that can uniquely identify a tuple and has no unnecessary attribute is a candidate key; here CustomerID, PANNumber and AadhaarNumber each qualify, so there are 3 candidate keys. Exactly one candidate key is chosen by the designer as the primary key, and here that is PANNumber. The candidate keys left over after this choice are called alternate keys (also secondary keys). So alternate keys = $3 - 1 = 2$, namely CustomerID and AadhaarNumber, and option C is correct. Option A would be right only if there were a single candidate key. Option B undercounts by treating only one leftover key. Option D wrongly counts the primary key itself as an alternate key, but a primary key is never its own alternate. Since 2 is available, option E is wrong.

472. Identify what the rejected value violates. The value 107 is a perfectly valid data type and format for a branch code, so nothing about the column's permitted set of values is broken. The problem is that no row with BranchCode 107 exists in the parent table BRANCH, so the new account would point at a branch that does not exist – a dangling reference. The rule that every foreign key value must either match some existing primary key value in the referenced table or be NULL is called referential integrity, so option C is correct. Domain integrity concerns whether a value lies within the allowed data type, range or format of its column, which is not the failure here, so option A is wrong. Entity integrity is the rule that a primary key must not be NULL or duplicated, and the primary key of ACCOUNT is not at fault, so option B is wrong. Physical integrity is not a standard relational constraint of this kind, so option D is wrong, and since C is correct option E is wrong.

473. A transaction here consists of two operations, the debit and the credit, which must succeed together or not at all. Only the first completed, so the transaction is partial and must be rolled back. The ACID property that a transaction is an indivisible unit, so that either all its operations take effect or none of them do, is Atomicity, and the rollback described is exactly its enforcement mechanism. Hence option A is correct. Consistency states that a transaction carries the database from one valid state to another obeying all constraints; it is the goal served here, but the specific all-or-nothing undo is atomicity, so option B is not the property being asked about. Isolation ensures that concurrently running transactions do not see each other's incomplete work, and no second transaction is mentioned, so option C is wrong. Durability ensures that once a transaction has been committed its effects survive a crash, whereas this transaction never committed, so option D is wrong. Since A is correct, option E is wrong.

474. Check the normal forms in increasing order, since a table must satisfy the lower ones first. First normal form (1NF) requires every cell of the table to hold a single, indivisible (atomic) value, with no repeating groups or lists. The cell here holds three mobile numbers as a list, so 1NF itself is broken and the table is not even in 1NF. The standard cure is to make the value atomic, typically by creating a separate CUSTOMER_CONTACT table holding one number per row along with the customer identifier. So option A is correct. Option B describes 2NF, which deals with a non-key attribute depending on only part of a composite key; the fault here is not about keys at all. Option C describes 3NF, which removes a non-key attribute depending on another non-key attribute; again not the fault here. Option D describes BCNF, a stricter form applied only after 3NF is reached; the

table has not even reached 1NF. Since A correctly names both the violation and the remedy, option E is wrong.

475. Match each requirement against the commands. The structure must survive, which rules out DROP, because DROP TABLE removes the rows, the structure and the definition altogether; so option B is wrong. All rows must go, which rules out UPDATE, which only changes values inside rows, so option E is wrong, and ALTER, which changes the structure such as adding or dropping a column rather than removing data, so option D is wrong. That leaves DELETE and TRUNCATE, both of which can empty a table. The deciding conditions are the last two: the command must be a DDL command and must not log row-by-row deletions. DELETE is a DML command and removes rows one at a time with each removal logged, so option A fails both tests. TRUNCATE TABLE is classified as DDL, deallocates the data pages in one step without individual row logging, and leaves the empty table with its columns intact. Hence option C is correct.

476. The description has three defining features: it is defined by a stored query, it holds no data of its own, and it appears to the user as a table. A view is precisely a virtual table derived from one or more base tables by a stored SELECT query; its rows are produced afresh whenever it is used, and restricting the visible columns for a class of users is one of its classic security uses. Hence option B is correct. An index is a separate physical structure that stores key values and pointers to speed up searching; it does occupy storage and is not presented to users as a table, so option A is wrong. A trigger is a block of code that fires automatically in response to an INSERT, UPDATE or DELETE event, so it is not a queryable object, and option C is wrong. A cursor is a programming construct used to step through a result set one row at a time inside procedural code, not a schema object shown to managers, so option D is wrong. Since B is correct, option E is wrong.

477. Test the normal forms in order. 1NF requires atomic cell values, and the question states that all values are atomic, so the relation is in 1NF. 2NF requires that the relation be in 1NF and that no non-key attribute depend on only a proper part of a composite primary key. The primary key is the pair (BranchCode, SchemeCode), and the non-key attribute SchemeName is determined by SchemeCode alone, which is a proper part of that key. This is a partial dependency, so 2NF fails. Because a relation must satisfy 2NF before 3NF or BCNF can even be considered, the relation cannot be in any higher form either. Therefore the highest form satisfied is 1NF only, and option A is correct. Option B is wrong because 2NF itself fails, and options C and D claim still higher forms, so they are wrong too. Since a definite answer exists, option E is wrong. The cure would be to split off SCHEME(SchemeCode, SchemeName).

478. Apply the tests one by one. 1NF holds because all values are atomic, so option A is wrong. For 2NF, a partial dependency can exist only when the primary key is composite; here the key is the single attribute AccountNo, so no non-key attribute can depend on merely part of it, and 2NF holds. Hence option B is wrong. For 3NF, no non-key attribute may depend on another non-key attribute. Here AccountNo determines BranchCode and BranchCode in turn determines BranchCity, where both BranchCode and BranchCity are non-key attributes. This is a transitive dependency, so 3NF fails and the relation stops at 2NF. Option C is therefore correct. Option D claims 3NF is satisfied, which has just been disproved, and BCNF is stricter still, so option D is wrong. Since C is correct, option E is wrong. Decomposing into ACCOUNT(AccountNo, BranchCode) and BRANCH(BranchCode, BranchCity) restores 3NF.

479. For the Cartesian product of two relations, each resulting tuple is formed by writing one tuple of the first relation followed by one tuple of the second. Degree: the attributes of both relations are placed side by side, so the degrees add. Degree = $4 + 3 = 7$. Cardinality: every tuple of the first relation is paired with every tuple of the second, so the tuple counts multiply. Cardinality = $60 \times 20 = 1200$. Hence degree 7 and cardinality 1200, i.e. option C. Option A gets the degree right but wrongly adds the tuple counts, using $60 + 20 = 80$ as the cardinality; addition applies to the attribute counts, not to the tuple counts. Option B gets the cardinality right but wrongly multiplies the attribute counts, using $4 \times 3 = 12$ as the degree; degrees add rather than multiply. Option D makes both errors together, multiplying the attributes and adding the tuples. Since the correct pair is present at C, option E is

wrong.

480. A super key is any set of attributes that determines a tuple uniquely; unlike a candidate key it may contain extra, unnecessary attributes. Since LoanNo alone identifies a tuple uniquely, any attribute set is a super key exactly when it contains LoanNo, and any set not containing LoanNo cannot be one, as LoanNo is the only candidate key. So count the subsets of the five attributes that include LoanNo. Fix LoanNo as present; each of the remaining 4 attributes, namely CustID, BranchCode, Amount and Tenure, may independently be either included or excluded. That gives $2^4 = 16$ such subsets, ranging from {LoanNo} alone to the full set of all five attributes. Hence the number of super keys is 16, i.e. option C. Option A uses $2^3 = 8$, dropping one free attribute. Option E, $2^5 = 32$, counts all subsets including those without LoanNo. Option D, 31, is $2^5 - 1$, all non-empty subsets. Option B, 15, wrongly excludes the set {LoanNo} itself or uses $2^4 - 1$.

481. ON DELETE CASCADE means that deleting a parent row automatically deletes every child row that refers to it, and the effect propagates down the chain. Work level by level. Level 1, CUSTOMER: the one row of Rakesh Menon is deleted, giving 1 row. Level 2, ACCOUNT: all rows whose foreign key points to that customer are cascaded away, which is his 3 accounts, giving 3 rows. Level 3, TRANSACTION: each deleted account cascades to its own transaction rows, so $12 + 7 + 5 = 24$ rows are deleted. Total rows removed = $1 + 3 + 24 = 28$, so option D is correct. Option A counts only the transactions and forgets the accounts and the customer. Option B adds the customer to the transactions but forgets the accounts. Option C adds the accounts to the transactions but forgets the customer row itself. Since 28 appears at option D, option E is wrong.

482. Decide which property governs the fault. The failure arises purely because a second transaction was allowed to see the uncommitted, intermediate work of a first transaction that was still running. The ACID property requiring that concurrently executing transactions be shielded from one another, so that each behaves as though it ran alone and no transaction sees another's uncommitted changes, is Isolation. Hence option C is correct. Atomicity is not violated: T_1 was rolled back completely, so its all-or-nothing guarantee was honoured, which rules out option A. Consistency is the broad requirement that a transaction map a valid state to a valid state; it is compromised only as a downstream consequence here, whereas the property directly breached by exposing uncommitted data is isolation, so option B is not the specific answer. Durability concerns committed data surviving a crash, and T_1 never committed, so option D is wrong. Since C names the property, option E is wrong. Raising the isolation level to Read Committed or higher prevents dirty reads.

483. A natural join pairs a tuple of one relation with a tuple of the other only when the values of the common attribute agree. Reason from the ACCOUNT side, tuple by tuple. Take any one of the 500 account tuples. Its BranchCode is non-NULL and is guaranteed to exist in BRANCH, so it finds at least one partner. Moreover BranchCode is the primary key of BRANCH, so it is unique there and the account tuple finds exactly one partner. Each account tuple therefore contributes exactly 1 joined tuple, giving $500 \times 1 = 500$ tuples in all. Hence option B is correct. Option A confuses the result with the number of branches, but a branch with many accounts appears many times. Option C adds $500 + 40$, which is not how joins combine tuples. Option D gives $500 \times 40 = 20000$, which is the Cartesian product size, obtained only if the matching condition were dropped altogether. Since 500 is available, option E is wrong.

Subtopic 5.6.2

484. A primary key has two defining properties: uniqueness (no two rows share the same value) and NOT NULL (the value must always be present). Option (B) states exactly this. Option (A) is wrong because repeated values destroy uniqueness. Option (C) is wrong because a primary key may be character data such as an account number like 'SB0231' or a PAN. Option (D) describes a **foreign key**, not a primary key. Since (B) is correct, (E) cannot be the answer. Hence (B).

485. Data retrieval in SQL is done only by the SELECT statement; the asterisk * is the wildcard meaning 'every column', and omitting the WHERE clause means every row is returned. So the correct

syntax is `SELECT * FROM ACCOUNTS`; `GET`, `READ`, `OPEN TABLE` and `FETCH ALL` are not valid SQL data-retrieval commands (`FETCH` exists only inside cursor processing, with a completely different syntax). Hence (C).

486. `Cust_ID` in `LOAN` takes its values from the primary key `Cust_ID` of `CUSTOMER`, i.e. it is a reference to the parent table. A column that references the primary key of another table is by definition a foreign key, so (B) is correct. It cannot be the primary key or a candidate key of `LOAN`, because a customer may take several loans, so the same `Cust_ID` repeats in `LOAN` and uniqueness fails. It is a single column, so it is not a composite key. Hence (B).

487. In the relational model the formal word for a row/record is a **tuple**. An 'attribute' is a column, a 'domain' is the set of permitted values for a column, the 'degree' is the number of columns, and the 'schema' is the structural definition of the table. Only 'tuple' means a row. Hence (C).

488. `WHERE` applies a condition to each row before any grouping, so '`Balance > 50000`' belongs in `WHERE`. `HAVING` is wrong because it filters *groups* produced by `GROUP BY`, not individual rows. `ORDER BY` only sorts the output and removes nothing. `GROUP BY` only collects rows into groups for aggregation. Hence (A).

489. `DELETE` removes rows but the empty table structure survives. `TRUNCATE` also removes all rows quickly, but again the table definition survives. `UPDATE` only modifies existing values. `ALTER` changes the structure (adds/removes a column) but does not remove the table. Only `DROP TABLE OLD_LEDGER`; erases the data *and* the definition from the database. Hence (D).

490. By definition, the **degree** of a relation is its number of attributes (columns) and the **cardinality** is its number of tuples (rows). Here columns = 6 and rows = 40, so degree = 6 and cardinality = 40. Option (A) interchanges the two terms, (C) repeats the column count, and (D) meaninglessly adds and multiplies them. Hence (B).

491. `AND` requires *both* conditions to hold. Step 1 – keep only City = Chennai: Ramesh (45,000), Aravind (91,000), Kavitha (1,20,000); Sunita and Meena are dropped. Step 2 – from these keep Balance > 50000: Ramesh has 45,000 < 50,000 and is dropped; Aravind (91,000) and Kavitha (1,20,000) survive. Note that Meena has Balance 60,000 but is from Coimbatore, so she fails the first condition. Surviving rows = 2. Hence (B).

492. `ORDER BY ... DESC` sorts from the largest salary downwards. Arranging the salaries: 75,000 (Harish), 61,000 (Farhan), 52,000 (Deepak), 48,000 (Geeta), 39,000 (Indu). Counting the output rows: first = Harish, second = Farhan, third = Deepak. A common error is to sort ascending, which would put Geeta third. Hence (C).

493. `COUNT(*)` counts every row of the table irrespective of `NULL`s, so it returns 8. `COUNT(column)` counts only the rows in which that column has a non-`NULL` value. `PAN` is `NULL` in 3 rows, so the non-`NULL` count is $8 - 3 = 5$. Therefore the pair returned is 8 and 5. Hence (B).

494. Listing two tables in the `FROM` clause with no join condition produces the Cartesian product (cross join): every row of the first table is paired with every row of the second. Rows = $5 \times 4 = 20$. The columns of both tables are placed side by side, so columns = $3 + 2 = 5$. Options that add the rows ($5 + 4 = 9$) or multiply/add the columns wrongly are incorrect. Hence (C).

495. The `WHERE` clause restricts the update to Salem rows only, so exactly 4 rows are modified; the Erode and Chennai rows are untouched. Each modified row gains Rs. 5,000. Total increase = $4 \times 5000 =$ Rs. 20,000. Rs. 75,000 would be the answer only if the `WHERE` clause were omitted (15×5000), and Rs. 35,000 would require all 7 non-Chennai rows to be updated. Hence (C).

496. A foreign key enforces referential integrity: a child row may never point to a non-existent parent. With the default `NO ACTION / RESTRICT` behaviour, the DBMS checks for dependent rows before deleting the parent. Since 2 `LOAN` rows still reference `C07`, the delete is refused and an error is raised, leaving both tables unchanged. Option (A) would need an explicit `ON DELETE CASCADE` clause,

and option (C) would need ON DELETE SET NULL; neither was specified. Option (D) is wrong because DELETE FROM CUSTOMER never targets the LOAN table. Hence (B).

497. A primary key column must satisfy two tests. Test 1 – all values distinct: Name fails (two brothers share it) and Mobile fails (a joint number repeats), so both are eliminated. Test 2 – no NULL permitted: Aadhaar is unique but is missing for one customer, and a NULL value cannot identify a row, so Aadhaar is eliminated. Acc_No is both unique and present for every row, so it alone qualifies. Since a valid choice exists, (E) is wrong. Hence (A).

498. Step 1 – form the groups. Anna Nagar has 2 rows, Adyar 1 row, Velachery 3 rows, Tambaram 1 row. Step 2 – apply HAVING COUNT(*) ≥ 2: only Anna Nagar and Velachery survive; Adyar and Tambaram are discarded even though Tambaram has the single largest loan. Step 3 – compute the surviving sums: Anna Nagar = 2,00,000 + 3,00,000 = Rs. 5,00,000; Velachery = 4,00,000 + 1,00,000 + 2,50,000 = Rs. 7,50,000. Step 4 – add the displayed sums: 5,00,000 + 7,50,000 = Rs. 12,50,000. (Rs. 19,00,000 is the grand total of all seven loans, i.e. what you get if HAVING is ignored.) Hence (C).

499. Cust_ID alone cannot be the key: one customer appears in several rows (many schemes). Scheme_ID alone cannot: one scheme has many customers. Join_Date alone cannot: several enrolments can occur on the same day. The pair (Cust_ID, Scheme_ID) is unique, because the rule states a customer can join a given scheme at most once, so no two rows can repeat that pair – it is a valid key. Option (E) is also unique but *not minimal*: dropping Join_Date still leaves a unique combination, so (E) is a super key, not the primary key, which must be irreducible. Hence (D).

500. Step 1 – matched rows. A LEFT JOIN first produces every matching pair, exactly as an INNER JOIN would: C1 gives 2, C3 gives 1, C4 gives 3, a total of 2 + 1 + 3 = 6 rows. Step 2 – unmatched left rows. LEFT JOIN additionally preserves every row of the left (CUSTOMER) table that found no partner, padding the LOAN columns with NULLs. C2, C5 and C6 have no loans, contributing 3 more rows. Step 3 – total = 6 + 3 = 9 rows. (6 would be the INNER JOIN answer, i.e. what you get if the unmatched customers are forgotten. Neither 12 nor 18 corresponds to any join of these two tables: LOAN itself holds 2 + 1 + 3 = 6 rows, so even the Cartesian product would be 6 × 6 = 36.) Hence (B).

501. Step 1 – evaluate the inner query. Keep LOAN rows with Amount strictly greater than 2,00,000: (C01, 2,60,000), (C03, 5,00,000) and (C03, 3,00,000). C05's loan is exactly Rs. 2,00,000, and > is strict, so C05 is excluded; C01's Rs. 1,50,000 loan and C02's Rs. 90,000 loan also fail. The inner query therefore yields the set of IDs {C01, C03} (C03 appears twice but IN treats it as one value). Step 2 – the outer query returns the CUSTOMER rows whose Cust_ID lies in that set: Rajesh (C01) and Vinod (C03). Anitha has no loan at all. Count = 2. Hence (B).

502. Step 1 – pick the CR rows: (A1, CR), (A1, CR), (A3, CR), (A2, CR), (A4, CR), (A4, CR). That is 6 rows, so $x = 6$. Step 2 – list the distinct account numbers among those CR rows: A1, A2, A3, A4, i.e. 4 different accounts, so $y = 4$. Note A3 also appears with DR and A2 with DR, but the WHERE clause has already removed those rows. Step 3 – $x - y = 6 - 4 = 2$. Hence (B).

503. (A) is false: a table may contain several candidate keys, but exactly one of them is designated the primary key – two primary keys are not permitted. (B) is true: UNIQUE enforces only distinctness and still permits a NULL entry, while PRIMARY KEY enforces distinctness *and* NOT NULL; this is precisely the difference between the two constraints. (C) is false: a foreign key normally repeats within its own table (many loans for one customer), so it is usually not that table's primary key. (D) is false: a standalone table with no relationship to any other table is perfectly legal; foreign keys are optional. Since (B) is correct, (E) is not the answer. Hence (B).

504. SQL evaluates clauses in the order FROM, WHERE, GROUP BY, HAVING, SELECT, ORDER BY. WHERE runs *before* the rows are grouped, so at that moment no group exists and an aggregate such as COUNT(*) has nothing to aggregate – placing an aggregate function in WHERE is illegal, and query (D) fails. The correct form is HAVING COUNT(*) > 3. Query (A) is a standard grouped count. Query (B) is legal because the aggregate condition sits in HAVING, which runs after grouping.

Query (C) uses only ordinary column conditions in WHERE, which is fine. Query (E) is a plain sort. Hence (D).

Subtopic 5.7.1

505. The defining test is: does the program need a host file and a human action to spread? A virus must attach itself to a host file or program and spreads only when that infected file is executed, so option A fails the “no host file” condition. A worm is a stand-alone self-replicating program that copies itself across a network by itself, which matches every word of the statement, so option B is correct. A Trojan horse does not replicate at all; it must be installed by a deceived user, so option C fails. A cookie is only a small text file a website stores for session data, not a program, so option D fails. A firewall is a protective device or software that filters traffic, so option E is the opposite of malware.

506. Identify the mechanism: the program pretends to be useful software, the user installs it voluntarily, and the damage is hidden behind the useful function. That is precisely the definition of a Trojan horse, so option D is correct. A worm would spread by itself to other machines over the network, which is not described here, so option A fails. A boot sector virus infects the master boot record and activates at start-up; nothing about booting is involved, so option C fails. A firewall filters network traffic for protection and a security patch fixes a software flaw, so options B and E describe protective items, not the malicious app.

507. Match the behaviour to the name. Encrypting data and demanding a ransom is the definition of ransomware, so option B is correct. Adware only displays unwanted advertisements and does not encrypt data, so option A fails. Freeware is legitimate software distributed free of cost and shareware is legitimate software offered on trial before payment, so options C and D are ordinary software categories, not malware. Firmware is the permanent software stored in a hardware chip, so option E is unrelated.

508. The stated function is the silent capture of keystrokes. A keylogger is exactly the spyware that logs each key pressed, so option A is correct. A compiler translates high-level source code into machine code, so option B is a development tool. A disk defragmenter rearranges scattered file fragments to speed up disk access, so option C is a utility. A bootloader loads the operating system into memory at start-up, so option D is system software. A search engine such as Google retrieves web pages, so option E is an internet service. None of B to E monitors typing.

509. “Malware” is a contraction of the two words “malicious” and “software”, so option B is correct. It is an umbrella term covering viruses, worms, Trojans, ransomware, spyware and rootkits. Option A wrongly makes it hardware, whereas malware is always a program. Options C and D invent expansions that do not exist. Since the correct expansion is present at option B, the answer cannot be “None of these”, so option E is wrong.

510. Test each item for malicious intent. A worm self-replicates across networks, a Trojan horse hides malicious code inside apparently useful software, spyware secretly collects personal information, and ransomware encrypts data for extortion, so options A, B, D and E are all malware. A firewall is a security mechanism, in hardware or software, that examines incoming and outgoing traffic and blocks unauthorised access. It defends the system rather than attacking it, so option C is the odd one out and is the required answer.

511. A signature-based antivirus compares files against a stored database of known malware patterns. Thousands of new malware samples appear daily, so a database frozen on the installation date would miss all of them; the daily definition update adds the new signatures and keeps detection current. Hence option D is correct. RAM size and processor clock speed are fixed hardware properties that no software update can enlarge, so options A and E are impossible. Reformatting the hard disk would destroy branch data and is never a routine antivirus action, so option C is wrong. An antivirus update does not replace the operating system, so option B is wrong.

512. Step 1: The program reproduces itself, so it is self-replicating; this rules out adware, which merely shows advertisements, so option E fails. Step 2: The investigation states that no existing file

was attached to or modified. A file infector virus survives by inserting its code into executable files and a macro virus embeds itself in the macros of a document or its template; both therefore require a host file, so options A and C fail. Step 3: A rootkit's purpose is to conceal itself and other malware, not to mail copies of itself and flood the network, so option B fails. Step 4: A stand-alone self-replicating program that spreads over a network, typically by mass-mailing itself, and consumes bandwidth is the classic definition of a worm, so option D is correct.

513. The distinguishing property of a Trojan horse is that it carries a hidden malicious payload inside something that looks desirable, and it relies wholly on deceiving the user; it has no self-replication mechanism of its own. Option C states exactly this and is correct. Option A describes a worm, not a Trojan. Option B describes a boot sector virus, and Trojans normally install as ordinary application files. Option D is false because a Trojan is malware and is never a bundled operating-system utility. Option E is false because a Trojan is software, so removing the infected files with antivirus or by reinstalling the software is enough; no hardware replacement is required.

514. Step 1: The code stays inactive until a specific condition, here a date together with the absence of a record, is satisfied. Malicious code that lies hidden inside a legitimate program and detonates only when a pre-set condition or date occurs is called a logic bomb, so option A is correct. Step 2: A worm must copy itself to other machines, which this code never does, so option B fails. Step 3: Adware shows unsolicited advertisements and a cookie is a small text file used by websites; neither deletes records, so options C and D fail. Step 4: The behaviour was deliberately programmed, so it is not an accidental compiler bug, and option E fails.

515. Step 1: Each infected machine, obeying an outside controller, is called a bot or zombie. Step 2: A collection of such bots under one command-and-control master is a botnet, commonly used to launch distributed denial-of-service attacks exactly as described, so option A is correct. Step 3: An intranet is an organisation's private internal network and an extranet extends limited access to outside partners; both are legitimate network designs, so options B and C fail. Step 4: A honeypot is a decoy system deliberately set up by defenders to attract and study attackers, so option D is a defensive tool. Since option A is genuinely correct, option E cannot be the answer.

516. Step 1: Two features are stated, namely privileged access and concealment by tampering with the operating system's own reporting. Step 2: A rootkit is defined as malware that obtains root or administrator level control and hides its presence and that of other malware from standard system tools, so option A is correct. Step 3: Adware is designed to be seen, since its aim is to display advertisements, so option B contradicts the concealment requirement. Step 4: A macro virus lives inside document macros and does not modify the operating system kernel, so option C fails. A spam filter separates unwanted e-mail and a patch repairs a software defect, so options D and E are protective, not malicious.

517. Step 1: Such a virus is called a polymorphic virus. Step 2: A signature-based antivirus works by comparing files with a fixed byte pattern taken from a known specimen. If the virus changes its own byte pattern at every infection, the stored signature will not match the fresh copies, so detection by simple signature matching fails and heuristic or behaviour-based methods become necessary. Hence option D is correct. Step 3: Changing appearance does not change the payload, so the virus remains harmful and option A is wrong. Option C invents a self-deletion timer that is not implied. Option B is wrong because defragmentation only reorganises file storage and has no role in detection. Option E is wrong because turning the machine into a server is a function of a backdoor or bot, not of code mutation.

518. Statement (i) is correct, because a worm is a self-contained program that copies itself across a network using system or application weaknesses and needs no user action. Statement (ii) is incorrect, because a Trojan horse has no self-replication mechanism at all; it spreads only when users are deceived into installing it, and this is the very feature that separates it from a virus and a worm. Statement (iii) is correct, since ransomware encrypts the victim's data and sells the decryption key back to the victim. So exactly (i) and (iii) are correct, which is option C. Options B, D and E all include the false statement (ii), and option A wrongly drops the true statement (iii).

519. The genuine common property of a virus and a worm is that both are self-replicating malware; that property, however, is not offered in any of options A to D, so each option must be tested and rejected. Option A holds for a virus but not for a worm, since a worm is a stand-alone program needing no host file. Option B again holds for a virus but not for a worm, since a worm propagates automatically without user action. Option C describes ransomware, and neither a virus nor a worm necessarily encrypts data for extortion. Option D is plainly false, as both are programs, not hardware. Since no listed option states a property common to both, the correct choice is “None of these”, option E.

520. Step 1: The situation described is a zero-day attack, meaning the vulnerability is unknown to the vendor and no signature exists. Step 2: Signature-based scanning can only recognise patterns already present in its database, so by definition it cannot match a signature that has never been published; option A therefore fails. Step 3: Heuristic and behaviour-based detection watches actions such as an unknown process modifying system files, injecting code into other processes or opening outbound connections, and raises an alert on the behaviour itself even when the code has never been seen before. This is the standard defence against zero-day malware, so option B is correct. Step 4: Defragmentation only rearranges file storage, compression only saves space, and screen resolution is a display setting; none of these examines program behaviour, so options C, D and E fail.

521. Step 1: The infection travelled inside a document and became active only when macros were enabled, which points to malicious code written in the application’s macro language. Step 2: The classic behaviour of a macro virus is to copy itself into the word processor’s default template, after which every document created from that template inherits the infection, which is exactly what is observed. Hence option B is correct. Step 3: A boot sector virus infects the master boot record and executes at start-up, and nothing here relates to booting, so option A fails. Step 4: A network worm would spread by itself to other machines over the LAN rather than into locally created documents, so option C fails. A rootkit conceals processes and a remote access Trojan hands remote control to an attacker; neither explains the infection of newly created documents, so options D and E fail.

522. Step 1: Malware that leaves no executable file on disk and abuses trusted built-in tools is called fileless malware or a living-off-the-land attack. Step 2: The consequence follows directly: an antivirus that scans stored files has no file to scan, so memory analysis and behaviour monitoring are needed instead. Option D states both the name and the correct implication, so it is correct. Step 3: A boot sector virus does write to the disk’s boot record, contradicting the stated facts, so option A fails. Step 4: Adware is defined by advertisement display, which is not described, so option C fails. A macro virus resides in document files, again contradicting the fileless nature, and printers are irrelevant, so option B fails. Firmware is legitimate software embedded in hardware chips and is not malware, so option E fails.

523. Step 1: Separate the two harms a worm can cause, namely the payload and the propagation. The question removes the payload, so the damage must arise from the act of spreading itself. Step 2: A worm replicates without limit; every copy occupies memory, demands processor time and, above all, generates network packets while hunting for fresh hosts. This flood of traffic starves genuine transactions of bandwidth and can exhaust server connections, producing an effective denial of service even though nothing was deleted. Option B states exactly this and is correct. Step 3: A worm is software and cannot physically damage cabling, so option A is wrong. Step 4: Nothing in the nature of a worm makes a disk read-only, so option C is wrong, and reinstalling an operating system is neither a worm’s mechanism nor consistent with “no payload”, so option D is wrong. Step 5: Since option B is genuinely correct, option E cannot be the answer.

524. Step 1: Ransomware usually tries to reach shared drives and other machines over the same network, so the immediate risk is lateral spread. Containment therefore comes before everything else, and disconnecting the terminal while alerting IT security is the standard first step in every incident-response procedure, making option B correct. Step 2: Paying the ransom is discouraged, because it funds the attacker and gives no guarantee of a working key, and in any case it does nothing to stop the spread, so option A is wrong. Step 3: Repeated restarting neither decrypts data nor contains the

infection and may trigger further payload activity, so option C is wrong. Step 4: Deleting the operating system folder destroys the machine without decrypting anything, and preserving evidence for forensic analysis is required, so option D is wrong. Step 5: Circulating the note to customers spreads panic and possibly the malicious links themselves, so option E is wrong.

525. Step 1: The malware arrived disguised as a desirable program that the user installed himself, which is the signature of a Trojan rather than of a virus or a worm. Step 2: Its payload gives the attacker interactive remote control of files, camera and commands, so the precise sub-class is a Remote Access Trojan, which installs a hidden backdoor. Option A therefore names both the class and the mechanism correctly. Step 3: No boot record was involved and nothing runs at start-up, so option B fails. Step 4: The program did not copy itself to other machines and no mutation is described, so option C fails. Step 5: Adware would be visible as advertisements, whereas here the user notices nothing, so option D fails. Since option A is genuinely correct, option E cannot be the answer.

Subtopic 5.7.2

526. Identify the essential features of the attack: (i) an e-mail that impersonates a trusted institution, (ii) a false sense of urgency, and (iii) a look-alike web page designed to harvest confidential credentials. That exact combination defines phishing. The other options are ordinary computing terms with no connection to fraud: defragmentation rearranges scattered file fragments on a hard disk to speed up access; spooling queues jobs (typically print jobs) in a buffer so the CPU need not wait for a slow device; encryption converts plaintext into cipher text to protect it, which is a security control and not an attack; debugging is the process of locating and removing errors from a program. Hence option (A).

527. The distinguishing feature here is the channel used: a live voice call on the telephone. Voice + phishing gives *vishing*, which is the standard term for credential fraud conducted over a phone call. Smishing is ruled out because that word is formed from SMS + phishing and applies only to fraudulent text messages, whereas no SMS was used to deceive him (the OTP was a genuine bank SMS). Pharming is ruled out because it involves tampering with DNS entries or the hosts file so that a correctly typed address silently loads a fake site; no web address is involved here. Spamming means sending unsolicited bulk messages, usually advertising, and need not involve any theft of credentials. Sniffing means passively capturing data packets travelling on a network. Hence option (B).

528. The program's defining action is capturing keystrokes, and the software that does exactly this is a keylogger (a category of spyware). A compiler merely translates high-level source code into machine code and has no monitoring function. A firewall is a defensive device or program that filters incoming and outgoing network traffic according to rules, so it protects rather than attacks. A cookie is a small text file a website stores in the browser to remember preferences or session state; it can raise privacy concerns but it cannot record keystrokes typed into other applications. Since a genuinely correct term is present at (C), "None of these" is wrong. Hence option (C).

529. Work from the behaviour described: the data is locked by encryption and released only against a payment, that is, the data is held to ransom. Malware that does this is ransomware. Adware only displays unwanted advertisements and does not encrypt data. Freeware is legitimate software distributed free of cost, and shareware is legitimate software distributed on a try-before-you-buy basis; neither is malware at all. Firmware is permanent software written into a hardware device's ROM, such as the BIOS, and again is not malicious. Hence option (C).

530. Two facts settle the classification: the testing is done with the owner's written authorisation, and the intention is to strengthen the system. A hacker who works with permission and for defensive purposes is a white hat or ethical hacker. A black hat hacker breaks in without authorisation for personal gain or damage, which contradicts "formally authorises". A cracker is essentially another name for a malicious intruder who breaks security or software protection illegally. A script kiddie is an unskilled person who merely runs ready-made attack tools written by others, and skill level is not the point here. A phisher specifically runs credential-stealing deception campaigns. Hence option (B).

531. Recall the CIA triad. Confidentiality means data is disclosed only to authorised persons; the question expressly says no data is stolen, so confidentiality is intact. Integrity means data is not altered in an unauthorised way; the question expressly says nothing is altered, so integrity is intact. Availability means authorised users can access the service whenever required; here genuine customers cannot reach the gateway at all, so this is precisely what has been destroyed. This is the classic effect of a denial-of-service attack. Non-repudiation means a party cannot later deny having performed a transaction, which is not the issue here. Since (C) is genuinely correct, "None of these" is wrong. Hence option (C).

532. Examine each practice. (A) Typing the address manually defeats look-alike links used in phishing mails, so it is safe. (C) Logging out and closing the browser clears the session and prevents session hijacking on a shared machine, so it is safe. (D) Applying updates removes known vulnerabilities that malware exploits, so it is safe. (E) A long mixed-character password resists dictionary and brute-force guessing, so it is safe. (B) A cyber-cafe machine is completely untrusted: it may already be running a keylogger or spyware planted by an earlier user, and instructing the browser to remember the password writes the credential permanently onto a computer that strangers will use next. Either route hands the customer ID and password to an outsider, who can then operate the account. This is therefore the unsafe practice. Hence option (B).

533. The key detail is that the victim entered the correct address himself and was still redirected, so no deceptive link and no deceptive message played any part. The redirection was achieved by corrupting name resolution (hosts file or DNS cache poisoning), and an attack that silently sends a correctly addressed request to a fake server in this way is called pharming. Spear phishing is ruled out because it necessarily involves a targeted deceptive message that the victim must act upon, which did not happen. Clickjacking is ruled out because it works by overlaying an invisible frame so that a click meant for one control actually triggers another, but here the problem arose before any click, at the address-resolution stage. Shoulder surfing is simply watching a person type credentials from close by, which requires physical presence. Since (A) is genuinely correct, "None of these" is wrong. Hence option (A).

534. The structure of the attack is: attacker positions himself between two communicating parties, both of whom believe the link is direct, and he can intercept and alter the traffic. That is the definition of a man-in-the-middle attack, and a rogue or "evil twin" hotspot is the commonest way of achieving it. A logic bomb is dormant code inside a program that triggers on a condition such as a particular date, so it has nothing to do with intercepting traffic. A brute-force attack tries every possible password combination until one works and involves no interception. A macro virus hides inside the macro language of documents such as spreadsheets and spreads when the document is opened. Since (B) is genuinely correct, "None of these" is wrong. Hence option (B).

535. Two features must be matched: the message is highly personalised using real facts about the recipient, and it went to a very small, chosen set of people. Phishing that is customised and aimed at specific individuals is spear phishing. Bulk spam is ruled out because spam is sent indiscriminately to enormous numbers of addresses with no personalisation. Smishing is ruled out because that term applies only to fraudulent SMS messages, whereas this arrived by e-mail. Whaling is the special case of spear phishing in which the target is a very senior executive such as a Managing Director or Chief Financial Officer; the victim here is a clerk, so the narrower term does not apply and spear phishing is the correct classification. Adware merely pushes advertisements. Hence option (B).

536. Work out what actually blocked the attack. The attacker already possessed the knowledge factor, that is, something the customer knows (ID and password). The transaction still failed because a second, independent factor was demanded, namely something the customer possesses, the registered mobile handset receiving the OTP. Requiring two different categories of evidence is two-factor authentication. Disk defragmentation only reorganises files on a disk for speed. Data compression only reduces file size for storage or transmission. Cache memory is fast memory between the CPU and main memory, used for performance. None of these last three has any authentication role, and since (B) is genuinely correct, "None of these" is wrong. Hence option (B).

537. Trace the mechanism. Untrusted text typed by the user is concatenated straight into a database (SQL) statement, which changes the meaning of that statement so that the authentication test always returns true. Injecting crafted SQL through an input field in this way is SQL injection. Cross-site scripting is ruled out because there the injected payload is script code that runs in the browser of *another* user, not a modification of a database query. A buffer overflow is caused by writing more data than an allocated memory buffer can hold so that adjacent memory is overwritten, which is a memory-handling flaw, not a query-syntax flaw. Denial of service aims to exhaust resources so the service becomes unavailable, whereas here the service works normally and merely admits an impostor. Since (B) is genuinely correct, "None of these" is wrong. Hence option (B).

538. Classify by the two decisive properties. First, the program is disguised as a useful application and is installed voluntarily by the user, who is deceived about its true purpose. Second, it explicitly does not replicate. Malware with a legitimate-looking cover that does not self-replicate is a Trojan horse. A worm is excluded because a worm's defining property is that it copies itself across a network without user action, and the question states it does not spread to other machines. A boot sector virus is excluded because a virus attaches itself to a host, and this one attaches to nothing, in particular not to the boot sector. "Rootkit remover" names a defensive utility, not a class of malware. Since (B) is genuinely correct, "None of these" is wrong. Hence option (B).

539. The critical fact is the timing: the vendor has had zero days in which to develop and ship a fix, so no patch exists and signature-based defences may not recognise the exploit. A vulnerability attacked in that window is a zero-day vulnerability. "Legacy bug" is not a standard security term and would in any case suggest an old, long-known defect, the opposite of the situation described. A syntax error is a violation of a programming language's grammar that is caught by the compiler, so such code would not even run. A deadlock is a state in which two or more processes each wait for a resource held by the other and none can proceed; it is a concurrency problem, not a security hole. Since (B) is genuinely correct, "None of these" is wrong. Hence option (B).

540. Reason from what a TLS certificate actually asserts. A basic domain-validated certificate certifies only that the server presenting it controls that particular domain name, and it causes the browser to encrypt the channel to that server. Anyone, including a criminal, can obtain such a certificate for a domain he owns, and `hdfc-bank-secure-verify.in` is not the bank's domain. So (A) is false: the padlock authenticates a domain name, not an organisation's genuineness. (C) is false: certificates have nothing to do with virus scanning. (D) is false and is the most dangerous misconception, because encryption protects data only *in transit*; once the data arrives, the site owner decrypts and reads it, and if that owner is the fraudster the credentials are lost. (B) states exactly the two correct halves: encryption of the channel is assured, but the certificate vouches only for control of the domain name shown, not for the identity or trustworthiness of the organisation running the site. Since (B) is correct, "None of these" is wrong. Hence option (B).

541. Fill the blanks one at a time. A large collection of compromised machines ("zombies" or "bots") that obey commands from a single controller is a botnet, which eliminates options (A), (D) and (E) at the first blank; a honeypot is a decoy set up by defenders, a firewall cluster is defensive equipment, and a rootkit is concealment software on one machine, not a network of machines. For the second blank, the flood arrived simultaneously from tens of thousands of separate sources, so it is distributed, not single-source; that eliminates (C), and it makes the service unavailable, which is denial of service. Both blanks are satisfied only by (B). Hence option (B).

542. The signature of this fraud is theft of a very large number of individually negligible amounts which together become substantial, exactly as a salami is consumed one thin slice at a time. It is therefore a salami attack (also called salami slicing). A logic bomb is malicious code that lies dormant until a trigger condition such as a date or an employee's removal from the payroll occurs; the fraud here runs continuously on every interest run and has no trigger. A denial-of-service attack seeks to make a service unavailable, but here the system keeps working normally, which is precisely why the fraud stays hidden. A dictionary attack guesses passwords from a word list. Session hijacking means taking over a user's authenticated session, typically by stealing the session token. Hence option (A).

543. Identify who is being deceived and by what means. The person deceived is the accounts officer, and the means is an e-mail whose display name impersonates the MD while the underlying domain is a near-identical look-alike; the goal is to induce an unauthorised payment, reinforced by urgency and secrecy. That is business e-mail compromise, popularly called CEO fraud. Option (A) inverts the roles: in whaling the senior executive is the *victim* who is phished, whereas here he is only the identity being impersonated, so the label does not fit. Option (C) fails because pharming means corrupting name resolution so that a correctly typed address loads a fake server; merely registering a similar-looking domain and sending mail from it is not pharming. Option (D) fails because cross-site request forgery makes a logged-in user's browser submit a request without his knowledge, whereas here a human being consciously performs the transfer after being deceived. Since (B) is correct, "None of these" is wrong. Hence option (B).

544. Locate the point at which the control failed. The bank's systems, its password store and its OTP software were never touched; what changed was the destination of the OTP, because the telecom operator was persuaded to issue a duplicate SIM for the victim's number to an impostor. Taking over a victim's mobile number in this way is SIM swap fraud, and the persuasion of the counter staff using personal details harvested from social media is textbook social engineering. Option (A) fails because a rainbow table attack reverses captured password hashes offline using precomputed hash chains, and no hash database was stolen here. Option (C) fails because a denial-of-service attack floods a service to make it unavailable to everyone, whereas here the network worked normally for all other subscribers and the victim's line died only because his SIM was deactivated by the legitimate re-issue process. Option (D) fails because steganography means concealing a message inside an innocuous carrier such as an image, which plays no part in this fraud. Option (E) fails because a buffer overflow is a memory-handling defect in code, and the OTP was generated and delivered exactly as designed, merely to the wrong handset. Hence option (B).

545. The system has three defining properties: it is a decoy with no genuine business data, it is deliberately made attractive and apparently vulnerable, and its purpose is to attract and record intruder activity. A decoy of this kind is a honeypot. A proxy server is ruled out because a proxy is an intermediary that forwards genuine client requests to real servers, providing caching, filtering or anonymity, and it is not a decoy. A DMZ is ruled out because it is a network *segment* placed between the internet and the internal network to host real public-facing servers such as mail and web servers; it is a location, not a decoy machine, and the honeypot here is isolated from production rather than serving the public. A load balancer distributes incoming requests across several real servers for performance. Since (B) is correct, "None of these" is wrong. Hence option (B).

546. Note precisely what the attacker feeds in: complete username-password *pairs* already known to be valid somewhere else, exploiting password reuse. Replaying stolen credential pairs against a different service is credential stuffing. A brute-force attack is excluded because that means systematically generating every possible character combination for a password, with no prior knowledge of it. A dictionary attack is excluded because that means trying likely words and common passwords from a prepared word list against a chosen account, again without knowing the true password. A rainbow table attack is excluded because it is an offline technique for reversing captured password *hashes* using precomputed hash chains, whereas here the plaintext passwords are already in hand and are being tried online. Since (C) is correct, "None of these" is wrong. Hence option (C).

Subtopic 5.7.3

547. An antivirus works mainly by comparing files on the disk against a stored library of known malicious byte-patterns. That library is the virus signature or definition file, and it is exactly what the nightly update refreshes. The boot sector is the first sector of a disk that holds start-up code, not malware patterns. The swap file is disk space used as an extension of RAM by the operating system. A cookie file stores small pieces of website data in the browser and has nothing to do with malware detection. Since option C is genuinely correct, None of these is wrong.

548. A firewall is defined precisely as hardware or software that sits at the boundary of a network and

filters traffic on the basis of a rule set (source address, destination address, port, protocol). A compiler translates source code into machine code. A scanner is an input device that digitises documents. A plotter is an output device for large drawings. A spooler queues print jobs. Only the firewall performs rule-based packet filtering, so it is the single correct option.

549. Symmetric key cryptography is named after the symmetry of the two operations: the identical secret key that scrambles the plaintext also unscrambles the ciphertext. Hence exactly one key is shared by sender and receiver. A public and private pair, as in option A, describes asymmetric cryptography such as RSA, which is a different family. Options C and D invent key counts that no standard symmetric scheme uses. Because option B is correct, None of these cannot be the answer.

550. Quarantine means the antivirus moves a suspicious file to a protected area where it cannot be executed or opened by other programs, so the threat is neutralised while the file is preserved in case it turns out to be a false alarm. Defragmentation rearranges file fragments on a disk to speed up access. Compiling converts source code to executable form. Formatting prepares a storage medium by erasing it. Booting is the start-up process of a computer. Only option E describes isolation of a suspected file.

551. The letter s in https stands for secure, and the security is supplied by the SSL/TLS protocol, which encrypts the session so that anyone intercepting the packets sees only ciphertext. Defragmentation is a disk-maintenance activity and offers no protection on a network. Cache memory is fast storage near the processor. Batch processing is a mode of running jobs without user interaction. Optical character recognition converts images of text into machine-readable characters. Only option B explains the padlock.

552. Encryption is by definition the transformation of plaintext into ciphertext using an algorithm and a key, with decryption as the reverse operation. Compilation translates a program into machine language and is not reversible with a key. Fragmentation is the scattering of file blocks on a disk, or the splitting of a packet in networking. Buffering is temporary storage of data while it is being transferred. As encryption is listed and correct, None of these is not the answer.

553. The question asks for the option that antivirus software does not do. Scanning on demand or by schedule, detecting and removing known malware, downloading definition updates and quarantining suspicious files are all standard antivirus features, so options B, A, E and D are genuine functions and cannot be the answer. Raising the clock speed of the processor is overclocking, a hardware and firmware setting quite unrelated to security software. Hence option C is the one that is not a function.

554. Work through the clue. First, the malware is only hours old, so no vendor definition exists for it; that immediately rules out signature-based detection, which can only match patterns already in the definition file. Second, the antivirus reacted to what the file was doing, namely overwriting system files and opening a connection to an unknown host. Judging a program by its actions and by suspicious code structure rather than by a stored pattern is precisely heuristic and behaviour-based detection. Disk mirroring duplicates a disk for fault tolerance and detects nothing. Data compression only reduces file size. So option B alone fits, and None of these is wrong.

555. Take the two requirements one at a time. For confidentiality, the message must be readable only by Meena, so it must be locked with a key that only Meena's private key can open; that key is Meena's public key. For authenticity, Rajesh must apply an operation that only he can perform, that is, he must use his own private key to create the signature. Combining the two gives: sign with Rajesh's private key, encrypt with Meena's public key, which is option C. Options D, E and B require Rajesh to possess Meena's private key or to encrypt with his own public key, which he alone could then decrypt; both are impossible or useless. Option A reverses the roles and would let anyone read the message, since Rajesh's public key is available to all.

556. Step 1: count the symmetric keys. One key is needed per unordered pair of officers, so the count is the number of pairs from 8 officers, that is $\frac{8 \times 7}{2} = 28$ keys. Step 2: count the asymmetric keys. Each officer holds exactly 2 keys, one public and one private, so the total is $8 \times 2 = 16$ keys. Step 3:

take the difference, $28 - 16 = 12$. Option B is the number of officers, option A is only the asymmetric total and option C is not obtained by any correct step, so 12 is the answer and None of these is wrong.

557. The defining phrase is the table of active connections. A stateless packet filter examines each packet in isolation, looking only at addresses, ports and flags, and therefore cannot know whether a packet belongs to an existing session; that eliminates option C. A stateful inspection firewall, by contrast, maintains a state table of open connections and validates each packet against it, which is exactly the behaviour described. A proxy printer is not a security device at all. A network switch forwards frames using MAC addresses and applies no security policy. Hence option A, and None of these is incorrect.

558. A network is often divided so that servers which must be reachable by the public are not placed on the same segment as sensitive internal systems. That intermediate segment, guarded by firewalls on both sides, is called the demilitarised zone or DMZ; if an attacker compromises the public web server, the second firewall still stands between the attacker and core banking. The recycle bin holds deleted files, the clipboard holds copied data, a registry hive is a section of the Windows configuration database and a cache line is a unit of processor cache. None of these is a network segment, so option D is uniquely correct.

559. Classify each name. DES, the older Data Encryption Standard, and AES, its replacement, are both block ciphers in which the same secret key encrypts and decrypts, so both are symmetric. RSA uses a mathematically linked public and private key pair and is therefore asymmetric. Diffie-Hellman is a key exchange method built on public and private values, so it too is not symmetric. Option A states exactly this and is correct. Option B wrongly calls RSA symmetric and DES asymmetric. Options D and E place all four in one family, which contradicts the RSA classification. Option C is wrong because DES performs reversible encryption rather than hashing, and AES does not compress data.

560. Shift each letter forward by 3. B is the 2nd letter, so it becomes the 5th letter, E. A is the 1st letter, so it becomes the 4th letter, D. N is the 14th letter, so it becomes the 17th letter, Q. K is the 11th letter, so it becomes the 14th letter, N. Reading the results in order gives EDQN, which is option C. Option B does not follow any single shift at all, since B to D is forward 2 while A to Z is backward 1, option D shifts some letters wrongly, and option A shifts N by only two places. Since a listed option is correct, None of these is wrong.

561. Step 1: server A publishes $A = 5^6$ reduced modulo 23. Now $5^2 = 25$ which leaves 2, so 5^4 leaves $2^2 = 4$ and $5^6 = 5^4 \times 5^2$ leaves $4 \times 2 = 8$. Hence $A = 8$. Step 2: server B publishes $B = 5^{15}$ reduced modulo 23. Using 5^8 , which leaves $4^2 = 16$, we get $5^{15} = 5^8 \times 5^4 \times 5^2 \times 5^1$, leaving $16 \times 4 \times 2 \times 5 = 640$; since $23 \times 27 = 621$, this leaves 19. Hence $B = 19$. Step 3: the shared key is B^A modulo 23, that is 19^8 modulo 23. As 19 leaves the same remainder as -4 , we need $(-4)^6 = 4096$; since $23 \times 178 = 4094$, the remainder is 2. Checking the other side, $A^B = 8^{15}$ modulo 23 gives the same value 2. So the shared key is 2. Options D and B are the transmitted public values A and B , not the secret, and option C is server B's private exponent $b = 15$, which is never the shared key, so only option A is correct.

562. Step 1: form the modulus, $n = p \times q = 3 \times 11 = 33$. Step 2: raise the plaintext to the public exponent, $M^e = 5^3 = 125$. Step 3: reduce modulo 33. Since $33 \times 3 = 99$, we get $125 - 99 = 26$, and 26 is less than 33, so the reduction is complete and $C = 26$. Option C is the unreduced power, which is not a valid ciphertext because it exceeds the modulus. Options B and A do not arise from any step of the computation. As a check, the private exponent satisfies $3d$ leaving remainder 1 on division by $\phi(n) = 2 \times 10 = 20$, giving $d = 7$, and 26^7 modulo 33 returns 5. Hence option D.

563. Examine each statement. Statement I is correct: port-based filtering is one of the most basic firewall rules, for example blocking port 23 for telnet while allowing port 443. Statement II is correct: an on-demand or scheduled scan inspects files already resident on the disk and can clean, delete or quarantine the infected ones. Statement III is incorrect: encryption protects confidentiality only, that is, it makes the contents unreadable, but the file remains an ordinary object in the file system and an intruder with delete permission can still erase it, which is why backups rather than encryption protect

availability. So I and II are correct and III is not, giving option C. Option E is too narrow because it discards the true statement II.

564. Trace what the signature achieves. Only the sender owns the private key, so a signature that verifies with the sender's public key proves who sent the message; that is authentication, and it also prevents the sender from later denying the act, which is non-repudiation. The signature is computed over the hash of the message, so any alteration changes the hash and breaks verification; that is integrity. However, the message body itself travels unchanged and unencrypted; anyone can read it and can also compute the hash and decrypt the signature using the freely available public key. Therefore confidentiality is the one property not supplied, and it requires separate encryption of the message. Hence option B, and None of these is wrong.

565. XOR gives 1 when the two bits differ and 0 when they are the same. Align the bytes and compare column by column, from the leftmost bit: 1 and 1 are same giving 0; 0 and 1 differ giving 1; 1 and 0 differ giving 1; 1 and 1 are same giving 0; 0 and 0 are same giving 0; 1 and 0 differ giving 1; 1 and 1 are same giving 0; 0 and 1 differ giving 1. Collecting the bits in order yields 01100101. Option B is the OR of the two bytes, since OR gives 1 whenever at least one bit is 1, and option D is the AND, since AND gives 1 only where both bits are 1; both are different operations from XOR. Option A does not arise from any standard bitwise operation on these two bytes. So option C is correct.

566. Apply the rules strictly in order. Rule 1 concerns port 22, but the packet is addressed to port 443, so rule 1 does not match. Rule 2 concerns traffic from 192.168.10.0/24 to port 443; the source 192.168.10.45 lies in that range and the port matches, so rule 2 matches and the packet is allowed. Because evaluation stops at the first match, rule 3 is never reached even though it would have denied the packet, which eliminates option D, and rule 4 is never reached either, which eliminates option A. Option C states a false principle: in a first-match access control list the position of a rule, not its action, decides precedence.

567. Compare the two families on two axes. On speed, symmetric ciphers such as AES perform simple substitutions and permutations and encrypt bulk data very quickly, whereas asymmetric ciphers such as RSA rely on large modular exponentiations and are several orders of magnitude slower; that makes option D the reverse of the truth. On key distribution, a symmetric cipher needs both sides to already share a secret, which two strangers on the Internet do not have, while an asymmetric cipher lets the browser lock a value with the server's published public key so that only the server can open it. The sensible design is therefore to use the slow asymmetric step once, purely to deliver the session key, and then use the fast symmetric cipher for all the traffic, which is what option A says. Option B is false as AES encrypts arbitrarily long streams block by block, and option C is false because AES is used over the Internet constantly. Since option A is correct, None of these is wrong.

Subtopic 5.7.4

568. A digital signature is produced by taking a hash (message digest) of the document and then encrypting that digest with the signer's own private key. The private key is held only by the signer, which is exactly why the resulting signature can be traced back to her. Meena is the signer, so option D is correct. Options A and B are wrong because the recipient's keys play no part in signing (they are used for encryption, not signing). Option C is wrong because Meena's public key is the verification key, distributed openly; if signing used a public key, anyone could forge her signature. Option E is wrong because a digital signature under the asymmetric model does not use a shared symmetric key at all – a shared key would give no non-repudiation, since both parties possess it.

569. The Information Technology Act was passed by Parliament and received assent in the year 2000 (it came into force on 17 October 2000). Option A, 1996, is the year of the UNCITRAL Model Law on Electronic Commerce, on which the Indian Act is modelled, but that is a United Nations model law and not the Indian statute. Option B, 1998, corresponds to no relevant enactment. Option D, 2005, is the year of the Right to Information Act, not the IT Act. Option E, 2008, is the year of the IT (Amendment) Act which inserted Sections 3A, 43A, 66A to 66F and 67A – an amendment to the parent Act of 2000, not the original enactment. Hence C.

570. Signing encrypts only the small hash of the message with the signer's private key; the body of the advice itself travels in plain form unless it is separately encrypted. Therefore confidentiality is NOT a service of a digital signature, making D the exception. Authentication (A) holds because only the signer's private key could have produced a signature that opens with her public key. Integrity (B) holds because any alteration changes the recomputed hash, so verification fails. Non-repudiation (C) holds because the signer cannot later deny an act only her private key could perform. Verifiability (E) holds precisely because the public key is public. To obtain confidentiality the sender must additionally encrypt the message with the recipient's public key.

571. The Act sets up a two-tier structure: the Controller of Certifying Authorities (CCA) is appointed under Section 17 and licenses Certifying Authorities (CAs), and it is these licensed CAs – for example eMudhra, Sify or nCode – that actually issue Digital Signature Certificates to subscribers on application. So A is correct. B is wrong: a bank branch may act as a registration point collecting documents, but it does not issue the certificate. C is wrong: the Registrar of Companies merely accepts digitally signed filings; it does not issue the certificates used to sign them. D is wrong: the RBI regulates banking and issues cyber-security directions, but certificate issuance is not its function under the IT Act. Since a valid option exists, E is wrong.

572. A hash function compresses an input of any size into a fixed-length fingerprint, and the standard term for this fingerprint in the IT Act's own language and in cryptography is the message digest (or hash value). Hence B. A is wrong: a cipher key is an input to an encryption algorithm, not an output of hashing. C is wrong: a digital certificate is a signed data structure binding a public key to an identity, issued by a CA – a completely different object. D is wrong: a session token is a temporary identifier used to maintain a logged-in session in web applications. E is wrong: plain text is the original unencrypted message, i.e. the input side, not the digest.

573. Verification reverses the signing operation. The signer encrypted a hash with her private key; the verifier therefore decrypts the signature with the signer's public key, obtaining the original digest. Independently, the verifier runs the same hash function over the received purchase order to get a second digest. If the two digests match, the order is authentic and unaltered. That is exactly option A. B is impossible: the supplier's private key is secret and Ashok never possesses it. C is wrong: Ashok's own private key relates to messages sent to Ashok in encrypted form, not to verifying someone else's signature. D is wrong: Ashok's public key has no relationship to a signature made by the supplier. Since A is correct, E is wrong.

574. The Schedule to the IT Act excludes a short list of instruments from the Act's operation, and a will or any other testamentary disposition is expressly on that list (along with a negotiable instrument other than a cheque, a power of attorney, a trust, and any contract for the sale or conveyance of immovable property). So a will cannot be made as a digitally signed electronic record, making B correct. A and D are wrong because tax returns and MCA filings are among the commonest uses of Digital Signature Certificates in India and are expressly permitted. C is wrong because an ordinary commercial contract for goods is fully valid in electronic form under Sections 4, 5 and 10A. E is wrong because electronic payment instructions are routine and legally recognised.

575. Work through the signing pipeline. Step one must be hashing, because there is nothing to encrypt until a digest exists – so (iii) comes first. Step two encrypts that digest with the signer's private key, producing the signature itself – so (ii) is second. Only after the signature exists can it be attached to the document and sent – so (i) is last. The order is (iii), (ii), (i), which is option C. Options A and E are wrong because they transmit or encrypt before any digest has been computed. Option B is wrong because it encrypts before hashing, leaving nothing meaningful to encrypt. Option D is wrong because it transmits the document before the signature has been generated, so the auditor would receive an unsigned resolution.

576. Take the two requirements separately. Requirement (b), proof of origin, needs a digital signature, and a signature is always made with the sender's own private key – here the branch's private key. Requirement (a), secrecy in transit, needs encryption for the intended reader only, and that means

encrypting with the recipient's public key – here the head office's public key, since only the head office holds the matching private key to open it. Combining them, the branch signs with its private key and then encrypts the signed package with the head office's public key. That is option B. A and C are wrong because they treat a public key as a signing key, which no one could rely on since public keys are freely available. D is wrong because encrypting with the branch's own public key would make the message readable only by the branch itself, defeating the purpose.

577. A verification failure means only that the digest recovered from the signature does not match the digest recomputed from the received document. Many different causes produce that single symptom: deliberate tampering, accidental corruption during transfer, the wrong certificate being used, an expired or revoked certificate, or a mismatch in encoding. The failure message alone therefore does not single out any one cause. Option A asserts deliberate alteration, which is only one possibility. Option B asserts key theft, which verification failure does not indicate at all – a stolen key would in fact produce signatures that verify successfully. Option C is unrelated, since signature checking says nothing about malware content. Option D is wrong because a hash mismatch of algorithm normally shows up as an unsupported-algorithm error, and in any case is not the only explanation. As no listed conclusion is definitely justified, the answer is None of these.

578. Two ideas combine here. First, a hash function always yields a fixed-length output whatever the input size, so the 5 MB file and the 20 KB file give digests of identical length – this immediately rules out option D, which gives different lengths. Second, SHA-256 produces 256 bits. Each hexadecimal character encodes 4 bits, so the number of characters is $256 \div 4 = 64$. Hence both digests are 64 hex characters long, which is option C. Option A, 32, is the digest length in bytes ($256 \div 8$), not in hex characters. Option B, 40, is the hex length of a SHA-1 digest ($160 \div 4$), a different algorithm. Since C is right, E is wrong.

579. Test the statements separately against the Act's scheme for suspension of certificates. Statement (i) is true: a Certifying Authority may suspend a Digital Signature Certificate on the subscriber's request or where it forms the opinion that suspension is in the public interest, but the certificate shall not be suspended for a period exceeding 15 days unless the subscriber has been given an opportunity of being heard. The fifteen-day ceiling is precisely the safeguard against an indefinite ex parte suspension, so Sneha's hearing becomes mandatory before 16 August. Statement (ii) is false: suspension takes the certificate out of operation immediately, and the Certifying Authority must communicate the suspension to the subscriber and publish notice of it in the repository so that relying parties stop trusting the key. A verifier who checks the repository during the suspension will find the certificate unusable, so signatures made in that window do not carry the assurance the certificate is meant to supply – suspension is a temporary halt, not a mere warning that awaits revocation to bite. Exactly one statement is correct, giving option A. Option B inverts both findings. Option C wrongly accepts (ii). Option D wrongly rejects (i), which the statute states in terms. Option E is wrong because both statements are settled by the provisions themselves and need no further facts.

580. The Act empowers the Central Government to appoint Adjudicating Officers, who must not be below the rank of a Director to the Government of India or an equivalent State officer, to hold inquiries and award compensation. Their pecuniary jurisdiction is limited to claims where the injury or loss does not exceed Rs. 5 crore; claims above that ceiling lie before the competent civil court. Hence D. Options A, B, C and E all state ceilings that do not appear in the statute. Remembering the figure matters in practice: most bank customer complaints over fraudulent electronic transfers fall well under Rs. 5 crore and are therefore adjudicated by the Adjudicating Officer of the State IT Department, with appeal lying to the appellate tribunal.

581. Match the conduct to the provision. Kailash impersonates the bank through a computer resource in order to cheat – that is precisely cheating by personation by using a computer resource, punishable under Section 66D with imprisonment up to three years and fine up to Rs. 1 lakh. Hence B. Section 65 (option A) punishes tampering with computer source documents, i.e. concealing or altering source code, which is not what happened. Section 67 (option C) deals with publishing or transmitting obscene material in electronic form, wholly unrelated. Section 70 (option D) concerns protected systems

declared by the appropriate Government and unauthorised access to them. Section 79 (option E) is not an offence at all – it is the safe-harbour provision limiting the liability of intermediaries.

582. Test each claim. (i) is false: hashing reduces any document to a fixed-length digest, so an RSA-2048 signature is the same size for a one-page letter and a 5 MB scanned file. (ii) is true: the digest is the same for both officers, but each encrypts it with a different private key, so the resulting signatures differ – this is what lets a verifier tell the two officers apart. (iii) is false: verification uses the signer's public key; if the private key were needed the scheme would collapse, because the whole point is that the private key never leaves the signer. (iv) is true: once the signer's certificate is trusted, the public key inside it lets anyone at all verify, which is why signed filings can be checked by regulators, auditors and courts alike. So exactly two claims, (ii) and (iv), are correct, giving option B.

583. Consider what an adversary can do under encrypt-then-sign. The ciphertext is a self-contained blob; the outer signature is merely wrapped around it. An interceptor who cannot read the ciphertext can still discard the genuine outer signature and attach his own signature to the same ciphertext. The recipient decrypts successfully, sees a valid signature from the interceptor, and wrongly concludes that the interceptor originated the payment file. Signing the plaintext first defeats this, because the signature is then bound to content the attacker cannot produce or alter. Hence B. Option A is wrong: signing operates on a fixed-size digest, so file size is never a constraint. Option C is wrong: encryption does not depend on a hash at all. Option D is false and in fact dangerous – good practice uses separate key pairs for signing and encryption. Since B is correct, E is wrong.

584. Revocation takes effect from the date recorded, so signatures made before that date can remain valid – but only if the signing time can be proved independently. A date typed into the document, or the clock on the signer's computer, is under the signer's control and proves nothing. A trusted timestamp from a time-stamping authority cryptographically binds the signature to a moment certified by a neutral third party, so the auditor can show the signature preceded the 10 March revocation. Hence B. Option A is wrong and is in fact a serious breach: retaining a copy of the private key destroys non-repudiation, since the bank could then have created the signature itself. Option C is wrong because a certificate issued after revocation contains a new key pair and says nothing about an earlier signature. Option D is wrong because an acknowledgement proves delivery, not the time of signing, and is easily backdated by the parties.

585. Two distinct inputs mapping to the same digest is by definition a collision, so the property broken is collision resistance. The consequence follows from how signing works: the signature is computed over the digest alone, not over the document text. If agreement *X* and agreement *Y* share a digest, then the signature the bank produced on the harmless *X* is arithmetically identical to a signature on the fraudulent *Y*, and verification of *Y* will succeed. This is exactly the substitution attack that retired MD5 and SHA-1 from signing use. Hence B. Option A is wrong: hashing is not an encryption scheme and confidentiality was never one of its goals. Option C is wrong: availability concerns service uptime and is unaffected by a mathematical collision. Option D is wrong: deriving a private key from a public key is a break of the asymmetric algorithm, an entirely separate matter from a hash collision.

586. Check each pairing against the statute. Section 3 does provide for authentication of electronic records by affixing a digital signature using an asymmetric crypto system and a hash function, so A is correct. Section 17 does provide for the appointment of the Controller, Deputy Controllers and Assistant Controllers of Certifying Authorities, so B is correct. Section 43A, inserted by the 2008 amendment, does require a body corporate handling sensitive personal data to maintain reasonable security practices and to pay compensation for negligence, so C is correct. Section 66F, also inserted in 2008, does define and punish cyber terrorism with imprisonment which may extend to imprisonment for life, so D is correct. Section 72, however, deals with breach of confidentiality and privacy by a person who has secured access to records under powers conferred by the Act; legal recognition of electronic signatures is Section 5. E is therefore the incorrect pairing and is the answer.

587. Two threads must be joined. Technically, non-repudiation rests on the assumption that exactly one person can operate the private key; once a second person holds a copy, Deepak can plausibly deny

any signature, and equally the outsider can create signatures that verify perfectly. So the assurance collapses. Legally, the Act places the duty of care over the private key on the subscriber and requires him, where the key has been compromised, to communicate the fact to the Certifying Authority without any delay so that the certificate can be suspended or revoked. Hence B. Option A is false in principle: a Certifying Authority never holds subscriber private keys – it certifies public keys only. Option C is wrong because the damage is to authenticity and non-repudiation, not merely confidentiality, and past signatures become open to challenge. Option D is wrong and reckless, since every signature made in the interim would be disputable.

588. eSign is an online service in which the signer’s identity is established by Aadhaar authentication using an OTP sent to the registered mobile or a biometric capture. On successful authentication the eSign Service Provider has a key pair generated within a hardware security module and a Certifying Authority issues a short-validity Digital Signature Certificate used for that single transaction, after which the key is destroyed. It operates as an electronic signature within the framework the Act provides for electronic signatures, so A is correct. B is wrong because a licensed Certifying Authority still issues the certificate – Aadhaar supplies authentication, not certification. C is wrong: dispensing with the physical USB token is the very convenience eSign offers, tokens being needed only for conventional Class 3 certificates. D is wrong on two counts: an Aadhaar number is an identifier and not a cryptographic key, and signing does not encrypt the form body at all.

Subtopic 5.8.1

589. The requirement has two parts: the text must be removed from its present position, and it must be held on the clipboard for pasting later. Only the Cut command does both, and Cut is Ctrl + X, so option C is correct. Ctrl + C is Copy, which places the text on the clipboard but leaves the original in place, so it fails the “remove” condition and option A is wrong. Ctrl + V is Paste, which brings clipboard contents in rather than taking text out, so option B is wrong. Ctrl + Z is Undo, which reverses the last action and does not use the clipboard at all, so option D is wrong. Ctrl + A selects the entire document, which only highlights text without removing it, so option E is wrong.

590. Ctrl + Z is the universal Undo shortcut, which reverses the most recent action, so option B is correct. Saving is Ctrl + S, so option A is wrong. Repeating or redoing the last action is Ctrl + Y, which is the exact opposite of Undo, so option C is wrong. Closing the document is Ctrl + W or Alt + F4, so option D is wrong. The letter Z suggests “zoom” to many candidates, but zoom has no single-key Ctrl shortcut in Word and is done through the View tab or the Ctrl key with the mouse wheel, so option E is wrong.

591. Print is invoked by Ctrl + P, the first letter of the command, so option C is correct. Ctrl + N creates a new blank document, so option A is wrong. Ctrl + O opens an existing saved file, so option B is wrong. Ctrl + F opens the Find box to search for text, so option D is wrong. Ctrl + D opens the Font dialog box in MS Word, so option E is wrong.

592. Windows key + L locks the workstation at once and returns the machine to the sign-in screen while all applications stay open in the background, which is exactly what is needed, so option A is correct. Windows key + E opens File Explorer, so option B is wrong. Windows key + R opens the Run dialog box, so option C is wrong. Ctrl + Alt + L is not an assigned Windows shortcut, so option D is wrong. Alt + F4 closes the active window and, if pressed on the desktop, offers to shut down the computer, but it does not lock the session, so option E is wrong.

593. Ctrl + B applies bold formatting to the selected text, B standing for Bold, so option A is correct. Italic is Ctrl + I, so option B is wrong. Underline is Ctrl + U, so option C is wrong. Ctrl + B does not apply bullets; the bullet-list style shortcut in MS Word is Ctrl + Shift + L, so option D is wrong. Moving text to the clipboard is Cut, that is Ctrl + X, so option E is wrong.

594. Adding Ctrl to a navigation key widens its scope from the line to the whole document. The Home key alone moves the cursor to the start of the current line, so option A describes Home without Ctrl and is wrong. Ctrl + Home therefore jumps to the very start of the document, that is the top

of page 1, so option C is correct. There is no shortcut that jumps only to the top of the current page in this manner, so option B is wrong. Moving to the very end of the document is Ctrl + End, the opposite shortcut, so option D is wrong. Page-wise movement is done with Page Up and Page Down, so option E is wrong.

595. Alt + F4 closes the active window and shuts down the running application, so option B is correct. Ctrl + F4 closes only the current document or child window inside an application while the application itself stays open, so it does not quit the application and option A is wrong. Shift + F4 is not a standard window-closing shortcut in Windows, so option C is wrong. Alt + Tab switches between open applications without closing any of them, so option D is wrong. Ctrl + Esc opens the Start menu, which is the same as pressing the Windows key, so option E is wrong.

596. A plain paste is Ctrl + V, which brings across formulas and formatting together and gives no choice, so option A does not open any dialog box and is wrong. The Paste Special dialog box, from which Values, Formats, Transpose and similar options can be chosen, is opened by Ctrl + Alt + V, so option B is correct. Ctrl + Shift + C is not an assigned shortcut in MS Excel and opens no dialog box, so option C is wrong. Alt + V alone activates a ribbon key tip rather than opening Paste Special, so option D is wrong. Ctrl + Shift + P opens the Font dialog box with the font size selected in Excel, so option E is wrong.

597. Ctrl + W is the Close shortcut, and it acts only on the document window that is currently active. Because that document holds edits that have not been saved, Word first displays a prompt offering Save, Don't Save and Cancel, and closes the document once the choice is made; the second document is untouched and Word keeps running. Option B is therefore correct. Ctrl + W never acts on more than the active document, and unsaved work always raises a prompt, so option A is wrong. Shutting the whole application down is Alt + F4, and Word itself quits only when the last remaining document is closed, so option C is wrong. Saving without any prompt is Ctrl + S, and in any case Ctrl + W closes the document rather than leaving it open, so option D is wrong. Reversing recent edits is Ctrl + Z, which has no closing action, so option E is wrong.

598. The F4 key cycles a cell reference through four states in a fixed order. Starting from the relative form A1, the first press makes the reference fully absolute by locking both the column and the row, giving \$A\$1, so option C is correct. A second press would give A\$1, the mixed form with only the row locked, so option B is the result of two presses and is wrong here. A third press would give \$A1, with only the column locked, so option A is the result of three presses and is wrong. A fourth press returns the reference to A1, so option D describes four presses, not one, and is wrong. Since a correct option is present, option E is wrong.

599. The Print Screen key alone copies the image of the entire screen, including the desktop and every visible window, to the clipboard, which is more than required, so option A is wrong. Adding the Alt key restricts the capture to the active window only and still places it on the clipboard, which meets both conditions, so option B is correct. Windows key + Print Screen captures the whole screen, not the active window alone, and additionally saves the capture as an image file in the Screenshots folder, so it fails the active-window-only requirement and option C is wrong. Ctrl + Print Screen is not a standard Windows capture combination, so option D is wrong. Shift + Tab moves the selection backwards between fields and has nothing to do with screen capture, so option E is wrong.

600. Ctrl with an arrow key jumps to the edge of the current block of filled cells, and adding Shift extends the selection over everything jumped across. Starting at A2 and moving downward, the block of continuous entries ends at A40 because A41 is blank, so the jump stops at A40 and the selection becomes A2 to A40, so option C is correct. The selection cannot remain at A2 alone because Shift extends it, so option A is wrong. A41 is empty and lies beyond the edge of the block, so it is not included and option B is wrong. Selection to the very last row of the sheet would happen only if every cell below A2 were empty, which is not the case here, so option D is wrong. The movement is downward from A2, so A1 above it can never be included and option E is wrong.

601. Alt + = is the AutoSum shortcut. It inserts the SUM function into the active cell and automat-

ically proposes the adjoining block of numbers immediately above as the range, which here is B2:B13, so option B is correct. Inserting a row is done with Ctrl + Shift + Plus, so option A is wrong. There is no shortcut that converts numbers into text in this way, so option C is wrong. The currency format is applied with Ctrl + Shift + 4, so option D is wrong. Copying the cell above into the active cell is Ctrl + D, the fill-down shortcut, so option E is wrong.

602. The shortcut that inserts the current time as a fixed value in Excel is Ctrl + Shift + ; (semicolon), and that combination does not appear in the list, so option E is correct. Ctrl + T converts the selected range into an Excel Table, so option A is wrong. Ctrl + Alt + T is not an assigned Excel shortcut, so option B is wrong. Ctrl + ; inserts the current date, not the time, so option C is a close trap and is wrong. Ctrl + Shift + T reopens the last closed tab in a web browser and has no time-stamping role in Excel, so option D is wrong.

603. Solve the two steps in order. Step 1: Ctrl + Home always returns the cursor to cell A1 of the worksheet, so from B5 the cursor lands on A1. Step 2: Ctrl + Right Arrow from a filled cell jumps to the last filled cell of the continuous block in that direction. The block A1 to F1 is unbroken and G1 is empty, so the jump stops at F1. Hence the final position is F1 and option C is correct. Option A gives only the result of the first step and ignores the second, so it is wrong. Option B would be the result of a single Right Arrow press without Ctrl, so it is wrong. The cursor stops at the last filled cell and does not step into the empty G1, so option D is wrong. Jumping to the last column of the worksheet would happen only if the entire row after A1 were empty, which is not the case, so option E is wrong.

604. Take the two keystrokes one at a time. Step 1: Ctrl + End moves the cursor from page 2 to the very end of the document, that is the end of page 4. Step 2: Ctrl + Enter inserts a manual page break at the cursor position. Since the cursor is at the end of the last page, the break creates a fresh page 5 and places the cursor at the top of it. The document therefore grows from 4 pages to 5 and the cursor sits at the top of page 5, so option B is correct. Option A ignores the effect of the second keystroke, so it is wrong. The cursor moves forward to the new page, not back to page 1, and jumping to page 1 would need Ctrl + Home, so options C and D are wrong. Ctrl + Enter adds a page break and never deletes content, so option E is wrong.

605. The references B2 and C2 are written without dollar signs, so they are relative references, and a relative reference shifts by the same number of rows and columns as the paste destination differs from the source. The formula is copied from row 2 to row 7, a downward shift of $7 - 2 = 5$ rows, and there is no shift of columns. Adding 5 to each row number gives B2 becoming B7 and C2 becoming C7, so cell D7 holds $= B7 * C7$ and option B is correct. Option A would be the result only if both references were absolute, which they are not. Option C applies a shift of one row instead of five, which would be the formula in D3, so it is wrong. Option D shows the locked absolute form that would appear only if F4 had been pressed on both references before copying, so it is wrong. A correct option is present, so option E is wrong.

606. Ctrl + Page Down moves one sheet to the right and Ctrl + Page Up moves one sheet to the left. Starting from Sheet2, the first Ctrl + Page Down gives Sheet3 and the second gives Sheet4. The single Ctrl + Page Up then moves one sheet back to the left, from Sheet4 to Sheet3. The net movement is $2 - 1 = 1$ sheet to the right of Sheet2, so the active sheet is Sheet3 and option C is correct. Option D ignores the final Ctrl + Page Up. Option B would be right only if the rightward and leftward presses were equal in number, which they are not. Option A would require a net movement of one sheet to the left, the opposite direction, so it is wrong. A correct option is present, so option E is wrong.

607. Work through the two commands in sequence. Ctrl + W closes the active tab, and after each closure the browser makes another tab active, so three presses close three tabs and the count falls from 6 to $6 - 3 = 3$. Ctrl + Shift + T reopens the most recently closed tab, and pressing it twice restores two of the three closed tabs, raising the count to $3 + 2 = 5$. Hence 5 tabs remain open and option C is correct. Option A stops after the closing stage and ignores the reopening. Option D would need all three closed tabs to be restored, that is three presses of Ctrl + Shift + T, not two. Option B would follow from only one reopening press. Option E treats Ctrl + Shift + T as opening brand new tabs on top of 6, but it restores previously closed tabs instead, so it is wrong.

608. Deal with the keystrokes in order. Ctrl + A selects the entire document, so whatever formatting follows will apply to all paragraphs, not just one. Ctrl + 2 then applies double line spacing to the selection. The clerk therefore gets exactly what he wanted, and option B is correct. Single line spacing is Ctrl + 1, so option A is wrong. Because Ctrl + A widened the selection to the whole document, the effect cannot be limited to the current paragraph, so option C is wrong. Line spacing and font size are different attributes, and font size is increased in steps with Ctrl + Shift + Greater-than sign, so option D is wrong. The 1.5 line spacing setting is Ctrl + 5, so option E is wrong.

609. The key point is that Windows key + M is a one-way command, not a toggle. The first press minimises every open window to the taskbar. The second press simply repeats the same instruction on a desktop where nothing is left to minimise, so nothing changes and the windows stay minimised, making option B correct. Restoring the minimised windows requires the separate combination Windows key + Shift + M, so option A is wrong. Minimising never closes an application, which would need Alt + F4, so option C is wrong. No single window is singled out for restoration by this shortcut, so option D is wrong. Maximising is done with Windows key + Up Arrow and is the opposite of what happened, so option E is wrong. Note the contrast with Windows key + D, which does toggle, so that a second press there would restore the windows.

Subtopic 5.8.2

610. RAM is the volatile main memory of a computer in which any storage location can be reached directly, in the same amount of time, without reading through the preceding locations. That property is called *random access*, and it gives the name Random Access Memory. Option A, C and D are invented expansions that do not appear in any standard text: memory is not described as 'Readily Available', 'Read Adjustable' or an 'Arithmetic Module' (arithmetic work is done by the ALU, not by memory). Since the correct expansion is present as option B, 'None of these' is not required. Hence the answer is B.

611. The machine performs, without human help, the work that a human *teller* (the counter clerk who pays out and receives cash) would otherwise do. Hence its standard name is Automated Teller Machine. 'Any Time Money' in option C is only a popular advertising slogan used by banks, not the technical expansion. Options A and D use the word Transaction/Transfer in place of Teller and are therefore wrong, because the defining idea in the abbreviation is the replacement of the teller. The correct expansion appears at option B, so E is ruled out. Answer: B.

612. A web address performs one job: it *locates a resource* (a page, an image, a file) on the Internet, and it does so in a standard, *uniform* format such as protocol, then domain, then path. Putting these three ideas together gives Uniform Resource Locator. Options A, C and D substitute Link, Retrieval and Registry for the standard words and are not recognised expansions. As the correct form is listed, option E is not the answer. Hence B.

613. The chip that fetches, decodes and executes instructions is the single *central* point of *processing* in the machine, and it is a hardware *unit*. Therefore CPU is expanded as Central Processing Unit. Option A wrongly uses Programming, which is a human activity, not what the chip does. Option B uses Utility, which suggests a software tool. Option D describes peripherals, which are the external devices (printer, mouse) and are the opposite of the central unit. The correct answer is present, so E is rejected. Answer: C.

614. The format was designed so that a *document* could be carried, or made *portable*, across different computers, printers and operating systems while keeping its layout fixed. Hence Portable Document Format. Option B is a common trap: it keeps 'Portable' but replaces Document with Data, and the standard expansion uses Document. Options A and D ('Printed', 'Public') describe how a file might be used, not the format itself. Since option C states the correct form, E is not required. Answer: C.

615. The device does two opposite jobs. While sending, it *modulates*, that is, it imposes the digital data on a carrier signal. While receiving, it *demodulates*, that is, it extracts the data back from the carrier. MODEM is a blend of the first letters of these two words: MODulator-DEModulator. Option

A gives only one of the two functions and adds ‘Mobile’, which is not part of the term. Options C and D are invented. The correct expansion is listed, so E is rejected. Answer: B.

616. NEFT is the country-wide, that is *national*, retail payment system operated electronically, in which *funds* are *transferred* from one bank account to another. Hence National Electronic Funds Transfer. Option B replaces National with New and Transfer with Transaction. Option C replaces Funds with Financial. Option D replaces Electronic with Express. Each differs from the official Reserve Bank of India terminology by at least one word, so only option A is defensible, and E is not needed. Answer: A.

617. Expand each abbreviation and check whether the expansion names a memory. ROM is Read Only Memory, DRAM is Dynamic Random Access Memory, EEPROM is Electrically Erasable Programmable Read Only Memory and SRAM is Static Random Access Memory, so all four end in the word Memory and are genuine memory types. SMTP does not end in the word Memory at all: its final letter P stands for Protocol, so it belongs to the networking side of computing, where it governs how electronic mail is passed between machines. It says nothing about the storage of data inside a machine. Hence the odd one out is SMTP. Answer: C.

618. Two conditions must be satisfied at the same time. First, the protocol must handle outgoing mail. POP3 and IMAP both handle *incoming* mail, that is, they let a client fetch or read messages already lying on the mail server, so options A and B fail this test even though their expansions are correct. Second, the expansion must begin with ‘Simple’. That leaves SMTP and SNMP. SNMP, Simple Network Management Protocol, is used to monitor and manage network devices such as routers and switches, not to send mail, so option D fails the first test. Only SMTP, Simple Mail Transfer Protocol, satisfies both conditions. Answer: C.

619. Check each pair word by word. In option A the third word must be Transfer, not Transmission: HTTP is HyperText Transfer Protocol. In option B the second word must also be Transfer: FTP is File Transfer Protocol, since it moves whole files between machines. In option C the middle word must be User, not Utility: GUI is Graphical User Interface, the screen of windows and icons through which the user interacts. Option D is exactly right: DNS is the Domain Name System, the service that translates a name such as a bank’s website address into its numeric IP address. Because one option is correct, E cannot be the answer. Answer: D.

620. The technology works in three stages: the digits are printed with iron oxide based *magnetic ink*; each printed digit is a *character* of a special font; and the machine identifies, that is *recognises*, those characters magnetically. Combining the stages gives Magnetic Ink Character Recognition. Option A replaces Character Recognition with Cheque Reader, which describes the application rather than the technology. Option C wrongly uses Image, which would make it an optical, not magnetic, method. Option D uses Manual, which contradicts the whole purpose of automatic reading. Answer: B.

621. The key idea described in the question is that the movement of the paper cheque is cut short, or *truncated*, at the presenting bank, and only the scanned image plus the MICR line move ahead. The word that captures ‘cutting short the physical flow’ is Truncation, giving Cheque Truncation System. Option A, Cheque Transfer System, wrongly suggests the paper is still transferred, which is exactly what the scheme prevents. Options B and D are invented terms; CTS is a clearing system, not a piece of tracking software. Answer: C.

622. Read the five letters in order: A for American, S for Standard, C for Code, I for Information and I for Interchange, giving American Standard Code for Information Interchange. Option B replaces Information with Internet, but the scheme was created long before the Internet and codes information of any kind. Option C replaces American with Advanced, which does not match the letter A used for the country of origin of the standard. Option D changes Standard to System and Interchange to Interface. Only option A matches letter for letter. Answer: A.

623. Take the options one at a time. ALU is the part of the CPU that performs arithmetic and logical operations, so Arithmetic Logic Unit is correct. USB is the standard port that carries data serially

and is used universally across devices, so Universal Serial Bus is correct. VDU is an older name for the monitor, that is the Visual Display Unit, so it is correct. NIC is the card that gives a computer its interface to a network, so Network Interface Card is correct. BIOS, however, is Basic Input Output System, the firmware that starts the machine and handles basic input and output before the operating system loads. Option D wrongly writes ‘Integrated Operating’ in place of ‘Input Output’, so it is the incorrect expansion. Answer: D.

624. Verify each statement separately. (i) A LAN joins machines within one building or campus, that is within a *local area*, so Local Area Network is correct. (ii) PROM is a read only memory that is blank when manufactured and can be written once by the user, so its expansion is Programmable **Read** Only Memory; the statement writes ‘Random’ in place of ‘Read’, which would confuse it with RAM, so (ii) is incorrect. (iii) ISDN carries voice and data together over digital telephone lines, and its expansion is Integrated Services Digital Network, which is correct. (iv) WAN spans cities or countries and is Wide Area **Network**; the statement writes ‘Nodes’ in place of ‘Network’, so (iv) is incorrect. (v) A CD-ROM is an optical disc whose contents can only be read, so Compact Disc Read Only Memory is correct. The correct statements are (i), (iii) and (v), that is 3 in number. Since ‘Three’ appears as option B, ‘None of these’ is not required. Answer: B.

625. Expand each abbreviation and locate the letter P. FTP is File Transfer **Protocol**, so P is Protocol. VoIP is Voice over Internet **Protocol**, so P is Protocol. TCP is Transmission Control **Protocol**, so P is Protocol. SMTP is Simple Mail Transfer **Protocol**, so P is Protocol. PDF is **Portable** Document Format; here P is the first letter and stands for Portable, and the abbreviation names a file format, not a communication rule set. Hence PDF is the only one in which P is not Protocol. Answer: D.

626. Two things must be settled: which technology suits job (1), and whether the expansion given for it is right. Job (1) involves detecting the presence or absence of a pencil *mark* in a fixed position, not identifying the shape of letters; the technology for that is OMR. Job (2), converting printed characters into editable text, is the work of OCR, so option A names the technology for the wrong job. Option D, MICR, reads magnetic ink on cheques and is irrelevant here. Between the two OMR options, option C expands it as ‘Optical Manual Reader’, which is self-contradictory because the reading is automatic, not manual; the accepted expansion is Optical Mark Recognition. Hence option B is correct on both counts. Answer: B.

627. Check each one. COBOL was designed for business data processing and its accepted expansion is Common Business Oriented Language, so A is correct. BASIC was designed as an easy first language, expanded as Beginner’s All-purpose Symbolic Instruction Code, so B is correct. FORTRAN was built for scientific formula work and comes from Formula Translation, so C is correct. UNIVAC, the early commercial machine, is the Universal Automatic Computer, so E is correct. ALGOL, however, comes from **Algorithmic** Language, since it was designed to express algorithms. Option D writes ‘Algebraic Oriented Language’, which is not the standard expansion. Answer: D.

628. Statement I: DNS is the Domain **Name** System, the directory that maps a website’s name to its numeric address, so the N does stand for Name. I is correct. Statement II: ISP is Internet **Service** Provider, the company such as a telecom operator that provides Internet connectivity. The S stands for Service, not Server, so II is incorrect. Statement III: every network interface card carries a permanent hardware address used by the Media Access Control sub-layer, so MAC address indeed stands for Media Access Control address. III is correct. Correct statements are I and III only. Answer: C.

629. Examine each expansion. CVV is the value printed on the card that is used to verify that the genuine card is in the customer’s hand during a card-not-present transaction; the accepted expansion is Card Verification Value, so option A is right. Option B is wrong because OTP is One Time **Password**, not Passcode. Option C is wrong because EMV is not an English phrase at all; it is formed from the names of the three founding organisations, Europay, Mastercard and Visa. Option D is wrong because NPCI is the National Payments **Corporation** of India, an umbrella organisation for retail payments, not a ‘Council’. Since option A is correct, E is ruled out. Answer: A.

630. Write out each full form and look only at its final word. HTML is HyperText Markup **Language**, so it counts. XML is eXtensible Markup **Language**, so it counts. CSS is Cascading Style **Sheets**, which ends in Sheets, so it does not count. SQL is Structured Query **Language**, so it counts. DBMS is Database Management **System**, which ends in System, so it does not count. The abbreviations that qualify are HTML, XML and SQL, that is 3 of them. Since 'Three' is available as option C, 'None of these' is not the answer. Answer: C.