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1. The approximate value of the integral

$$\int_0^1 x^2\,dx$$

using trapezoidal rule with step size 0·5 is

(A) $\frac{1}{3}$ (B) $\frac{3}{8}$

(C) $\frac{3}{10}$ (D) $\frac{2}{7}$

2. The approximate value of ln 2 obtained from the numerical integration of

$$\int_0^1 \frac{1}{1+x}\,dx$$

using Simpson's one-third rule with step size 0·5 is

(A) $\frac{25}{36}$ (B) $\frac{26}{36}$

(C) $\frac{25}{40}$ (D) $\frac{26}{40}$

3. The value of

$$\lim_{x\to 0}\frac{\sin x}{x^3+3x}$$

is

(A) 0 (B) $\frac{1}{5}$

(C) $\frac{1}{8}$ (D) $\frac{1}{3}$

4. The function $f(x) = |x| / x$ if $x \neq 0$ and $f(x) = 0$ if $x = 0$ is

(A) differentiable at 0

(B) continuous at 0

(C) continuous but not differentiable at 0

(D) not continuous at 0

5. The value of

$$\int_{-\infty}^{\infty}\frac{1}{e^x+e^{-x}}\,dx$$

is

(A) π

(B) $\frac{\pi}{2}$

(C) $\frac{\pi}{4}$

(D) None of the above

6. If $f(x, y) = \sin xe^{xy}$, then $\frac{\partial f}{\partial x}$ is equal to

(A) $e^{xy}(x\cos x + \sin x)$

(B) $e^{xy}(y\cos x + \sin x)$

(C) $e^{xy}(x\sin x + \cos x)$

(D) $e^{xy}(y\sin x + \cos x)$

7. If x and y are two positive integers such that $x + y = n$, then the maximum value of the product xy is

(A) n^2

(B) $\frac{n^2}{2}$

(C) $\frac{n^2}{4}$

(D) $\frac{n^2}{16}$

8. If p and q are logical statements, p is true and q is false, then

(A) both $p \wedge q$ and $p \vee q$ are true

(B) both $p \wedge q$ and $p \vee q$ are false

(C) only $p \wedge q$ is true

(D) only $p \vee q$ is true

9. If p and q are logical statements and both are false, then

(A) both $p \to q$ and $q \to p$ are false

(B) both $p \to q$ and $q \to p$ are true

(C) only $p \to q$ is true

(D) only $q \to p$ is false

10. The total number of possible non-empty subsets of a set containing 5 elements is

(A) 10 (B) 25

(C) 31 (D) 32

11. If

$A = \{1, 2, 3, 4\}$ and $B = \{a, b, c, d, e\}$

then the number of possible injective function from A to B is

(A) 120 (B) 20

(C) 1024 (D) 625

12. The function $f : [-1, \infty) \to \mathbb{R}$ defined by $f(x) = x^2$ is

(A) one-one

(B) onto

(C) one-to-one

(D) None of the above

13. The contrapositive of the statement $p \to q$ is

(A) $\sim p \to q$

(B) $q \to \sim p$

(C) $\sim p \to \sim q$

(D) $\sim q \to \sim p$

14. In the group $G = \{1, 2, 3, 4, 5, 6\}$ with the operation multiplication modulo 7, the inverse of 5 is

(A) 1

(B) 2

(C) 3

(D) 4

15. If G is a finite group of order 9 with identity element e and $a \in G$, then a^8 is equal to

(A) e

(B) a^{-1}

(C) a

(D) None of the above

16. A partial order on a set is

(A) reflexive and symmetric

(B) reflexive but not transitive

(C) symmetric but not transitive

(D) antisymmetric, reflexive and transitive

17. If $f(x, y, z) = x \wedge (\sim y \vee z)$ is a Boolean function, then $f(1, 0, 1)$ and $f(1, 1, 0)$ are equal to

(A) 0, 0 (B) 0, 1

(C) 1, 0 (D) 1, 1

18. The contents of two urns are respectively 3 white, 5 black and 5 white, 2 black balls. One ball is chosen at random from urn–1 and without noticing its colour, it is put into urn–2 and then a ball is drawn from urn–2. The probability that it is white is

(A) $\frac{2}{7}$

(B) $\frac{3}{8}$

(C) $\frac{1}{4}$

(D) None of the above

19. The mean of 50 observations was 106. Subsequently, it was discovered that one of the observations 31 was in error while the correct value is 51. The corrected value of the mean is

(A) 106·1 (B) 106·2

(C) 106·3 (D) 106·4

20. The median of 50 consecutive natural numbers is 65·5. The smallest of these 50 numbers is

(A) 39 (B) 40

(C) 41 (D) 42

21. The mean, median and mode coincide in

(A) normal distribution

(B) binomial distribution

(C) Poisson distribution

(D) exponential distribution

22. The standard deviation of 97 consecutive natural numbers is

(A) 27 (B) 28

(C) 29 (D) 30

23. Let the random variable X denote the number of times a fair coin is tossed till the first head appears. The value of $\Pr(X \geq 3)$ is

(A) $\frac{3}{4}$ (B) $\frac{1}{2}$

(C) $\frac{1}{4}$ (D) $\frac{7}{8}$

24. Let X be a random variable following the exponential distribution $f(x) = 2e^{-cx}$ if $x > 0$ and $f(x) = 0$ otherwise, where c is a positive unknown constant. The value of c is

(A) $\frac{1}{2}$ (B) 2

(C) $\frac{1}{4}$ (D) 4

25. The mean of a Poisson distribution is 5. Its variance is

(A) 25 (B) $\sqrt{5}$

(C) $5\sqrt{5}$ (D) 5

26. If μ and σ^2 are the mean and variance of a normal distribution, then about 95% of the area under the curve the distribution is being covered between the limits

(A) $\mu - \sigma$ to $\mu + \sigma$

(B) $\mu - 2\sigma$ to $\mu + 2\sigma$

(C) $\mu - 3\sigma$ to $\mu + 3\sigma$

(D) $\mu - 4\sigma$ to $\mu + 4\sigma$

27. The minimum number of times a fair coin must be tossed so as to ensure two or more heads with a probability of 0·99 or more is

(A) 8 (B) 9

(C) 10 (D) 11

28. The number of five-digit numbers that can be formed using the digits 0, 1, 2, 3, 4 without repetition is

(A) 120

(B) 96

(C) 3125

(D) 2500

29. The number of ways a committee of five members with at least one girl can be formed from a group of 4 boys and 3 girls is

(A) 21 (B) 20

(C) 15 (D) 7

30. The number of 2×2 matrices that can be constructed with elements from the set $\{0, 1\}$ is

(A) 9

(B) 16

(C) 25

(D) None of the above

31. A sequence is defined by a recurrence relation $x_1 = 1$, $x_2 = 6$ and for $n \geq 3$, $x_n = 6x_{n-1} - x_{n-2}$. The value of x_6 is

(A) 204 (B) 1189

(C) 6930 (D) 40391

32. A graph has 10 edges and 6 vertices. The sum of degrees of vertices is equal to

(A) 10 (B) 16

(C) 20 (D) 60

33. A connected graph with 11 vertices is a tree. The number of edges it is having is

(A) 10 (B) 11

(C) 21 (D) 22

34. A connected planner graph has 17 edges, dividing the plane into 9 regions. The number of vertices of the graph is

(A) 8 (B) 9

(C) 10 (D) 11

35. The determinant of a 3×3 matrix is 2·5. The determinant of its adjoint matrix is

(A) 5 (B) 6·25

(C) 7·5 (D) 15·625

36. The generating function of the set of natural numbers is

(A) $(1-x)^{-1}$

(B) $(1+x)^{-1}$

(C) $(1-x)^{-2}$

(D) $(1+x)^{-2}$

37. The system of equations

$$2x - 3y + 5z = 4$$
$$3x + 2y - z = 4$$
$$x + 5y - 6z = 0$$

has

(A) no solution

(B) not more than two solutions

(C) the only solution $x = y = z = 1$

(D) infinitely many solutions

38. The eigenvalues of a real symmetric matrix are

(A) all real

(B) all complex

(C) all zero

(D) None of the above

39. If Newton-Raphson method with initial approximation $x_0 = 1$ is used to find the positive square root of 2, then the next approximation x_1 is equal to

(A) 1 (B) 1·25

(C) 1·5 (D) 1·75

40. The order of convergence of secant method is

(A) 1

(B) 1·5

(C) 2

(D) None of the above

41. Which one of the following tests refers to the retesting of a unit, integration and system after modification, in order to ascertain that the change has not introduced new faults?

(A) Regression test

(B) Smoke test

(C) Alpha test

(D) Beta test

42. The expected value for the estimation variable (size), S can be computed as a weighted average of the optimistic (Sopt), most likely (Sm) and pessimistic (Spess) estimates given as

(A) EV = (Sopt + 4Sm + Spess)/4

(B) EV = (Sopt + 4Sm + Spess)/6

(C) EV = (Sopt + 2Sm + Spess)/6

(D) EV = (Sopt + 2Sm + Spess)/4

43. When inorder traversing a tree resulted E A C K F H D B G; the preorder traversal would return

(A) F A E K C D B H G

(B) F A E K C D H G B

(C) E A F K H D C B G

(D) F E A K D C H B G

44. The database system must take special actions to ensure that transactions operate properly without interference from concurrently executing database statements. This property is referred to as

(A) atomicity

(B) durability

(C) isolation

(D) All of the above

45. Which of the following is a fundamental operation in relational algebra?

(A) Set intersection

(B) Natural join

(C) Assignment

(D) None of the above

46. DTD (document type definition) includes the specifications about the markup that can be used within the document, the specifications consists of all, ***except***

(A) the browser name

(B) the size of element name

(C) entity declarations

(D) element declarations

47. Which one of the following attributes will you use with TD tag to merge two cells horizontally?

(A) merge = colspan2

(B) rowspan = 2

(C) colspan = 2

(D) merge = row2

48. The transformation between the parallel and serial ports is done with the help of

(A) flip-flops
(B) logic circuits
(C) shift registers
(D) None of the above

49. The fetch and execution cycles are interleaved with the help of

(A) modification in processor architecture
(B) clock
(C) special unit
(D) control unit

50. CPU has two modes privileged and non-privileged. In order to change the mode from privileged to non-privileged

(A) a hardware interrupt is needed
(B) a software interrupt is needed
(C) Either (A) or (B)
(D) a non-privileged instruction (which does not generate an interrupt) is needed

51. A binary tree whose every node has either zero or two children is called

(A) complete binary tree
(B) binary search tree
(C) extended binary tree
(D) None of the above

52. Which of the following standard algorithms is not a greedy algorithm?

(A) Dijkstra's shortest path algorithm
(B) Bellman-Ford shortest path algorithm
(C) Kruskal's algorithm
(D) Prim's algorithm

53. Let X be a problem that belongs to the Class NP. Which one of the following statements is true?

(A) There is no polynomial time algorithm for X.
(B) If X can be solved deterministically in polynomial time, then $P = NP$.
(C) If X is NP-hard, then it is NP-complete.
(D) X may be undecidable.

54. Which of the following is true about NP-complete and NP-hard problems?

(A) If we want to prove that a problem X is NP-hard, we take a known NP-hard problem Y and reduce Y to X.
(B) The first problem that was proved as NP-complete was the circuit satisfiability problem.
(C) NP-complete is a subset of NP-hard.
(D) All of the above

55. A complete n-ary tree is one in which every node has 0 or n sons. If x is the number of internal nodes of a complete n-ary tree, the number of leaves in it is given by

(A) $x(n-1)+1$

(B) $xn-1$

(C) $xn+1$

(D) $x(n+1)$

56. The minimum number of interchanges needed to convert the array 89, 19, 40, 17, 12, 10, 2, 5, 7, 11, 6, 9, 70 into a heap with the maximum element at the root node is

(A) 0

(B) 1

(C) 2

(D) 3

57. Given the language

$$L = \{ab, aa, baa\}$$

which of the following strings are in L^*?

1. $abaabaaabaa$
2. $aaaabaaaa$
3. $baaaaabaaaab$
4. $baaaaabaa$

(A) 1, 2 and 3

(B) 2, 3 and 4

(C) 1, 2 and 4

(D) 1, 3 and 4

58. For a database relation $R(a, b, c, d)$ where the domains of a, b, c, d include only atomic values, only the following functional dependencies and those that can be inferred from them hold :

$$a \rightarrow c$$
$$b \rightarrow d$$

The relation is

(A) in first normal form but not in second normal form

(B) in second normal form but not in third normal form

(C) in third normal form

(D) None of the above

59. Consider a relation scheme $R = (A, B, C, D, E, H)$ on which the following functional dependencies hold :

$$(A \rightarrow B, BC \rightarrow D, E \rightarrow C, D \rightarrow A)$$

What are the candidate keys of R?

(A) AE, BE

(B) AE, BE, DE

(C) AEH, BEH, BCH

(D) AEH, BEH, DEH

60. Consider the following relation scheme pertaining to a student's database :

Student (rollno, name, address)

Enroll (rollno, courseno, coursename)

The primary keys are shown underlined. The numbers of tuples in the "Student" and "Enroll" tables are 120 and 8 respectively. What are the maximum and minimum numbers of tuples that can be present in (Student * Enroll), where '*' denotes natural join?

(A) 8, 8

(B) 120, 8

(C) 960, 8

(D) 960, 120

61. Packets of the same session may be routed through different paths in

(A) TCP but not UDP

(B) TCP and UDP

(C) UDP but not TCP

(D) neither TCP nor UDP

62. The address resolution protocol (ARP) is used for

(A) finding the IP address from the DNS

(B) finding the IP address default gateway

(C) finding the IP address that corresponds to MAC address

(D) finding the MAC address that corresponds to an IP address

63. The tightest lower bound on the number of comparisons, in the worst case, for comparison-based sorting is of order of

(A) n

(B) n^2

(C) $n \log n$

(D) $n \log_2 n$

64. For IPv4 address formats 16384, networks with up to 64k hosts each are allowed in

(A) Class A

(B) Class B

(C) Class C

(D) Class D

65. The run-time polymorphism where the selection of the appropriate function is carried out dynamically at run time is achieved with the help of the

(A) friend function

(B) virtual function

(C) inline function

(D) None of the above

66. The grammar $S \rightarrow aSa|bS|c$ is

(A) LL(1) but not LR(1)

(B) LR but not LR(1)

(C) both LL(1) and LR(1)

(D) neither LL(1) nor LR(1)

67. Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both uses the same net mask N. Which of the values of N given below should not be used if A and B should belong to the same network?

(A) 255.255.255.0

(B) 255.255.255.128

(C) 255.255.255.192

(D) 255.255.255.224

68. Which of the following is a key factor for preferring B+ trees to binary search trees for indexing database relations?

(A) Database relations have a large number of records

(B) Database relations are sorted on the primary key

(C) B+ trees require less memory than binary search trees

(D) Data transfer from disks is in blocks

69. A decimal number has 25 digits. The number of bits needed for its equivalent binary representation is approximately

(A) 50 (B) 60

(C) 70 (D) 75

70. The Boolean expression $X + X'Y$ equals

(A) $X + Y$

(B) $X + XY$

(C) $Y + YX$

(D) $X'Y + Y'X$

71. The minimum number of gates required to implement the Boolean expression

$$AB + AB' + A'C$$

is

(A) 1 AND gate and 1 OR gate

(B) 2 NAND gates

(C) 3 AND gates and 2 OR gates

(D) None of the above

72. Concurrent processes are processes that

(A) do not overlap in time

(B) overlap in time

(C) are executed by a processor at the same time

(D) None of the above

73. Which of the following registers holds the address of the instruction?

(A) Address register

(B) Instruction register

(C) Accumulator

(D) Program counter

74. An overloaded relational operator != is used in string handling as

```
return (strcmp (s, x.c)!=0?
                    true: false;)
```

Assuming that s and x.c contain different strings, what value is returned?

(A) True

(B) False

(C) Syntax error

(D) Null

75. If s is a semaphore variable, then which of the following depicts wait(s)?

(A) while not (s > 0) do; s: = s – 1;

(B) while not (s > 0) do s: = s – 1;

(C) while (s > 0) do; s: = s – 1;

(D) while (s < 0) do s: = s + 1;

76. For the two-level implementation of Boolean functions, OR-NAND is equivalent to

(A) OR-AND-INVERT

(B) NOR-OR

(C) Both (A) and (B)

(D) None of the above

77. Simplify the following Boolean function in sum of products form :

$F(A, B, C, D, E) = \Pi\ (1, 3, 5, 7, 8, 10, 12, 14, 16, 18, 19, 20, 22, 23, 24, 26, 28, 30)$

(A) $CBE + D'E + A'B'E'$

(B) $BE + AD'E + A'B'E'$

(C) $BE + D'E + A'B'E'$

(D) $AD'E + A'B'E'$

78. For a 256 k memory, the number of address lines required is

(A) 8

(B) 14

(C) 16

(D) 18

79. In Binary Code Decimal (BCD) system, 92 is represented as

(A) 10010010

(B) 1011100

(C) 100110

(D) 10101110

80. Which one of the following is ***not*** a network protocol?

(A) SMTP

(B) FTP

(C) HTTP

(D) NMP

81. The assembly language program must be translated into machine code by a separate program called

(A) Assembler

(B) Interpreter

(C) Compiler

(D) Loader

82. Which one of the following normal forms is considered practically adequate for relational database design?

(A) 2NF

(B) 3NF

(C) 4NF

(D) BCNF

83. Which one of the following statements is false?

(A) There is unique minimal DFA for every regular language.

(B) Every NFA can be converted to an equivalent PDA.

(C) Complement of every context-free language is recursive.

(D) Every non-deterministic PDA can be converted to an equivalent deterministic PDA.

84. $S \rightarrow aSa|bSb|a|b$

The language generated by the above grammar over the alphabet $\{a, b\}$ is the set of

(A) all palindromes

(B) all odd length palindromes

(C) strings that begin and end with the same symbol

(D) all even length palindromes

85. Which one of the following statements is false?

(A) Any relation with two attributes is in BCNF.

(B) A relation in which every key has only one attribute is in 2NF.

(C) A prime attribute can be transitively dependent on a key in a 3NF relation.

(D) A prime attribute can be transitively dependent on a key in a BCNF relation.

86. Which one of the following is the tightest upper bound that represents the time complexity of inserting an object into a binary search tree of n nodes?

(A) $O(1)$

(B) $O(\log n)$

(C) $O(n)$

(D) $O(n \log n)$

87. Consider a B+ tree in which the maximum number of keys in a node is 5. What is the minimum number of keys in any non-root node?

(A) 1 (B) 2

(C) 3 (D) 4

88. Which of the following is ***not*** a valid deadlock prevention scheme?

(A) Release all resources before requesting a new resource.

(B) Number the resources uniquely and never request a lower numbered resource than the last one requested.

(C) Never request a resource after releasing any resource.

(D) Request and all required resources be allocated before execution.

89. Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will

(A) always decrease the number of page faults

(B) always increase the number of page faults

(C) sometimes increase the number of page faults

(D) never affect the number of page faults

90. Which of the following data structures are indexed structures?

(A) Linear arrays

(B) Linked lists

(C) Graphs

(D) Trees

91. Recursive algorithms are based on

(A) divide and conquer approach

(B) top-down approach

(C) bottom-up approach

(D) hierarchical approach

92. How do you determine the cost of a spanning tree?

(A) By the sum of the costs of the edges of the tree

(B) By the sum of the costs of the edges and vertices of the tree

(C) By the sum of the costs of the vertices of the tree

(D) By the sum of the costs of the edges of the graph

93. Information systems that use combination of several AI technologies are called as

(A) hybrid AI system

(B) component system

(C) fuzzy logic

(D) All of the above

94. _____ is a black-box testing method.

(A) Boundary-value analysis

(B) Basic path testing

(C) Code path testing

(D) All of the above

95. A graphic representation of information system is called

(A) flowchart

(B) dataflow diagram

(C) pictogram

(D) histogram

96. Which of the following models remains operative until the software retires?

(A) Waterfall

(B) Incremental

(C) Spiral

(D) None of the above

97. What type of errors are missed by black-box testing but can be uncovered by white-box testing?

(A) Behavioural errors

(B) Subtle logic errors

(C) Performance errors

(D) Input errors

98. In OSI network architecture, the dialogue control and token management are responsibilities of

(A) session layer

(B) network layer

(C) transport layer

(D) data-link layer

99. Which one of the following protocols works at the transport layer and provides virtual circuits between hosts?

(A) IP (B) ARP

(C) TCP (D) UDP

100. What range of address can be used in the first octet of a Class B network address?

(A) 1–127 (B) 128–190

(C) 128–191 (D) 192–220

★★★