

Q. No. 1 – 25 Carry One Mark Each

1. A Graph G is a connected planar simple graph with 'e' edges and 'v' vertices, with $v \geq 3$, if all cycles in G have length ≥ 4 then which of the following relations always hold?
 (A) $e \leq 2v - 4$ (B) $e \leq 2v - 2$ (C) $e \leq 3v - 4$ (D) None of these

2. $\int \frac{x^2}{x^2 + 4} dx =$
 (A) $x - \frac{1}{2} \tan^{-1}\left(\frac{x}{2}\right) + c$ (B) $x - 2 \tan^{-1}\left(\frac{x}{2}\right) + c$
 (C) $x - \tan^{-1}\left(\frac{x}{2}\right) + c$ (D) $x + \frac{1}{2} \tan^{-1}\left(\frac{x}{2}\right) + c$

3. If $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$, then
 (A) $A^3 + 3A^2 + A - 9I = 0$ (B) $A^3 - 3A^2 - A + 9I = 0$
 (C) $A^3 - 3A^2 + A + 9I = 0$ (D) $A^3 + 3A^2 - A + 9I = 0$

4. Which of the following gives an approximate run time of OSPF routing protocol?
 $\left. \begin{array}{l} N: \text{Number of vertices} \\ M: \text{Number of edges} \end{array} \right\} \text{ Assume } M = O(N^2)$
 (A) $O(M + N \log M)$ (B) $O(N + M \log M)$ (C) $O(M + N \log N)$ (D) $O(N + M \log N)$

5. In a computer system, size of logical address space and physical address space is 32MB and 256KB respectively. If page size is 4 KB, then the number of pages in the system is_____

6. A linker reads four modules whose lengths are 200, 800, 600 and 500 words respectively. If they are loaded contiguously in the given order, then which of the following are possible relocation constants respectively?
 (A) 200, 500, 600, 800 (B) 0, 200, 500, 600
 (C) 0, 200, 1000, 1600 (D) 200, 700, 1300, 2100

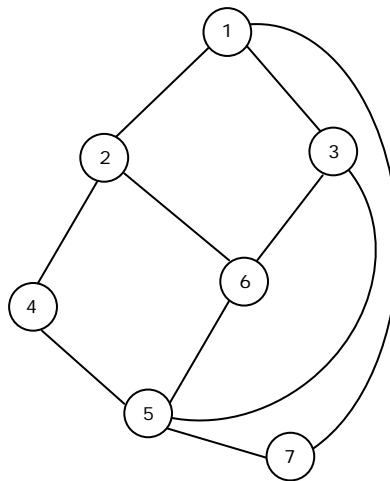
7. Pick up the correct statements from the following.
 (P) Primary index is sparse index.
 (Q) Only one clustered index is allowed per table.
 (R) Secondary index is created on key field.
 (S) Clustered index is dense index.
 (A) P, Q, R only (B) Q, R, S only (C) P, Q, S only (D) P, Q only

8. Consider a relation $R(A, B, C, D, E)$, with given FD's
 $AB \rightarrow C, BC \rightarrow D, CD \rightarrow E, DE \rightarrow A$
 The number of candidate keys for relation R is _____.
9. There is a token ring with 100 stations with 15mt distance between each station. The propagation speed is 3×10^8 m/s and in each station there is 6 bit delay. If the ring bandwidth is 12 Mbps, then the ring latency in μ s is _____.
10. A coin is tossed 9 times. What is the probability that only first two tosses will yield tails?
 (A) $\left(\frac{1}{2}\right)^2$ (B) $9C_2 \left(\frac{1}{2}\right)^2$ (C) $9C_2 \left(\frac{1}{2}\right)^9$ (D) $\left(\frac{1}{2}\right)^9$
11. Predict the output of the following program.

```
int main()
{
    char arr[];
    int i;
    printf("%d", scanf ("%d %s",&i, arr));
    return i;
}
```

 //inputs given is 5 & "abcd"
 (A) 1 (B) 2 (C) 9 (D) 5
12. A full 3-ary tree is one in which every node has 3 or 0 children. Number of articulation points in such a tree with n leaves is
 (A) $\frac{3n-1}{4}$ (B) $\frac{n}{2}$ (C) $\frac{3n-1}{2}$ (D) $\frac{n-1}{2}$
13. Consider the following graph:
-
- Which one of the following is a topological sort for the above graph?
 (A) 1, 6, 2, 5, 3, 4 (B) 4, 5, 6, 3, 2, 1
 (C) 6, 4, 5, 2, 1, 3 (D) None of these
14. In a system, main memory access time is 100 ns, TLB access time is 20 ns. TLB hit ratio is 90%. The effective memory access time (in ns) is _____.

15. Which of the following statement is true?
 (A) Every unambiguous grammar is SLR(1)
 (B) Every LL(1) is SLR(1)
 (C) Every LL(1) is LR(0)
 (D) Every SLR(1) grammar is unambiguous grammar
16. Suppose $L_1 = \{a^n b^n c^m \mid m, n \geq 0\}$ and $L_2 = \{a^p b^n c^n \mid p, n \geq 0\}$ then $(L_1 \cup L_2)$ is
 (A) Context Free (B) Deterministic Context Free
 (C) Regular (D) Context Sensitive
17. What is the correct output of the breadth first traversal of the following graph?



- I. 1,2,3,7,4,6,5
 II. 1,3,2,7,6,4,5
 III. 1,7,3,2,5,6,4
- (A) I only (B) I & III only (C) II & III only (D) All three
18. Consider two relations R and S. what is the minimum and maximum cardinality of $(R \cup S)$, respectively?
 (A) $|R| + |S|, |R| * |S|$ (B) $\min(|R|, |S|), \max(|R|, |S|)$
 (C) $\min(|R|, |S|), |R| + |S|$ (D) $\max(|R|, |S|), |R| + |S|$
19. The maximum number of modulus possible in Ring counter and Johnson counter with 6 – FlipFlops, respectively are
 (A) 6, 12 (B) $2^6, 12$ (C) $6, 2^{12}$ (D) $2^6, 2^{12}$
20. The set of successively referred unique pages are given in the form of logical addresses. They are 463, 182, 134, 195, 435, 963, 967, 834, 128, 534, 765, 784, 012, 634, 686. Page size is 100 words. What is the respective page reference string?
 (A) {4, 1, 4, 9, 8, 1, 5, 7, 0, 6} (B) {4, 1, 9, 8, 3, 9, 1, 5, 0, 6}
 (C) {1, 4, 4, 9, 8, 1, 5, 7, 0, 6} (D) {1, 4, 9, 8, 3, 9, 1, 5, 0, 6}

21. Match the following:
- | | |
|--------------------------------|----------------------------|
| (i) Base addressing | (p) Pointers |
| (ii) Indexed addressing | (q) Loops |
| (iii) Indirect addressing | (r) Position independent |
| (iv) Auto increment addressing | (s) Array |
| (A) i-p, ii-q, iii-r, iv-s | (B) i-r, ii-s, iii-p, iv-q |
| (C) i-r, ii-p, iii-s, iv-q | (D) i-r, ii-s, iii-q, iv-p |
22. A computer has common bus system for 16 registers of 32 bit each and the bus is constructed with multiplexers. The number of multiplexers required for the construction of bus is _____
23. Match the following.
- | | | | |
|------|---------------------------------------|----|--------------------------|
| i. | Peterson solution | p. | Circular waiting |
| ii. | Dead lock avoidance | q. | Sleep() & wakeup() |
| iii. | Mutual exclusion without busy waiting | r. | Banker's Algorithm |
| iv. | Deadlock | s. | Synchronization solution |
- (A) i-s, ii-r, iii-q, iv-p (B) i-s, ii-q, iii-r, iv-p
(C) i-r, ii-s, iii-q, iv-p (D) i-r, ii-s, iii-p, iv-q
24. Given that $A_{3 \times 3} X_{3 \times 1} = B_{3 \times 1}$ and $P(A) = 2$. Consider the following statements. Which of the following is not true?
 S_1 : The system has no solution
 S_2 : The system has one linearly independent solution
 (A) S_1 (B) S_2 (C) both S_1 and S_2 (D) None
25. Number of blocks in main memory is 'M' and number of words in each block is 'w'. What is the total size of main memory in words?
 (A) $M \times w$ (B) $2^{M \times w}$ (C) $\log_2 M \times w$ (D) M/w

Q. No. 26 – 51 Carry Two Marks Each

26. Which of the following set of operations represents the micro-operations of Instruction Fetch?
- | | |
|--|--|
| (A) $PC \Rightarrow MAR$
$Data[MAR] \Rightarrow MBR$
$MBR \Rightarrow IR$
$PC = PC + 1$ | (B) $PC \Rightarrow PC + 1$
$PC \Rightarrow MAR$
$Data[MAR] \Rightarrow MBR$
$MBR \Rightarrow IR$ |
| (C) $PC \Rightarrow MAR$
$MAR \Rightarrow IR$
$PC \Rightarrow PC + 1$ | (D) $PC \Rightarrow MAR$
$Data[MAR] \Rightarrow IR$
$IR \Rightarrow MBR$
$PC = PC + 1$ |

27. Consider the following grammar:

A \rightarrow aABC/abC

cB \rightarrow BC

bB \rightarrow bb

bC \rightarrow bc

cC \rightarrow cc

Which of the following string is accepted by the grammar?

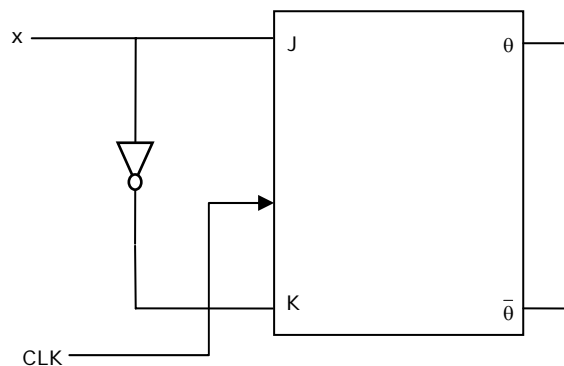
- (A) abbc (B) aabbcc (C) aabc (D) abcc
28. In a Unix operating system, each data block size is 2048 B. I-node has 10 direct data block addresses and 6 additional addresses, 1 for single indirect block, 2 for double indirect blocks and 3 for triple indirect blocks. Each block can contain addresses for 64 blocks. Which of the following options will be the maximum size of a file in this system?
- (A) 0.55 GB (B) 1.63 GB (C) 3.22 GB (D) 0.82 GB
29. Consider the following snapshot of the system:

n	Max	Allocation
	A B C	A B C
P ₀	7 5 3	0 1 0
P ₁	3 2 2	2 0 0
P ₂	9 0 2	3 0 2
P ₃	2 2 2	2 1 1
P ₄	4 3 3	0 0 2

If total available resources are $(A, B, C) = (10, 5, 7)$, then which of the following is not a safe sequence?

- (A) $\langle P_1, P_3, P_4, P_0, P_2 \rangle$ (B) $\langle P_3, P_1, P_4, P_0, P_2 \rangle$
 (C) $\langle P_3, P_4, P_2, P_1, P_0 \rangle$ (D) $\langle P_3, P_4, P_1, P_2, P_0 \rangle$
30. The total derivative $\frac{du}{dx}$ of the function $u = x^2 - y^2 - 2x$; $y = x^2 - \frac{1}{x}$ is
- (A) $2x - 2y - 2$ (B) $2x + 4xy + 2$ (C) $2x - \frac{2y}{x^2} - 4xy$ (D) $2x - \frac{2y}{x^2} - 4xy - 2$
31. $A \cap B$ is equivalent to
- (A) $A \cup B - (A - B) - (B - A)$ (B) $A - B - (A - B) - (B - A)$
 (C) $A \cup B - (A' - B') - (B - A)$ (D) $A \cup B - (A' - B') - (A - B)$
32. Consider the set $S = \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$ with an operation \otimes_9 (multiplication modulo 9). Which of the following is false with respect to the algebraic structure (S, \otimes_9) ?
- (A) Inverse of elements 0, 3 & 6 does not exist
 (B) (S, \otimes_9) is not a group
 (C) Identity of S is 1
 (D) (S, \otimes_9) is not a monoid

33. How many distinct binary trees can be formed with three distinct keys?
(A) 5 (B) $3 \times 5!$ (C) $3!$ (D) $5 \times 3!$
34. Let $S(V,T)$ be any DFS tree for a given connected undirected graph $G(V,E)$. Which of the following statements is/are true?
(A) A leaf of S cannot be an articulation point of G
(B) The root of S is an articulation point of G iff it has at least two children in S
(C) Both (A) & (B)
(D) None of these
35. Suppose we are using timestamp-based concurrency control, and there are two transactions T_1 and T_2 with timestamps 100 and 200, respectively. The following schedule is executed in the order shown below using time stamping protocols:
 $r_1(A); w_1(A); r_2(A); r_2(B); w_1(B); c_1; w_2(A); c_2;$
Which of the following is true regarding the above schedule?
(A) It is allowed under Basic Timestamp ordering protocol
(B) It is not allowed under Basic Timestamp ordering protocols since T_1 is rolled back
(C) It is not allowed under Basic Timestamp ordering protocol but allowed under Thomas Write Rule
(D) It is not allowed under Basic timestamp ordering protocol and Thomas Write Rule but allowed under Multi version Timestamp ordering protocol
36. A building, running CSMA – CD protocol is having a bandwidth of 512Mbps and distance of 2 kilometres. If the signal speed is 2,00,000km/s, then the minimum frame size (in bytes) in order to detect a collision is _____.
37. Consider the following circuit:



The above circuit behaves as

- (A) D Flip – Flop (B) RS Flip – Flop
(C) T Flip – Flop (D) None of these

38. The value of the integral $\int_0^{\pi} \frac{dx}{1+x+\cos x}$ evaluated using the trapezoidal rule for two trapezoids is equal to

(A) 2.51 (B) 1.25 (C) 2.61 (D) 1.61

39. Match the following

(P)	Redundancy elimination	(1)	Stack
(Q)	Loop Jamming	(2)	Moving loop invariant code outside
(R)	Frequency reduction	(3)	Combining bodies of loops
(S)	Use of m/c idioms	(4)	DAG
		(5)	Machine dependent optimization
		(6)	Process flow analysis

(A) P – 1, Q– 2, R– 3, S– 4 (B) P – 6, Q– 4, R– 3, S– 5
(C) P – 4, Q– 3, R– 2, S– 5 (D) P – 4, Q– 2, R– 3, S– 6

40. Consider the following grammars:

$G_1 : S \rightarrow aaAB$ $G_2 : S \rightarrow ABbbb$

$A \rightarrow aA / \epsilon$ $A \rightarrow Caa$

$B \rightarrow bbbC$ $C \rightarrow Ca / \epsilon$

$C \rightarrow bC / \epsilon$ $B \rightarrow Bb / \epsilon$

Which of the following is true about the given grammars?

(A) $L(G_1) \subset L(G_2)$ (B) $L(G_2) \subset L(G_1)$
(C) $L(G_1) = L(G_2)$ (D) $L(G_1) \neq L(G_2)$

41. The capacity of Hard disk (in GB) with 32 platters, 2k cylinders, 512 sectors per track and 512 bytes per sector is _____.

(Assume each platter with single recording surface)

42. An experiment yield three mutually exclusive evens A, B, C such that $P(A) = 2P(B) = 3P(C)$. Then $P(\bar{A}) =$

(A) $\frac{6}{11}$ (B) $\frac{5}{11}$ (C) $\frac{3}{11}$ (D) $\frac{4}{11}$

43. Which of the following binary pattern have identical decimal value in both sign magnitude and 2's complement representation?

(A) 1100 0000 (B) 1000 0000
(C) 1110 0000 (D) No such number is possible

44. Let L_1 and L_2 are context free languages but not regular then which of the following is definitely true?

(A) $L_1 \cap L_2$ is regular (B) $L_1 \cup L_2$ is not CFL
(C) $L_1.L_2$ is CFL (D) $L_1 \cap L_2$ is context free

45. A random variable X has the following probability distribution
- | | | | | | | |
|------|---|-----------------|----------------|----|----|----------------|
| x | 0 | 1 | 2 | 3 | 4 | |
| P(x) | C | 5C ² | C ² | 2C | 2C | Then C = _____ |
- (A) $\frac{1}{6}$ (B) -1 (C) 0.5 (D) None
46. A Relation R is defined on the set $A = \{2, 3, 4, 5, \dots, 20\}$ as follows
 xRy , if their greatest prime divisor is same $\forall x, y \in A$.
 How many equivalence classes the relation R contains?
 (A) 0 (B) 8 (C) 18 (D) 10
47. Consider the following digit string in base 3.
 $(212122101212)_3$
 Which of the following is equivalent string of the given in base 9?
 (A) $(775333)_9$ (B) $(778355)_9$ (C) $(884133)_9$ (D) $(884355)_9$

Common Data Questions: 48 & 49

Consider the following code:

```
int gcd (int a, int b)
{
while (a!=b)
{
    if (a>b)
        a=a-b;
    else b=b-a;
}
}
```

48. The number of edges in the control flow graph of the above code is _____.

Consider the following code:

```
int gcd (int a, int b)
{
while (a!=b)
{
    if (a>b)
        a=a-b;
    else b=b-a;
}
}
```

49. The cyclomatic complexity C of this code is _____.

Common Data Questions: 50 & 51

Consider two independent events A and B. The probability of occurrence of both A and B = $\frac{2}{5}$. The probability that neither of them occurs is $\frac{2}{15}$.

50. The probability of occurrence of B is

- (A) $\frac{2}{3}$ or $\frac{2}{5}$ (B) $\frac{2}{5}$ or $\frac{2}{3}$ (C) $\frac{2}{3}$ or $\frac{3}{5}$ (D) $\frac{1}{2}$ or $\frac{1}{5}$

Consider two independent events A and B. The probability of occurrence of both A and B = $\frac{2}{5}$. The probability that neither of them occurs is $\frac{2}{15}$.

51. The probability of occurrence of \bar{A} is

- (A) $\frac{1}{3}$ or $\frac{3}{5}$ (B) $\frac{2}{5}$ or $\frac{1}{3}$ (C) $\frac{1}{3}$ or $\frac{2}{5}$ (D) $\frac{2}{3}$ or $\frac{4}{5}$

Linked Answer Questions: Q.52 to Q.55 Carry Two Marks Each

Statement for Linked Answer Questions: 52 & 53

Consider the following language

$$L = \{a^n b^m c^m d^n / n \geq 1\}$$

52. What is the grammar for the above language?

- (A) $S \rightarrow asd / aAd$
 $A \rightarrow bAc / bc$
- (B) $S \rightarrow AB$
 $A \rightarrow aAb / ab$
 $B \rightarrow cBd / cd$
- (C) $S \rightarrow aAd$
 $A \rightarrow bAc / bc$
- (D) $S \rightarrow ABCD$
 $A \rightarrow aA / a$
 $B \rightarrow bB / a$
 $C \rightarrow cB / d$
 $D \rightarrow a$

Consider the following language

$$L = \{a^n b^m c^m d^n / n \geq 1\}$$

53. What is the length of the minimum yield obtained from the parse tree for the above correct grammar?

- (A) 5 (B) 4 (C) 7 (D) 8

Statement for Linked Answer Questions: 54 & 55

A transmission channel operates at 10 kbps bandwidth. Distance between two stations in the channel is 2 km. Assume that the speed of propagation of a bit is 200 m/sec

54. If stop and wait ARQ is used with 50% efficiency, what is the frame length?
(A) 25 KB (B) 50 KB (C) 100 KB (D) 200 KB

A transmission channel operates at 10 kbps bandwidth. Distance between two stations in the channel is 2 km. Assume that the speed of propagation of a bit is 200 m/sec

55. IF Go Back-n ARQ is used with n value set to 7 then what is the maximum data rate of the system?
(A) 8.75 MB/s (B) 8.75 KB/s (C) 8.75 GB/s (D) None of these

Q. No. 56 – 60 Carry One Mark Each

Choose the appropriate antonym for the given words given below:

56. Raffish
(A) grotesque (B) uncaring (C) delinquent (D) noble

Choose grammatically wrong sentences:

57. (A) She is better able to speak than to write
(B) I will have him realize his mistake
(C) As a student of arts you are better than he
(D) I intend to sit in my room and read novels

Spot the error part of the sentences given below:

58. (A) Ram is junior (B) than shyam
(C) and Ram is (D) older than shyam

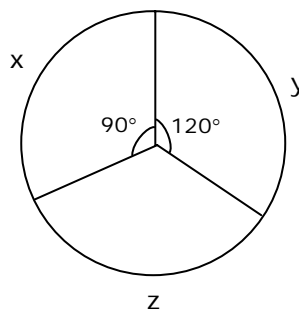
Find the proper meaning of the word given in bold letters.

59. After working for years in the same company, Ramu decided to Jack it all.
(A) Continue (B) Change (C) Stop (D) Cheat

60. In a box, there are 8 Red, 7 Blue & 6 Green balls. One ball is picked up randomly. What is the probability that is neither red nor green?
- (A) $\frac{2}{13}$ (B) $\frac{1}{3}$ (C) $\frac{5}{13}$ (D) $\frac{4}{13}$

Q. No. 61 – 65 Carry Two Marks Each

61. Urban services have not expanded fast enough to cope with urban expansion. Low investment allocations have tended to be under spent. Both public and private infrastructure quality has declined. The impact of the environment in which children live and the supporting services available to them when they fall ill, seem clear. The decline in average food availability and the rise in absolute poverty, point in the same unsatisfactory directions. Choose the weakest statement related to the above passage
- (A) Though adequate provisions of funds were made but they were received under spent
(B) Low cost urban housing is on the priority
(C) There is nothing to boast about urban services
(D) Birth rate is higher in urban areas than in rural areas
62. The cost of the components x, y, z of a machine worth Rs.45,000 in 1996 is given as a pie chart. In the following year, the cost of the components x, y, z increased by 10%, 30%, and 20% respectively. What is the cost of the three components in 1997?



- (A) 54375 (B) 52375 (C) 54475 (D) 54365
63. A man on a platform notices that a train going in one direction takes 15 seconds to pass him, and a train of same length going in the opposite direction takes 20 seconds to pass him. What is the time taken by the two trains to pass one another, if the length of the train is 600m each?
- (A) 16 sec (B) 17 sec (C) 17.14 sec (D) 16.5 sec
64. Find out the present value of a Bus, if after 2 years due to two successive increases of 30% and 50% respectively, the price becomes Rs. 72,600.
- (A) 50,000 (B) 60,000 (C) 55,000 (D) 40,000

65. The sum is $3^{57} + 13^{59}$ divisible by
(A) 5 (B) 10 (C) Both (A) & (B) (D) None of these