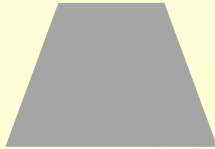## GENERAL APTITUDE

### Q. No. 1 - 5 Carry One Mark Each

**1.** A polygon is convex if, for every pair of points, P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon.

Which one of the following is NOT a convex polygon?

(A)

(B)

(C)

(D)

**Answer:** **(B)**        **Click here to watch video explanation**

**2.** _____ is to surgery as writer is to _____.

Which one of the following options maintains a similar logical relation in the above sentence?
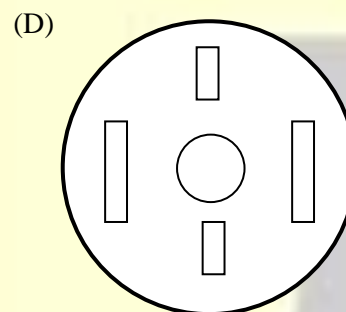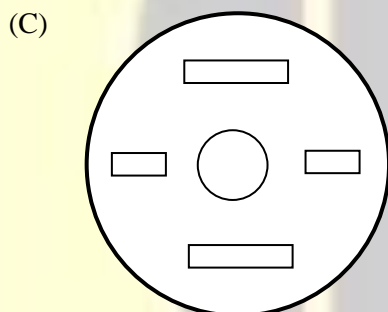
(A) Doctor, book

(B) Plan, outline

(C) Medicine, grammar

(D) Hospital, library

**Answer:** **(A)**        **Click here to watch video explanation**

**3.** A circular sheet of paper is folded along the lines in the directions shown. The paper, after being punched in the final folded state as shown and unfolded in the reverse order of folding, will look like

(A)

(B)

(C)

(D)
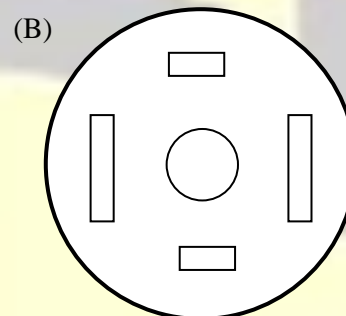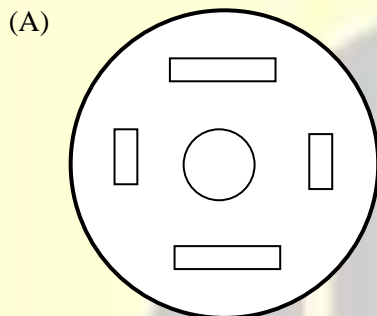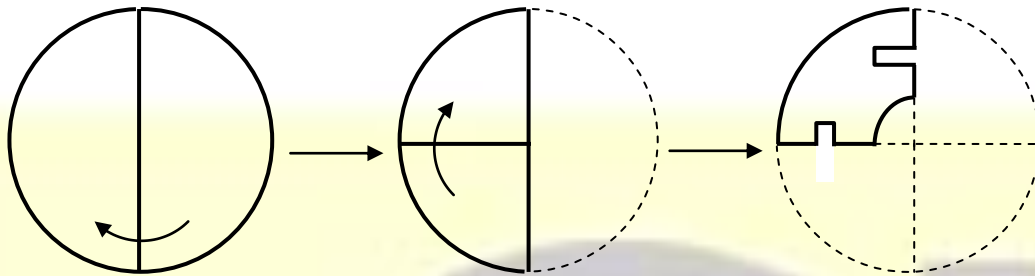
**4.** Consider the following sentences:

**(i)** Everybody in the class is prepared for the exam.

**(ii)** Babu invited Danish to his home because he enjoys playing chesss.

Which of the following is the CORRECT observation about the above two sentences?

(A) (i) is grammatically incorrect and (ii) is unambiguous

(B) (i) is grammatically correct and (ii) is unambiguous

(C) (i) is grammatically correct and (ii) is ambiguous

(D) (i) is grammatically incorrect and (ii) is ambiguous

**5.**  The ratio of boys to girls in a class is 7 to3.

Among the options below, an acceptable value for the total number of students in the class is:

(A)  21          (B)  73          (C)  37          (D)  50

**Answer:   (D)**                    **Click here to watch video explanation**

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## Q. No. 6- 10 Carry Two Marks Each

**6.**

| Items | Cost (₹) | Profit % | Marked Price |
|-------|----------|----------|--------------|
| P     | 5, 4000  | …        | 5,860        |
| Q     | …        | 25       | 10,000       |

Details of prices of two items P and Q are presented in the above table. The ratio of cost item P to cost of item Q is 3:4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost, to the cost

$$\left( \text{Profit \%} = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100 \right)$$

The discount on item Q, as a percentage of its marked price, is _____

(A)  25          (B)  10          (C)  12.5          (D)  5

**Answer:   (B)**                    **Click here to watch video explanation**

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**7.**  Given below are two statements 1 and 2, and two conclusions I and II.

**Statement 1:** All bacteria are microorganisms.

**Statement 2:** All pathogens are microorganisms.

**Conclusion I:** Some pathogens are bacteria.

**Conclusion II:** All pathogens are not bacteria.

Based on the above statements and conclusions, which one of the following options is logically CORRECT?

(A)  Only conclusion II is correct          (B)  Either conclusion I or II is correct

(C)  Neither conclusion I nor II is correct          (D)  Only conclusion I is correct

**Answer:   (C)**                    **Click here to watch video explanation**

8.  There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag.

    (A) 0.6976      (B) 0.3024      (C) 0.8125      (D) 0.4235

**Answer:    (A)**                                                      **Click here to watch video explanation**

9.  We have 2 rectangular sheets of paper, M and N, of dimension 6 cm × 1 cm each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches and assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is _____.

    (A) $3\pi$          (B) $\dfrac{9}{\pi}$          (C) $\dfrac{3}{\pi}$          (D) $\dfrac{\pi}{2}$

**Answer:    (B)**                                                      **Click here to watch video explanation**

10. Some people suggest anti-obesity measures (AOM) such as displaying calorie information in restaurant menus, such measures sidestep addressing the core problem that cause obesity: poverty and income inequality.

    Which one of the following statements summarizes the passage?

    (A) AOM are addressing the core problems and are likely to succeed

    (B) If obesity reduces, poverty will naturally reduce, since obesity causes poverty

    (C) The proposed AOM addresses the core problems that cause obesity

    (D) AOM are addressing the problem superficially

**Answer:    (D)**                                                      **Click here to watch video explanation**

## COMPUTER SCIENCE

### Q. No. 1 to 25 Carry One Mark Each

**1.** A relation r(A, B) in a relational database has 1200 tuples. The attribute A has integer values ranging from 6 to 20, and the attribute B has integer values ranging from 1 to 20. Assume that the attributes A and B are independently distributed.

The estimated number of tuples in the output of $\sigma_{(A>10)\vee(B=18)}(r)$ is _____.

**Answer:** **(820)** **Click here to watch video explanation**

**2.** Consider the following representation of a number in IEEE 754 single-precision floating point format with a bias of 127.

S:1                          E: 10000001                          F: 11110000000000000000000

Here S, E and F denote the sign, exponent and fraction components of the floating point representation

The decimal value corresponding to the above representation (rounded to 2 decimal places) is _____.

**Answer:** **(–7.75)** **Click here to watch video explanation**

**3.** Suppose that $L_1$ is a regular language and $L_2$ is a context-language. Which one of the following languages is NOT necessarily context-free?

(A) $L_1 \cap L_2$          (B) $L_1 \cup L_2$          (C) $L_1 - L_2$          (D) $L_1 . L_2$

**Answer:** **(C)** **Click here to watch video explanation**

**4.** Consider the following expression

$$\lim_{z \to -3} \frac{\sqrt{2x+22}-4}{x+3}$$

The value of the above expression (rounded to 2 decimal places) is _____.

**Answer:** **(0.25)** **Click here to watch video explanation**

5. Suppose a database system crashes again while recovering from a previous crash.

   Assume checkpointing is not done by the database either during the transactions or during recovery.

   Which of the following statements is/are correct?

   (A) The system cannot recover any further.

   (B) All the transactions that are already undone and redone will not be recovered again.

   (C) The same undo and redo list will be used while recovering again.

   (D) The database will become inconsistent

**Answer:** **(C)**                                                     **Click here to watch video explanation**

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6. Consider the following statements.

   $S_1$: Every SLR(1) grammar is unambiguous but there are certain unambiguous grammars that are not SLR(1).

   $S_2$: For any context-free grammar, there is a parser that takes at most $O(n^3)$ time to parse a string of length n.

   Which one of the following options is correct?

   (A) $S_1$ is true and $S_2$ is true

   (B) $S_1$ is false and $S_2$ is false

   (C) $S_1$ is false and $S_2$ is true

   (D) $S_1$ is true and $S_2$ is false

**Answer:** **(A)**                                                     **Click here to watch video explanation**

---

7. Consider the following statements.

   $S_1$: The sequence of procedure calls corresponds to a preorder traversal of the activation tree.

   $S_2$: The sequence of procedure returns corresponds to a postorder traversal of the activation tree.

   Which one of the following options is correct?

   (A) $S_1$ is false and $S_2$ is false.

   (B) $S_1$ is true and $S_2$ is false

   (C) $S_1$ is false and $S_2$ is true.

   (D) $S_1$ is true and $S_2$ is true

**Answer:** **(D)**                                                     **Click here to watch video explanation**

---

8. Consider the following sequence of operations on an empty stack.

```
push (54); push (52); pop (); push (55); push (62); s = pop ();
```

Consider the following sequence of operations on an empty queue.

enqueue (21), enqueue (24), deque (); enqueue (28); enqueue (32); q = dequeue ();

The value of $s + q$ is _____ .

**Answer:** **(86)**        **Click here to watch video explanation**

9. Consider a linear list based directory implementation in a file system. Each directory is a list of nodes, where each node contains the file name along with the file metadata, such as the list of pointers to the data blocks. Consider a given directory foo.

Which of the following operations will necessarily require a full scan of foo for successful completion?

(A) Opening of an existing file in foo      (B) Creation of a new file in foo

(C) Renaming of an existing file in foo     (D) Deletion of an existing file from foo

**Answer:** **(B, C)**        **Click here to watch video explanation**

10. In an undirected connected planner graph G, there are eight vertices and five faces.

The number of edges in G is _____ .

**Answer:** **(11)**        **Click here to watch video explanation**

11. Consider the following three functions.

$$f_1 = 10^n \quad f_2 = n^{\log n} \quad f_2 = n^{\sqrt{n}} \; f$$

Which one of the following options arranges the functions in the increasing order of asymptotic growth rate?

(A) $f_1, f_2, f_3$      (B) $f_3, f_2, f_1$      (C) $f_2, f_3, f_1$      (D) $f_2, f_1, f_3$
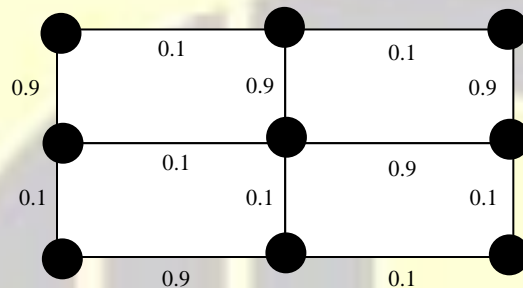
**Answer:** **(C)**        **Click here to watch video explanation**

**12.** Three processes arrive at time zero with CPU bursts of 16, 20 and 10 milliseconds. If the scheduler has prior knowledge about the length of the CPU bursts, the minimum achievable average waiting time for these three processes in a non-preemptive scheduler (rounded to nearest integer) is_____milliseconds.

**Answer:** **(13)** **Click here to watch video explanation**

**13.** Consider the following undirected graph with edge weights as shown:



The number of minimum-weight spanning trees of the graph is _____.

**Answer:** **(3)** **Click here to watch video explanation**

**14.** The lifetime of a component of a certain type is a random variable whose probability density function is exponentially distributed with parameter 2. For a randomly picked component of this type, the probability that its life time exceeds the expected life time (rounded to 2 decimal places) is _____.

**Answer:** **(0.37)** **Click here to watch video explanation**

**15.** Consider the following two statements.

$S_1$ : Destination MAC address of an ARP reply is a broadcast address.

$S_2$ : Destination MAC address of an ARP request is a broadcast address.

Whichone of the following choices is correct?

(A)   $S_1$ is false and $S_2$ is true

(B)   Both $S_1$ and $S_2$ are false

(C)   $S_1$ is true and $S_2$ is false

(D)   Both $S_1$ and $S_2$ are true

**Answer:** **(A)** **Click here to watch video explanation**

16. Let p and q be two propositions. Consider the following two formula in propositional logic.

$$S_1 : \left( \neg p \wedge \left( p \vee q \right) \right) \rightarrow q$$
$$S_2 : q \rightarrow \left( \neg p \wedge \left( p \vee q \right) \right)$$

Which one of the following choices is correct?

(A) Neither $S_1$ nor $S_2$ is a tautology

(B) $S_1$ is a tautology but $S_2$ is not a tautology

(C) Both $S_1$ and $S_2$ are tautologies

(D) $S_1$ is not a tautology but $S_2$ is a tautology

Answer: **(B)**                          **Click here to watch video explanation**

17. Let P be an array containing n integers, Lett be the lowest upper bound on the number of comparisons of the array elements, required to find the minimum and maximum values in an arbitrary array of n elements. Which one of the following choices is correct?

(A) $t > 2n - 2$

(B) $t > \lceil \log_2 (n) \rceil$ and $t \leq n$

(C) $t > n$ and $t \leq 3 \left\lceil \dfrac{n}{2} \right\rceil$

(D) $t > 3 \left\lceil \dfrac{n}{2} \right\rceil$ and $t \leq 2n - 2$

Answer: **(C)**                          **Click here to watch video explanation**

18. In the context of operating systems, which of the following statements is/are are correct with respect to paging?

(A) Page size has no impact on internal fragmentation

(B) Paging helps solve the issue of external fragmentation

(C) Paging incurs memory overheads

(D) Multi-level paging is necessary to support pages of different sizes

Answer: **(B, C)**                          **Click here to watch video explanation**

19. Consider a computer system with a byte-addressable primary memory of size $2^{32}$ bytes. Assume the computer system has a direct-mapped cache of size 32 KB (1 KB = $2^{10}$ bytes), and each cache block is of size 64 bytes.

The size of the tag field is _____ bits.

Answer: **(17)**                          **Click here to watch video explanation**

**20.** Let G be a group of order 6, and H be a subgroup of G such that $1 < |H| < 6$. Which one of the following options is correct?

(A) Both G and H are always cyclic

(B) G is always cyclic, but H may not be cyclic

(C) G may not be cyclic, but H is always cyclic

(D) Both G and H may not be cyclic

**Answer: (C)** **Click here to watch video explanation**

**21.** The following relation records the age of 500 employees of a company, where empNo(indicating the employee number) is the key:

$$empAge\left(\underline{empNo}, age\right)$$

Consider the following relational algebra expression:

$$\Pi_{emp\ No}\left(emp\ Age \bowtie_{(age > age1)} \rho_{empNo1, age1}\left(emp\ Age\right)\right)$$

What does the above expression generate?

(A) Employee numbers of only those employees whose age is the maximum

(B) Employee numbers of only those employees whose age is more than the age of exactly one other employee

(C) Employee numbers of all employees whose age is the minimum

(D) Employee numbers of all employees whose age is not the minimum.

**Answer: (D)** **Click here to watch video explanation**

**22.** There are 6 jobs with distinct difficulty level, and 3 components with distinct processing speeds. Each job is assigned to a computer such that:

• The fastest computer gets the toughest job and the slowest computer gets the easiest job.

• Every computer gets at least one job

The number of ways in which this can be done is _____.

**Answer: (65)** **Click here to watch video explanation**

**23** Let the representation of a number in base 3 be 210. What is the hexadecimal representation of the number?

(A) 528        (B) 21        (C) 15        (D) D2

**Answer:** **(C)**            **Click here to watch video explanation**

**24.** Which of the following standard C library functions will always invoke a system call when executed from a single-threaded process in a UNIX/Linux operating system?

(A) sleep        (B) malloc        (C) strlen        (D) exit

**Answer:** **(A, D)**            **Click here to watch video explanation**

**25.** A binary search tree T contains n distinct elements. What is the time complexity of picking an element in T that is smaller than the maximum element in T?

(A) $\Theta(1)$        (B) $\Theta(\log n)$        (C) $\Theta(n\log n)$        (D) $\Theta(n)$

**Answer:** **(A)**            **Click here to watch video explanation**

## Q. No. 26 - 55 Carry One Mark Each

**26.** Assume that a 12-bit Hamming codeword consisting of 8-bit data and 4 check bits is $d_8 d_7 d_6 d_5 c_8 d_4 d_3 d_2 c_4 d_1 c_2 c_1$, where the data bits and the check bits are given in the following tables:

| Data bits | | | | | | | | | Check bits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_8$ | $d_7$ | $d_6$ | $d_5$ | $d_4$ | $d_3$ | $d_2$ | $d_1$ | | $c_8$ | $c_4$ | $c_2$ | $c_1$ |
| 1 | 1 | 0 | x | 0 | 1 | 0 | 1 | | y | 0 | 1 | 0 |

Which one of the following choices gives the correct values of x and y?

(A) x is 0 and y is 0                  (B) x is 1 and y is 1

(C) x is 1 and y is 0                  (D) x is 0 and y is 1

**Answer:** **(A)**            **Click here to watch video explanation**

**27.** Consider the following instruction sequence where registers R1, R2 and R3 are general purpose and MEMORY[X] denotes the content at the memory location X.

| Instruction | Semantics | Instruction Size (bytes) |
|---|---|---|
| Mov R1, (5000) | R1 ← MEMORY[5000] | 4 |
| Mov R2, (R3) | R2 ← MEMORY[R3] | 4 |
| ADD R2, R1 | R2 ← R1 + R2 | 2 |
| MOV (R3), R2 | MEMORY[R3] ← R2 | 4 |
| INC R3 | R3 ← R3 + 1 | 2 |
| DEC R1 | R1 ← R1 − 1 | 2 |
| BNZ 1004 | Branch if not zero to the given absolute address | 2 |
| HALT | Stop | 1 |

Assume that the content of the memory location 5000 is 10, and the content of the register R3 is 3000. The content of each of the memory location from 3000 to 3010 is 50. The instruction sequence starts from the memory location 1000. All the numbers are in decimal format. Assume that the memory is byte addressable.

After the execution of the program, the content of memory location 3010 is

**Answer: (50)** **Click here to watch video explanation**

**28.** An articulation point in a connected graph is a vertex such that removing the vertex and its incident edges disconnected the graph into two or more connected components.

Let T be a DFS tree obtained by doing DFS in a connected undirected graph G.

Which of the following options is/are correct?

(A) Root of T can never be an articulation point in G.

(B) If u is an articulation point in G such that x is ancestor of u in T and y is a descendent of u in T, then all paths from x to y in G must pass through u.

(C) A leaf of T can be an articulation point in G

(D) Root of T is an articulation point in G if and only if it has 2 or more children

**Answer: (D)** **Click here to watch video explanation**

**29.** Consider the following array

| 23 | 32 | 45 | 69 | 72 | 73 | 89 | 97 |

Which algorithm out of the following options uses the least number of comparisons (among the array elements) to sort the above array in ascending order?

(A) Insertion sort

(B) Merge sort

(C) Selection sort

(D) Quick sort using the last element as pivot

**Answer:** **(A)** <span style="color:blue">Click here to watch video explanation</span>

**30.** Let (M) denote an encoding of an automation M, suppose that $\Sigma = \{0,1\}$. Which of the following languages is/are NOT recursive?

(A) $L = \{\langle M \rangle \mid M \text{ is a DFA such that } L(M) = \phi\}$

(B) $L = \{\langle M \rangle \mid M \text{ is a PDA such that } L(M) = \phi\}$

(C) $L = \{\langle M \rangle \mid M \text{ is a DFA such that } L(M) = \Sigma *\}$

(D) $L = \{\langle M \rangle \mid M \text{ is a PDA such that } L(M) = \Sigma *\}$

**Answer:** **(D)** <span style="color:blue">Click here to watch video explanation</span>

**31.** Consider the following context-free grammar where the set of terminals is {a, b, c, d, f}

$S \rightarrow daT \mid Rf$
$T \rightarrow aS \mid baT \mid \in$
$R \rightarrow caTR \mid \in$

The following is a partially-filled LL(1) parsing table.

|   | a | b | c | d | f | $ |
|---|---|---|---|---|---|---|
| S |   |   | ① | S → daT | 2 |   |
| T | T → aS | T → baT | ③ |   | T → ∈ | ④ |
| R |   |   | R → caTR |   | R → ∈ |   |

Which one of the following choices represent the correct combination for the numbered cells in the paring table ("blank" denotes that the corresponding cell is empty)?

(A)  ① S→Rf    ② blank    ③ blank    ④ T→∈

(B)  ① blank    ② S→Rf    ③ blank    ④ blank

(C)  ① blank    ② S→Rf    ③ T→∈    ④ T→∈

(D)  ① S→Rf    ② S→Rf    ③ T→∈    ④ T→∈

**Answer:    (D)**                                      Click here to watch video explanation

32.  For a Turing machine M, $\langle M \rangle$ denotes an encoding of M. Consider the following two languages.

$L_1 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on all inputs}\}$

$L_2 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on some input}\}$

Which one of the following options is correct?

(A)  Both $L_1$ and $L_2$ are undecidable

(B)  Both $L_1$ and $L_2$ are decidable

(C)  $L_1$ is decidable and $L_2$ is undecidable

(D)  $L_1$ is undecidable and $L_2$ is decidable

**Answer:    (B)**                                      Click here to watch video explanation

33.  Consider the following matrix

$$\begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

The largest eigenvalue of the above matrix is _____

**Answer:    (3)**                                      Click here to watch video explanation

**34.** A relation R is said to be circular if aRb and bRc together imply cRa. Which of the following options is/are correct?

(A) If a relation S is reflexive and circular, then S is an equivalence relation

(B) If a relation S is circular and symmetric, then S is an equivalence relation

(C) If a relation S is reflexive and symmetric, then S is an equivalence relation

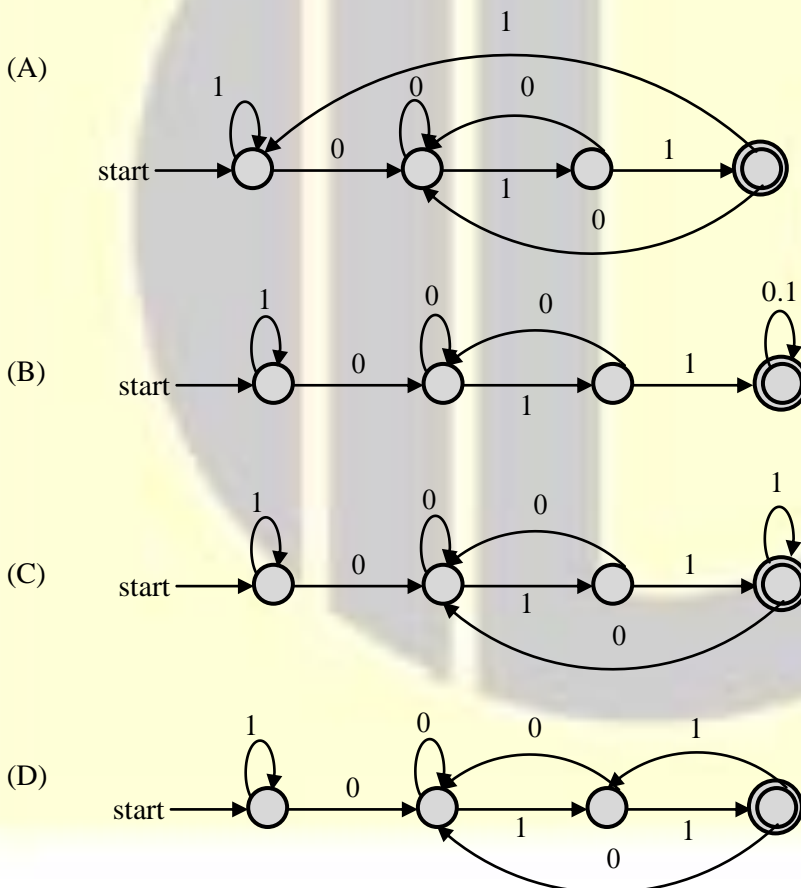(D) If a relation S is transitive and circular, then S is an equivalence relation

**Answer:** **(A)** Click here to watch video explanation

**35.** Consider the following language.

$L = \{ w \in \{0,1\}^* \mid w \text{ ends with the substring } 011 \}$

Which one of the following deterministic finite automata accepts L?



**Answer:** **(A)** Click here to watch video explanation

**36.** Consider the following ANSI C function

```
int SimpleFunction(int Y[], int n, int x)
{
Int total = Y[], loopIndex;
For (loopIndex = 1; loopIndex<=n-1; loopIndex++)
    total = x * total Y[loopIndex];
return total;
}
```

Let Z be an array of 10 elements with Z[i] = 1 for all I such that $0 \le i \le 9$. The value returned by simpleFunction (Z, 10, 2) is _____.

**37.** A sender(S) transmits a signal, which can be one of the two kinds. H and L with probabilities 0.1 and 0.9 respectively, to a receiver (R)

In the graph below, the weight of edge (u, v) is the probability of receiving v and u is transmitted, where $u, v \in \{H, L\}$. For example, the probability that the received signal is L given the transmitted signal was H, is 0.7
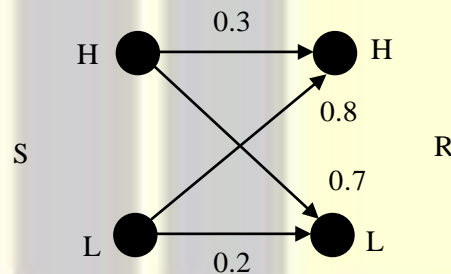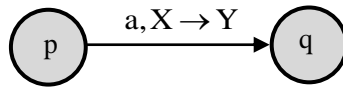


If the received signal is H, the probability that the transmitted signal was H (rounded to 2 decimal places) is _____.

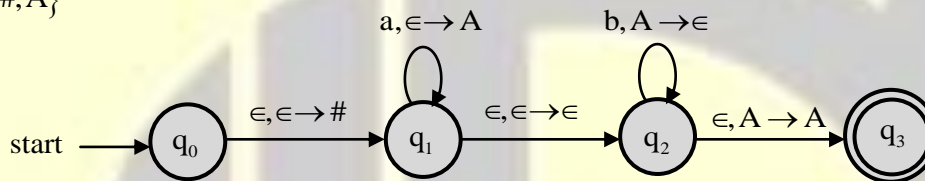**38.** In a pushdown automaton $P = (Q, \Sigma, \Gamma, \delta, q_0, F)$, a transition of the form,



where $p, q \in Q$, $a \in \Sigma \cup \{\in\}$, and $X, Y \in \Gamma\{\in\}$, represents

$(q, Y) \in \delta(p, a, X)$

Consider the following pushdown automaton over the input alphabet $\Sigma = \{a, b\}$ and stack alphabet $\Gamma = \{\#, A\}$



The number of strings of length 100 accepted by the above pushdown automaton is _____

**Answer:     (50)**                                              **Click here to watch video explanation**

**39.** Consider the following grammar (that admits a series of declaration, followed by expression) and the associated syntax directed translation (SDT) actions, given as pseudo-code:

$P \rightarrow D^* E^*$

$D \rightarrow$ int ID {record that ID.lexeme is of type int}

$D \rightarrow$ bool ID {record that ID.lexemeis of type bool}

$E \rightarrow E_1 + E_2$ {check that $E_1$.type = $E_2$.type = int; set E.type := int}

$E \rightarrow !E_1$ {check that $E_1$.type = bool; set E.type := bool}

$E \rightarrow$ ID {set E.type := int}

With respect to the above grammar, which one of the following choices is correct?

(A) The actions will lead to an infinite loop

(B) The actions can be used to type-check syntactically correct Boolean variable declaration and Boolean expression

(C) The actions can be used to type-check syntactically correct integer variable declaration and integer expressions.

(D) The actions can be used to correctly type-check any syntactically correct program.

**Answer:     (B)**                                              **Click here to watch video explanation**

**40.** Let $r_i(z)$ and $w_i(z)$ denote read and write operations respectively on a data item z by a transaction $T_i$.

Consider the following two schedules.

$S_1$ : $r_1(x)r_1(y)r_2(x)r_2(y)w_2(y)w_1(x)$

$S_2$ : $r_1(x)r_2(x)r_2(y)w_2(y)r_1(y)w_1(x)$

Which one of the following options is correct?

(A) Both $S_1$ and $S_2$ are conflict serializable

(B) $S_1$ is not conflict serializable, and $S_2$ is conflict serializable

(C) $S_1$ is conflict serializable, and $S_2$ is not conflict serializable

(D) Neither $S_1$ and $S_2$ are conflict serializable

**Answer:    (B)**                                         **Click here to watch video explanation**

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**41.** Consider the following recurrence relation

$$T(n) = \begin{cases} T(n/2) + T(2n/5) + 7n & \text{if } n > 0 \\ 1 & \text{if } n = 0 \end{cases}$$

Which one of the following options is correct?

(A) $T(n) = \Theta(n \log n)$                    (B) $T(n) = \Theta\left((\log n)^{5/2}\right)$

(C) $T(n) = \Theta\left(n^{5/2}\right)$                    (D) $T(n) = \Theta(n)$

**Answer:    (D)**                                         **Click here to watch video explanation**

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**42.** Consider the following pseudocode, where S is a semaphore initialized to 5 in line #2 and counter is a shared variable initialized to 0 in line #1. Assume that the increment operation in line #7 is not atomic.

```
1.  int counter = 0;
2.  Semaphore S = int (5);
3.  void parop (void)
4.  {
5.  wait (S);
6.  wait (S);
7.  counter ++;
8.  signal (S);
```

```
9.  signal (S);
10. }
```

If we threads execute the function parop concurrently, which of the following program behavior(s) is/are possible?

(A) There is a deadlock involving all the threads.

(B) The value of counter is 5 after all the threads successfully complete the execution of parop

(C) The value of counter is 1 after all the thread successfully complete the execution of parop

(D) The value of counter is 0 after all the threads successfully complete the execution of parop

**Answer:** **(A, B, C)** **Click here to watch video explanation**

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**43.** Consider a 3-bit counter, designed using T flip-flops, as shown below:
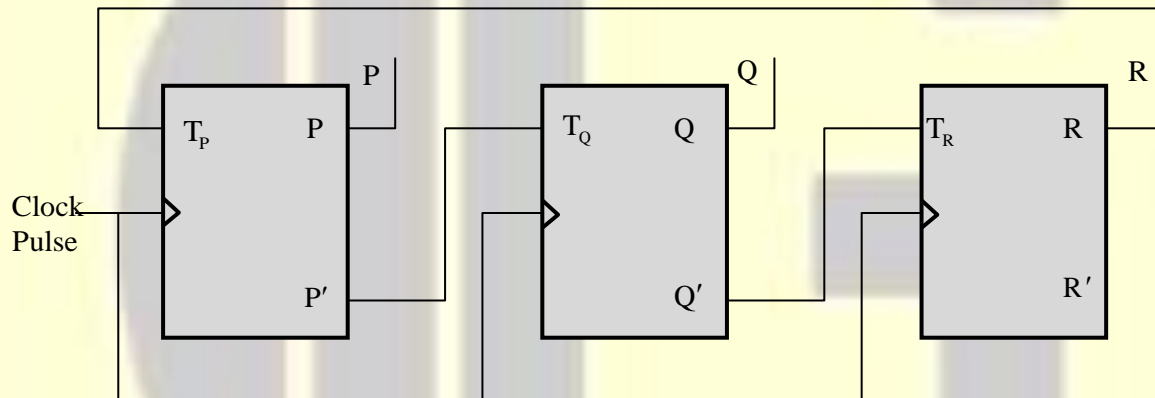


Assuming the initial state of the counter given by PQR as 000, what are the next three states?

(A) 011, 101, 111                 (B) 001, 010,000

(C) 011, 101, 000                 (D) 001, 010, 111

**Answer:** **(C)** **Click here to watch video explanation**

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**44.** Consider two hosts P and Q connected through a router R. The maximum transfer unit (MTU) value of the link between P and R is 1500 bytes, and between R and  is 820 bytes.

A TCP segment of size 1400 bytes was transferred from P to Q through R, with IP identification value as $0 \times 1234$.

Assume that the IP header size is 20 bytes. Further the packet is allowed to be fragmented, i.e., Don't Fragment (DF) flag in the IP head is not set by P.

Which of the following statements is/are correct?

(A) If the second fragment is lost, P is required to resend the whole TCP segment

(B) TCP destination port can be determined by analyzing only the second fragment

(C) If the second fragment is lost, R will resend the fragment with the IP identification

(D) Two fragments are created at R and the IP datagram size carrying the second fragment is 620 bytes

**Answer: (A, D)**            **Click here to watch video explanation**

45. Consider the sliding window flow-control protocol operating between a sender and a receiver over a full-duplex free link. Assume the following:

- The time take for processing the data frame by the receiver is negligible.

- The time taken for processing the acknowledgement frame by the sender is negligib**le.**

- The sender has infinite number of frames available for transmission

- The size of the data frame is 2,000 bits are the size of the acknowledgement frame is 10 bits.

- The link data rate in each direction is 1 Mbps ($10^6$ bits per second)

- One way propagation delay of the link is 100 milliseconds

The minimum value of the sender's window size in terms of the number of frames, (rounded to the nearest integer) needed to achieve a link utilization of 50% is _____.

**Answer: (50)**            **Click here to watch video explanation**

46. Let G = (V, E) be an undirected unweighted connected graph. The diameter of G is defined as:

$$\text{diam}(G) = \max_{u,v \in V}\{\text{the length of shortest path between u and v}\}$$

Let M be the adjacency matrix of G.

Defined graph $G_2$ on the same set of vertices with adjacency matrix N, where

$$N_0 = \begin{cases} 1 & \text{if } M_{ij} > 0 \text{ or } P_{ij} > 0, \text{ where } P = M^2 \\ 0 & \text{otherwise} \end{cases}$$

Which one of the following statements is true?

(A) $\lceil \text{diam}(G)/2 \rceil < \text{diam}(G_2) < \text{diam}(G)$

(B) $\text{diam}(G_2) \le \lceil \text{diam}(G)/2 \rceil$

(C) $\text{diam}(G_2) = \text{diam}(G)$

(D) $\text{diam}(G) < \text{diam}(G_2) \le 2\,\text{diam}(G)$

**Answer: (B)**            **Click here to watch video explanation**

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**47.** Consider a dynamic hashing approach for 4-bit integer keys:

1. There is a main has tables of size 4.

2. The 2 lease significant bits of a key is used to index into the main hash table.

3. Initially, the main hash table entries are empty.

4. All keys corresponding to a main has table entry is organized as a binary tree that grows on demand.

5. First, the 3$^{rd}$ least significant bit is used to divide the keys into left and right subtrees.

6. To resolve more collisions, each mode of the binary tree is further sub-divided into left and right subtrees based on the 4$^{th}$ least significant bit.

7. A split is done only if it is needed, i.e., only when there is a collision.

Consider the following state of the hash table.
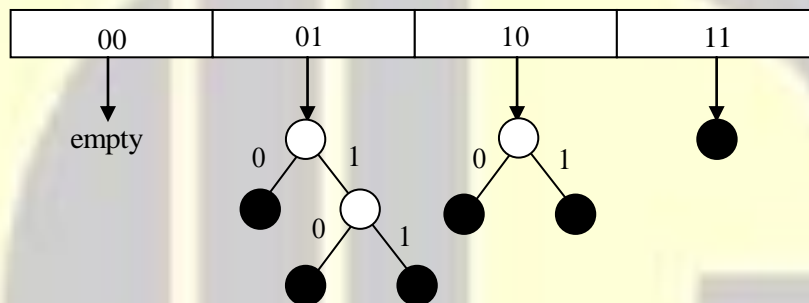


Which of the following sequence of key insertion can cause the above state of the hash table (assume the keys are in decimal notation)?

(A) 5, 9, 4, 13, 10, 7

(B) 9, 5, 10, 6, 7, 1

(C) 10, 9, 6, 7, 5, 13

(D) 9, 5, 13, 6, 10, 14

**Answer:** **(C)** **Click here to watch video explanation**

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**48.** A TCP server application is programmed to listen on port number P on host S. A TCP client is connected to the TCP server over the network.

Consider that while the TCP connection was active, the server machine S crashed and rebooted. Assume that the client does not use the TCP keepalive timer.

Which of the following behaviors is/are possible?

(A) The TCP serve application on S can listen on P after reboot

(B) If the client sends a packet after the server reboot, it will receive a FIN segment

(C) If the client was waiting to receiver a packet, it may wait indefinitely

(D) If the client sends a packet after the server reboot, it will receive a RST segment

**Answer:** **(A, C, D)** **Click here to watch video explanation**

**49.** Consider the following Boolean expression

$$F = (X + Y + Z)(\bar{X} + Y)(\bar{Y} + Z)$$

Which of the following Boolean expression is/are equivalent to $\bar{F}$ (complement of F)?

(A) $X\bar{Y} + Y\bar{Z} + \bar{X}\bar{Y}\bar{Z}$

(B) $(X + \bar{Z})(\bar{Y} + \bar{Z})$

(C) $(\bar{X} + \bar{Y} + \bar{Z})(X + \bar{Y})(Y + \bar{Z})$

(D) $X\bar{Y} + \bar{Z}$

**Answer:** **(A, B, D)**  **Click here to watch video explanation**

**50.** Consider the following C code segment:

$a = b + c;$
$e = a + 1;$
$d = b + c;$
$f = d + 1$
$g = e + f;$

In a compiler, this code segment is represented internally as a directed acyclic graph (DAG). The number of nodes in the DAG is _____.

**Answer:** **(6)**  **Click here to watch video explanation**

**51.** Consider the two statements:

$S_1$ : There exist random variables X and Y such that

$$\left(E\left[(X - E(x))(Y - E(Y))\right]\right)^2 > Var[X]Var[Y]$$

$S_2$ : For all random variables X and Y,

$$Cov[X, Y] = E\left[X - E[X]\big|Y - E[Y]\big|\right]$$

(A) Both $S_1$ and $S_2$ are false

(B) $S_1$ is false but $S_2$ is true

(C) Both $S_1$ and $S_2$ are true

(D) $S_1$ is true but $S_2$ is false

**Answer:** **(A)**  **Click here to watch video explanation**

**52.** Consider the relation $R(P, Q, S, T, X, Y, Z, W)$ with the following functional dependencies.

$PQ \rightarrow X : P \rightarrow YX : Q \rightarrow Y : Y \rightarrow ZW$

Consider the decomposition of the relations R into the constituent relations according to the following two decompositions schemes.

$D_1 :$ $R = \left[ (P, Q, S, T); (P, T, X); (Q, Y); (Y, Z, W) \right]$

$D_2 :$ $R = \left[ (P, Q, S); (T, X); (Q, Y); (Y, Z, W) \right]$

Which one of the following options is correct?

(A)  $D_1$ is law lossy decomposition, but $D_2$ is a lossless decomposition

(B)  Both $D_1$ and $D_2$ are lossy decomposition

(C)  $D_1$ is lossless decomposition, but $D_2$ is a lossy decomposition

(D)  Both $D_1$ and $D_2$ are lossless decompositions

**Answer:    (C)**                                    **Click here to watch video explanation**

**53.** A five-state pipeline has stage delays of 150, 120, 150, 160 and 140 nanoseconds. The registers that are used between the pipeline stages have a delay of 5 nanoseconds each.

The total time to execute 100 independent instructions on this pipeline, assuming there are not pipeline stalls, is _____ nanoseconds.

**Answer:    (17160)**                                **Click here to watch video explanation**

**54.** Consider the following ANSI C program.

```
# include <stdio.h>
int main
{
    int i, j, count;
    count = 0;
    i = 0;
    for (j  = -3; j < = 3; j++)
    {
                if ((j . = 0 && (i++))
                    Count = count + j;
    }
    count = count + i;
    printf ("%d", count);
    return 0;
}
```

Which one of the following options is correct?

(A) The program will not compile successfully

(B) The program will compile successfully and output 13when executed

(C) The program will compile successfully and output 8 when executed

(D) The program will compile successfully and output 10 when executed

**Answer:** **(D)**                                                   **Click here to watch video explanation**

**55.** Define $R_n$ to be the maximum amount earned by cutting a rod of length n meters into one or more pieces of integer length and selling them. For $i > 0$, let p[i] denote the selling price of a rod whose length is 1 metres. Consider the array of prices:

$$p[1] = 1, p[2] = 5, p[3] = 8, p[4] = 9, p[5] = 10, p[6] = 17, p[7] = 18$$

Which of the following statements is/are correct about $R_7$ ?

(A) $R_7$ is achieved by three different solutions

(B) $R_7 = 19$

(C) $R_7$ cannot be achieved by a solution consisting of three pieces

(D) $R_7 = 18$

**Answer:** **(A, D)**                                                 **Click here to watch video explanation**

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