

**Q. No. 1 – 25 Carry One Mark Each**

- For a complete bipartite graph  $K_{4,5}$ , lines covering number ( $\alpha_1$ ) and line independence number ( $\beta$ ) are \_\_\_\_\_.  
(A)  $\alpha_1 = 9, \beta_1 = 4$  (B)  $\alpha_1 = 4, \beta_1 = 4$  (C)  $\alpha_1 = 5, \beta_1 = 9$  (D)  $\alpha_1 = 5, \beta_1 = 4$
- The solution to the recurrence relation  $T(n) = T(n-1) + n$ ,  $T(0) = 2$  is:  
(A)  $T(n) = n! + n$  (B)  $T(n) = \frac{n^2 + n + 2}{2}$   
(C)  $T(n) = \frac{n^2 + n + 4}{2}$  (D)  $T(n) = n!$
- The system of equations  $x + 4y + 8z = 16$ ,  $3x + 2y + 4z = 12$  and  $4x + y + 2z = 10$  have  
(A) only one solution (B) Two solutions  
(C) infinitely many solutions (D) No solution
- A LAN uses CSMA/CD protocol. The end to end propagation delay between two stations is  $125\mu$  sec. Find the contention time.  
(A)  $62.5\mu$  sec (B)  $125\mu$  sec (C)  $250\mu$  sec (D)  $187.5\mu$  sec
- Two processes A and B are operating on counting semaphore variable C and binary semaphore variable M as follows:  
Initially  $C = 0$  and  $M = 1$ ;

Process A	Process B
<pre>while(1) {     wait(M);     produce_data;     signal(C);     signal(M); }</pre>	<pre>while(1) {     wait(M);     wait(C);     consume_data;     signal(M); }</pre>

Statement:

- I: It is classical producer consumer problem with bounded buffer.  
 II: It is classical producer consumer problem with unbounded buffer.  
 III: It may go into deadlock.

Which statement is/are true?

- (A) I only (B) II only (C) I and III (D) II and III

6. A shift reduce parser carries out the action specified within braces immediately after reducing with the corresponding rule of grammar.

$S \rightarrow aaX\{\text{Print "2"}\}.$

$S \rightarrow b\{\text{Print"3"}\}$

$X \rightarrow Sc\{\text{Print"1"}\}.$

What is the translation of "aaaabcc" using the syntax directed translation scheme described by the above rules?

- (A) 32311                      (B) 31212                      (C) 12321                      (D) 23131

7. The number of rows returned by SQL query on the given EMP table is \_\_\_\_\_

```
SELECT *
FROM EMP
WHERE eno NOT IN (
SELECT manager FROM EMP);
```

eno	ename	manager
1	a	2
2	b	3
3	c	4
4	d	NULL

8. The number of nodes in  $B^+$  tree when we construct it with order of internal node as 3 and order of leaf node as 2, for the key sequence 5, 8, 1, 7, 3, 12, 9, 6 is\_\_\_\_\_.

9. Which of the following is true?

- (A) Maximum size of both sender and receiver window for data transmission using Go back N protocol with n bit frame sequence number is  $2^n - 1$   
 (B) We can use the piggybacking technique to improve the efficiency of unidirectional protocols  
 (C) If the sequence number for Selective Repeat protocol goes from 0 to 63, then the maximum sender window size will be 32  
 (D) Go back N protocol is more efficient in noisy channel than Selective Repeat protocol

10. There is a channel with bandwidth 2 MBPS, propagation delay 50 ms and packet size 4KB. What will be the channel utilization?

- (A) 1.96%                      (B) 3.84%                      (C) 4.7%                      (D) 9.67%

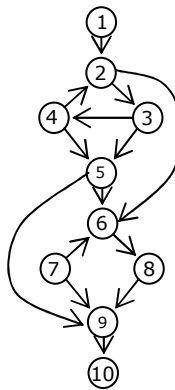
11. The length of longest common subsequence of

$X = \langle 1, 0, 0, 1, 0, 1, 0, 1 \rangle$  and

$Y = \langle 0, 1, 0, 1, 1, 0, 1, 1, 0 \rangle$  is \_\_\_\_\_

- (A) 4                      (B) 5                      (C) 6                      (D) 7

12. What is the worst-case time complexity for heapsort to sort an array of  $n$  elements?  
(A)  $O(\log n)$  (B)  $O(n)$  (C)  $O(n \log n)$  (D)  $O(n^2)$
13. Which of the following are TRUE?  
i)  $n! = \theta((n+1)!)$   
ii)  $\log_4^n = \theta(\log_2^n)$   
iii)  $\sqrt{\log n} = O(\log \log n)$   
(A) (i) & (ii) only (B) (i) & (iii) only (C) (ii) only (D) (i), (ii) and (iii)
14. According to Brooks, if there are 4 programmers in a team, then the total number of communication paths possible is\_\_\_\_\_.
15. A flow graph for a program is given as follows:

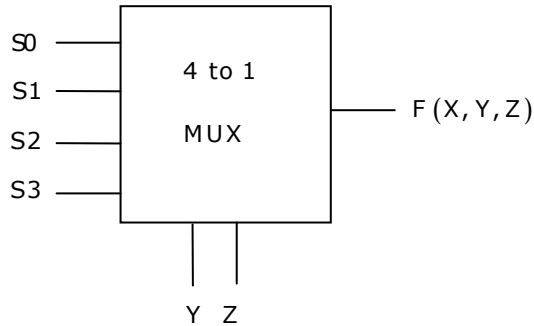


- Which of the following nodes are dominated by node 3?  
(A) 5,6,7,8,9 (B) 4,5,6,7,8,9 (C) 4 only (D) 4,5
16. Match the correct automaton given in Y for the given transition function in X.
- |   |                            |
|---|----------------------------|
| X   | Y                          |
| I. $Q \times \Sigma \rightarrow Q$                      | A. NFA                     |
| II. $Q \times \Sigma \rightarrow 2^Q$                   | B. DFA                     |
| III. $Q \times \Sigma \rightarrow Q \times \{L, R\}$    | C. NFA with null moves     |
| IV. $Q \times \{\Sigma \cup \epsilon\} \rightarrow 2^Q$ | D. Turning machine         |
|   | E. 2 way DFA               |
|   | F. PDA                     |
| (A) I-B, II-A, III-D, IV-F                              | (B) I-B, II-A, III-E, IV-C |
| (C) I-A, II-B, III-E, IV-F                              | (D) I-B, II-A, III-F, IV-D |

17. What will be the number of states in the minimal DFA which accepts the language represented by regular expression  $(a+aaa)^*$  over the alphabet  $\{a\}$ ?  
(A) 1 (B) 2 (C) 3 (D) 4

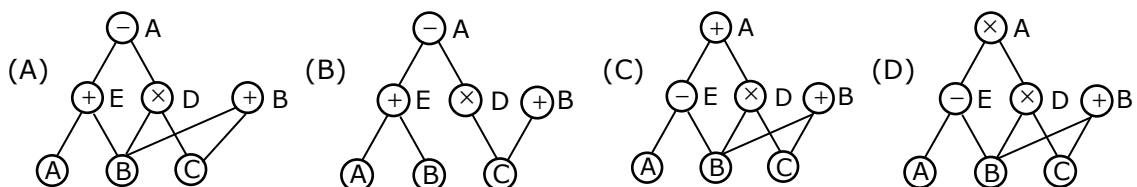
18. In a B-Tree, the block size is **512 Bytes**, search key is '4' bytes, block pointer size is 8 bytes, and record pointer size is 8 bytes. Every node contains 'n-1' record pointers, 'n-1' search keys, 'n' block pointers (where n is the order of the B-tree). The maximum number of search keys that can be accommodated in level 0 of above B-tree (root is at level 0) is \_\_\_\_\_.

19. If a 4 to 1 MUX is used to implement  $F(X, Y, Z) = X'Y + XY'$  then which of the following is correct?



- (A)  $S_0 = 1$   $S_1 = X$   $S_2 = 1$   $S_3 = X'$  (B)  $S_0 = X$   $S_1 = X$   $S_2 = X'$   $S_3 = X'$   
(C)  $S_0 = X$   $S_1 = X'$   $S_2 = X'$   $S_3 = X$  (D) Both (B) and (C)
20. Two cells in the same locations but spread on two maps of a 5 variable K-map differ in their decimal representation by  
(A) 4 (B) 8 (C) 16 (D) 2
21. Consider a pipeline with 5 stages. Assume the 1<sup>st</sup> stage takes 5 units of time, 2<sup>nd</sup> takes 2 units of time, 3<sup>rd</sup> takes 3 unit of time, 4<sup>th</sup> takes 1 unit of time and 5<sup>th</sup> takes 4 unit of time. The speed up factor of pipeline is \_\_\_\_\_.
22. A micro program control unit is required to generate a total 120 control signals. The number of bits required in the control word to achieve maximum parallelism is \_\_\_\_\_.
23. The following basic block supports which of DAG?

$$\begin{aligned} D &= B * C \\ E &= A + B \\ B &= B + C \\ A &= E - D \end{aligned}$$



24. A lot had 20% defective items. Ten items are chosen randomly from this lot. The probability that exactly 3 of the chosen items are defective is  
(A) 0.2013 (B) 0.3915 (C) 0.2916 (D) 0.2561
25. By assuming that the numbers are in 2's complement notation, evaluate the following product.  
**1111010 \* 00001010**  
(A) 100 (B) -100 (C) 60 (D) -60

**Q. No. 26 – 51 Carry Two Marks Each**

26. 16 line address bus has lines  $A_{15}-A_0$ , an address of a peripheral is  $(AFC6)_{16}$  and address decoder for that peripheral ignore line  $A_8$  and  $A_9$ . What are the addresses to which this device will respond?  
(A)  $(AFC6)_{16}, (BFC6)_{16}, (CFC6)_{16}, (DFC6)_{16}$   
(B)  $(AFC6)_{16}, (AEC6)_{16}, (ADC6)_{16}, (ACC6)_{16}$   
(C)  $(AFC6)_{16}, (AFC7)_{16}, (AFC8)_{16}, (AFC9)_{16}$   
(D)  $(AFC6)_{16}, (BEC6)_{16}, (CDC6)_{16}, (DCC6)_{16}$
27. The following grammar abstracts the dangling-else problem.  
 $S \rightarrow iEtS \mid iEtSeS \mid a$   
 $E \rightarrow b$   
Here  $i$ ,  $t$  and  $e$  stand for if, then and else respectively,  $E$  and  $S$  for "Expression" and "statement". Which of the following represents the left factored form of given grammar?  
 $S \rightarrow iEtSS' \mid a$  (A)  $S' \rightarrow eS \mid \epsilon$   
 $E \rightarrow b$   
 $S \rightarrow aS'$   
(C)  $S' \rightarrow iEtS \mid iEtSeSS'$   
 $E \rightarrow b$   
 $S \rightarrow iES' \mid a$  (B)  $S' \rightarrow tS \mid tSeS$   
 $E \rightarrow b$   
 $S \rightarrow iES' \mid a$   
(D)  $S' \rightarrow eSS'' \mid S''$   
 $S'' \rightarrow tSS''$   
 $E \rightarrow b$
28. A two-level paging scheme uses a Translation look aside Buffer (TLB). A TLB access takes 10 ns and a main memory access takes 100 ns. What should be the TLB hit ratio (in %), so that effective access time (EAT) is no more than 150 ns?  
(A) 60% (B) 70% (C) 80% (D) 90%

29. Implementation of synchronization problem of the two processes  $P_0$  &  $P_1$  is as follows

Semaphore  $S_x, S_y$

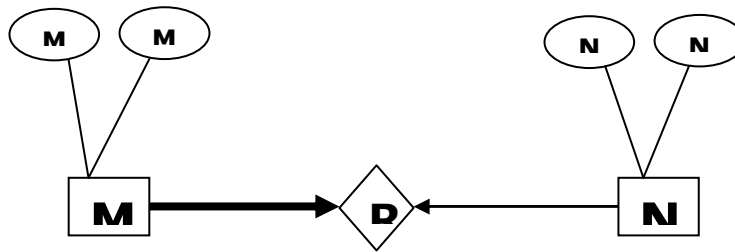
$$S_x = 1, S_y = 1$$

$P_0$	$P_1$
wait ( $S_x$ )	wait ( $S_x$ )
wait ( $S_y$ )	wait ( $S_y$ )
⟨critical section⟩	⟨critical section⟩
signal ( $S_y$ )	signal ( $S_y$ )
signal ( $S_x$ )	signal ( $S_x$ )

Which of the following statement is false for the above implementation?

- (A) Mutual exclusion exist  
 (B) There is progress in the system  
 (C) There will not be any effect on the system if process  $P_0$  reverse order of wait() function  
 (D) None of these
30. In a test, answering a question is a multiple choice. A student either knows the answer or guesses the answer. Let  $P$  be the probability that the student knows the answer to a question.  $(1-p)$  be the probability that the student guess the answer. Assume that if the student guess the answer to a question will be correct with probability  $= \frac{1}{5}$ . What is the conditional probability that if the student knew the answer to a question given that the question is answered correctly?
- (A)  $\frac{4p}{5p+1}$  (B)  $\frac{4}{5}$   
 (C)  $\frac{5p}{4p+1}$  (D)  $\frac{4p+1}{5}$

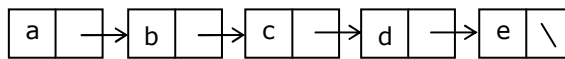
31. What would be the correct relational model for the given E-R Model?



- (A)  $MN(M1, M2, N1, N2)$   
 (B)  $M(M1, M2, N1), N(N1, N2)$   
 (C)  $M(M1, M2), N(N1, N2, M1)$   
 (D)  $M(M1, M2), R(M1, N1), N(N1, N2)$

32. Assume that p & q are pointers. What will be the output after performing following sets of operations on a given linked list?

```
struct node {
    char info;
    struct node *link;
};
```



Operations are:

```
q = p -> link -> link ;
p -> link = q -> link -> link ;
q -> link -> link -> link = q -> link ;
printf ("%c", p -> link -> link -> link -> info);
```

- (A) e (B) d (C) c (D) b

33. The following elements are inserted in sequence to create an AVL tree.

31, 36, 40, 19, 14, 24, 50

What is the pre-order traversal of the created AVL tree?

- (A) 31, 19, 14, 24, 36, 40, 50 (B) 31, 19, 14, 24, 40, 36, 50  
 (C) 36, 19, 14, 31, 24, 40, 50 (D) None of these

34. The time complexity of function given below with constants is

```
void fun(int a[], int n)
{
    int i;
    printf("%d", n);
    for(i=0; i<n; i++)
    {
        printf("%d", a[i]);
    }
    printf("\n");
}
```

- (A)  $O(1)$  (B)  $O(n)$  (C)  $O(\log n)$  (D)  $O(n^2)$

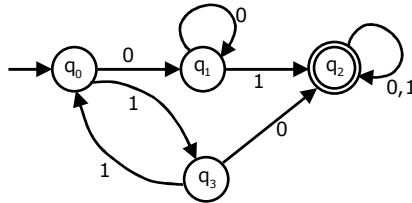
35. The number of comparisons required to search 28 in hash table with bucketing is  $\text{pos} = x \% 10$

0	→ 0 → 100 → 50 → 20 → 10
1	
2	→ 22 → 32 → 12
3	
4	
5	
6	
7	
8	→ 38 → 18 → 98 → 28
9	

- (A) 1 (B) 2 (C) 3 (D) 4
36. Consider a CRC generator polynomial  $x^3+1$ . Match the following data polynomial and their corresponding remainder.
- |                          |              |
|--------------------------|--------------|
| A. $x^8 + x^5 + x^3$     | I. $x^2 + x$ |
| B. $x^6 + x^3 + x^2 + x$ | II. $x^2$    |
| C. $x^7 + x^5 + x^4$     | III. 1       |
- (A) A-3, B-1, C-2 (B) A-3, B-2, C-1  
(C) A-2, B-3, C-1 (D) A-2, B-1, C-3
37. In a IPv4 packet, the value of HLEN is 1011 in binary. How many bytes of optional information are carried by the Header of this packet?
- (A) 0 B (B) 12 B (C) 20 B (D) 24 B
38. Which of the following statements is/are true?
- (i) Let  $(G, *)$  and  $(H, \Delta)$  be two groups. A mapping  $f : G \rightarrow H$  is called Group Homorphism from  $(G, *)$  to  $(H, \Delta)$  if for all  $a, b \in G$ ,  $f(a * b) = f(a) \Delta f(b)$
- (ii) A group can have more than one identity element.
- (iii) The inverse of every element of a group is unique.
- (A) (ii) and (iii) only (B) (i) and (ii) only  
(C) (i) and (iii) only (D) All are true
39. What will be the grammar after eliminating left recursion from the following grammar?
- $S \rightarrow SaSbS/ab$
- (A)  $S \rightarrow abA, A \rightarrow aSbSA/\epsilon$  (B)  $S \rightarrow aSbA, A \rightarrow aSbSA/\epsilon$   
(C)  $S \rightarrow abSA, A \rightarrow aSbSA/\epsilon$  (D) None of these

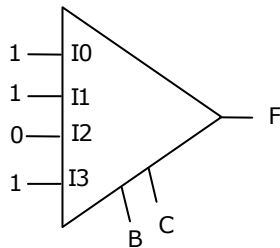


40. Find out the regular expression corresponding to the given DFA.

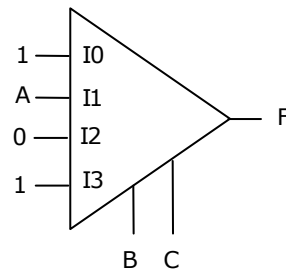


- (A)  $(00^*1 + 11^*0)(0+1)^*$  (B)  $(11)^*(0^*1 + 1^*0)(0+1)^*$   
 (C)  $((11)^*0 + 00^*1)(0+1)^*$  (D)  $(11)^*(00^*1 + 10)(0+1)^*$
41. Consider a set of messages  $M_1, M_2, M_3$  &  $M_4$  with the probability of their occurrence in a transmission as 0.05, 0.3, 0.15 & 0.5 respectively. What is the average number of bits per message required using Huffman coding?  
 (A) 2 (B) 2.25 (C) 1.7 (D) None of these
42. An experiment yield three mutually exclusive events 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 is not the correct implementation for the Boolean function  $F(A, B, C) = \sum m(0, 1, 3, 4, 5, 7)$  using 4 : 1 multiplexer?

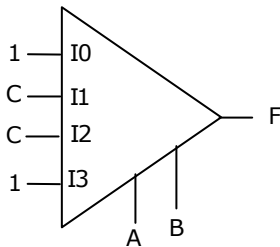
(A)



(B)



(C)



(D) Both (B) and (C)

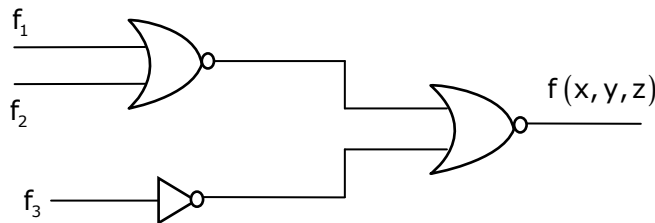
44. Which of the following is false?
- (A) All the schedules which are allowed under basic time stamp ordering protocols are also allowed under Thomas write rule.
  - (B) Schedule which are allowed under Thomas write rule are also allowed under multi version time stamp ordering protocol.
  - (C) All the schedules which are not allowed under Thomas write rule are also not allowed under multiversion time stamp ordering protocol.
  - (D) None of these

45. 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)  $A^3 + 3A^2 - A + 9I = 0$

46. The Conjunctive Normal form of the formula X is  $(P \vee Q \vee P) \wedge (P \vee Q \vee Q) \wedge (\neg P \vee \neg Q \vee \neg P) \wedge (\neg P \vee \neg Q \vee \neg Q)$ . Then find the X value?
- (A) T
  - (B)  $\neg(P \wedge Q) \Leftrightarrow (P \vee Q)$
  - (C)  $(P \vee Q) \Leftrightarrow (P \wedge Q)$
  - (D)  $\neg(P \wedge Q) \rightarrow (P \vee Q)$

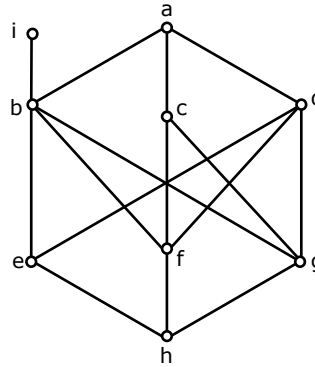
47.



- If  $f_1(x, y, z) = \Sigma(0, 1, 3, 5)$ ,  $f_2(x, y, z) = \Sigma(4, 5)$  and  $f(x, y, z) = \Sigma(1, 4, 5)$  then find  $f_3(x, y, z) = \underline{\hspace{1cm}}$ ?
- (A)  $\Sigma(1, 4, 5)$
  - (B)  $\pi(1, 4, 5)$
  - (C)  $\Sigma(0, 1, 3, 5)$
  - (D)  $\Sigma(0, 1, 5)$

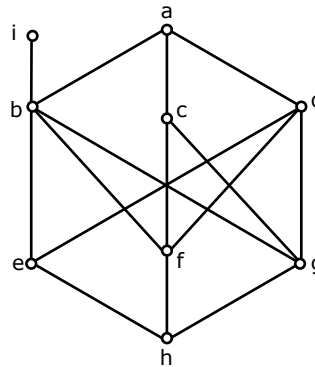
**Common Data Questions: 48 & 49**

Consider the Hasse diagram given below for some poset:



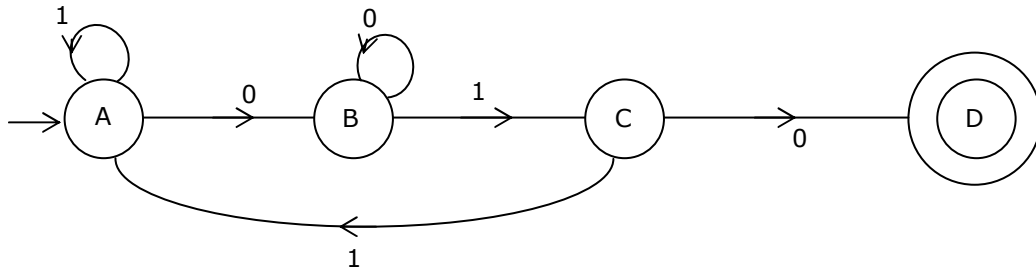
48. Find the lower bound and upper bound for the set  $A_1 = \{e, f, g\}$ , respectively
- (A)  $\{h\}, \{b, c, d\}$  (B)  $\{h\}, \{a, b, d, i\}$   
 (C)  $\{h, e, f, g\}, \{a, b, d, i\}$  (D)  $\{h\}, \{a, b, c, d\}$

Consider the Hasse diagram given below for some poset:



49. What is the number of maximal elements of the given poset and identify the infimum element for the set  $\{c, d\}$ , respectively?
- (A) 2,  $\{f\}$  (B) 1,  $\{a\}$  (C) 2,  $\{h\}$  (D) 2, does not exist

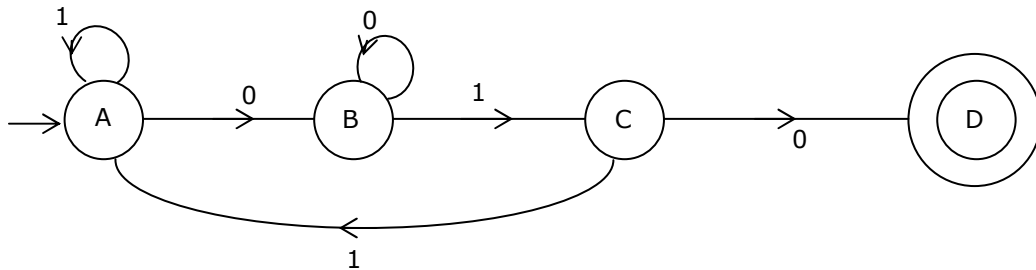
Consider the following incomplete DFA.



50. What will be the transitions for state D such that automata will accept the set of all binary strings ending with 010?

(A)  $\delta(D,0)=B$        $\delta(D,1)=C$       (B)  $\delta(D,0)=A$        $\delta(D,1)=C$   
 (C)  $\delta(D,0)=A$        $\delta(D,1)=A$       (D)  $\delta(D,0)=D$        $\delta(D,1)=D$

Consider the following incomplete DFA.



51. What will be the transitions of state D such that automata will accept the set of all binary strings containing 010 as substring?

(A)  $\delta(D,0)=A$        $\delta(D,1)=A$       (B)  $\delta(D,0)=D$        $\delta(D,1)=D$   
 (C)  $\delta(D,0)=B$        $\delta(D,1)=A$       (D)  $\delta(D,0)=C$        $\delta(D,1)=B$

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

**Statement for Linked Answer Questions: 52 & 53**

A project team "Vision" works on a project named "Online Grievances Redressal System" for one year. The size of team is 10 and team works on the project for about 200 working days. (Assume size of program is 1000 KLOC)

52. What is the productivity of the given project?

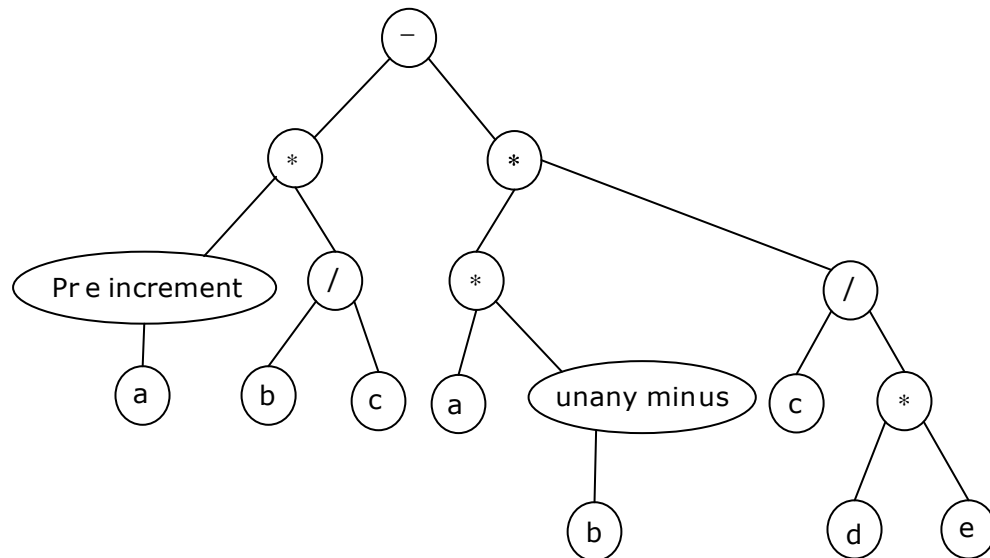
(A) 500 LOC/Programmer – day      (B) 100 LOC/Programmer – day  
 (C) 50 LOC/Programmer – day      (D) 1000 LOC/Programmer – day

A project team "Vision" works on a project named "Online Grievances Redressal System" for one year. The size of team is 10 and team works on the project for about 200 working days. (Assume size of program is 1000 KLOC).

53. If team size is 25, then what is the difference of productivity of the given project achieved now when compare to the one achieved in previous question?
- (A) 200 LOC/Programmer – day      (B) 300 LOC/Programmer – day  
(C) 400 LOC/Programmer – day      (D) 500 LOC/Programmer – day

**Statement for Linked Answer Questions: 54 & 55**

Consider the following syntax tree.



54. To which of the following expression this syntax tree belongs to?
- (A)  $(++a/b * c) - (a * (-b) * c/cd * e)$       (B)  $(++a * (b/c)) - ((a * (-b)) * (c/(d * e)))$   
(C)  $(a ++/b * c) - (-a * b * c/(d * e))$       (D)  $(++a * (b/c)) - (a * (-b) * c/(d * e))$
55. The Post fix notation for the above derived expression is?
- (A)  $a + +bc/*ab - *cde */* -$       (B)  $a + +bc/ab * - *cde */* -$   
(C)  $a + +bc/*ab * -cd * e/* -$       (D)  $a + +bc/c * ab - *cde */* -$

**Q. No. 56 – 60 Carry One Mark Each**

**Choose the appropriate antonyms for the given words given below:**

56. Tedious  
(A) unlimited (B) confined  
(C) appetizing (D) enthralling

**Choose grammatically wrong sentences:**

57. (A) The scenery of Kashmir is awesome  
(B) I need three hairs of a black horse  
(C) The furnitures in the shop are expensive  
(D) I have no information more than this

**Spot the error part of the sentences given below:**

58. (A) the horse is (B) quite good but  
(C) so small to (D) accommodate

**Find the proper meaning of the word given in bold letters:**

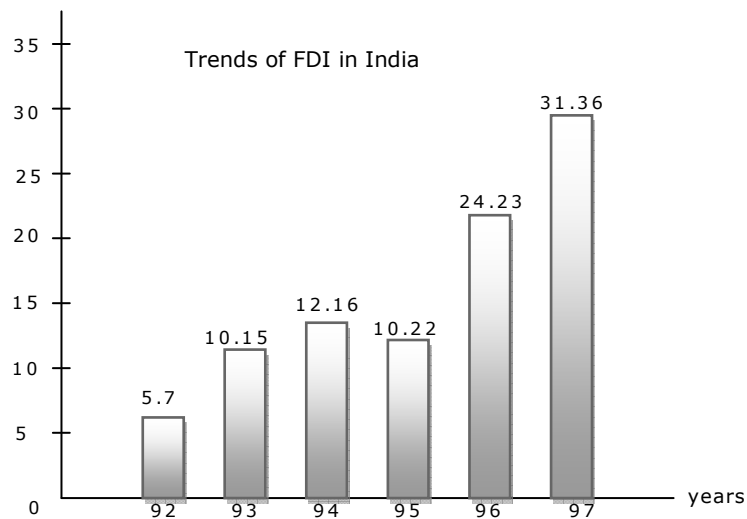
59. APP won the election fair and square.  
(A) Honestly (B) Falsely (C) Corruptedly (D) Unexpectedly
60. Tickets numbered 1 to 20 are mixed up & then a ticket is drawn at random. What is the probability that ticket drawn as a number of which is multiple of 3 or 5?  
(A)  $\frac{3}{20}$  (B)  $\frac{9}{20}$  (C)  $\frac{5}{21}$  (D)  $\frac{7}{20}$

**Q. No. 61 – 65 Carry Two Marks Each**

**Fill in the blanks with appropriate words:**

61. None but the rich can afford air travel. Some of those who travel by air become sick. Some of those who become sick require treatment.  
Choose the best conclusion:  
(A) All the rich travel by air  
(B) All the persons who travel by air become sick  
(C) All sick persons travel by air  
(D) Only rich can travel by air
62. What is the unit digit in  
 $\{(3474)^{1793} \times (225)^{317} \times (451)^{491}\}$   
(A) 2 (B) 5 (C) 3 (D) 0

63. Consider the below data:



What is the percentage increment in FDI in 1997 over 1995?

- (A) 106                      (B) 150                      (C) 207                      (D) 100

64. Rs. 540 is divided among A, B and C so that if Rs. 15, Rs.60, and Rs.30 be subtracted from their respective share the remainders may be in the ratio 3:8:4. What was the initial share of C?

- (A) 102                      (B) 292                      (C) 146                      (D) 210

65. A boat is moving downstream and reaches its destination in 25 hr. while moving at a speed of 50 km/hr (given speed in still water) one particular day due to engine problem at mid-point, ship's speed is reduced by 20% of the original. It reaches the destination 2.5 hr late. Find out the speed of the river.

(Assume its speed to be uniform).

- (A) 10                      (B) 20                      (C) 15                      (D) 5