

Q. No. 1 – 25 Carry One Mark Each

1. In a tennis tournament 12 players, say $P_1, P_2, P_3, \dots, P_{12}$ are divided into 6 pairs at random. From each pair, a winner is decided on the basis of a game played between the two players. Assume that all the players are of same strength. Find the probability that the player P_5 is among the six winning players.

(A) $\frac{1}{4}$ (B) $\frac{8}{15}$ (C) $\frac{1}{2}$ (D) $\frac{15}{8}$

2. If A and B are two events such that $P(A^c) = 0.4$, $P(B) = 0.3$ and $P(A \cap B^c) = 0.5$, then find $P(B/A \cup B^c)$.

(A) $\frac{1}{4}$ (B) $\frac{1}{8}$ (C) $\frac{3}{8}$ (D) None of these

3. The number of location(s) of the local maxima of the function $f(x) = \cos x$ in the interval $\left[\frac{\pi}{5}, \frac{11\pi}{5}\right]$ is

(A) one at π (B) two at π and 2π (C) one at 2π (D) none of these

4. Assume that a certain process executes the following code segment.
for i = 0, i <= 8, i++
fork ;
The number of new processes created is _____

5. Which of the following statements is/are true?
S1. If there is a cycle in RAG then there will be deadlock.
S2. If there is a cycle in RAG where all the resource types are of single instance then there is a dead lock.
S3. Unsafe state results in dead lock.
S4. Deadlock state is subset of unsafe state.
(A) S4 only (B) S2 & S4 only
(C) S1 & S4 only (D) S1, S3 and S4 only

6. Consider an operating system containing 'n' processes each requiring 4 resources. The maximum number of processes that can be executed without any deadlock if there are 18 resources is

12. Consider the following pseudo code for post order traversal of binary tree:

```
Postorder struct node*node
{
    if node == NULL
        return;
    X : _____
    Y: _____
    Z: _____
}
```

Then X,Y and Z are

- (A) X: Postorder node → left Y: Postorder node → right Z: print node
- (B) X: Postorder node → left Y: print node Z: Postorder node → right
- (C) X: Postorder node → left Y: Postorder node Z: print node
- (D) X: print node Y: Postorder node → right Z: Postorder node → left

13. Map the following statements to true(T)/false(F) respectively.

S1: Suppose $Y \leq_p X$ (Y is polynomially reduced to X). If Y cannot be solved in polynomial time, then X also cannot be solved in polynomial time.

S2: To prove a problem to be NP – complete one needs to reduce that problem to another known NP –Complete problem.

- (A) FF
- (B) FT
- (C) TF
- (D) TT

14. Which among the following is a pre-processor directive?

- | | |
|------------------------------|---------------------------|
| i) File Inclusion | ii) Type Coercion |
| iii) Conditional Compilation | iv) Macro Expansion |
| (A) i, ii, iii but not iv | (B) i, ii, iv but not iii |
| (C) i, iii, iv but not ii | (D) ii, iii, iv but not i |

15. Which of the following specifies a way in which the attribute of grammar symbols are related to each other?

- | | |
|--------------------|-------------------|
| (A) Syntactic Rule | (B) Semantic Rule |
| (C) Lexical Rule | (D) None of these |

16. Given that a language $L_A = L_1 \cup L_2$, where L_1 & L_2 are two other languages. If L_A is known to be a regular language, then which of the following statements is necessarily TRUE?

- (A) If L_1 is regular, then L_2 will also be regular
- (B) If L_1 is regular & finite, then L_2 will be regular
- (C) If L_1 is regular & finite, then L_2 will be regular & finite
- (D) None of these

Q. No. 26 – 55 Carry Two Marks Each

26. Consider a computer system that has a cache with 512 blocks, each of which can store 32 bytes of data. All addresses are byte addresses. Then to which cache line will the memory address 0xFBFC map to if the cache is direct mapped and 8 way set – associative, respectively?
(A) DBA, 3C (B) 1DA, 1D (C) 1DF, 1F (D) 1CF, 3E
27. Suppose that a direct-mapped cache has 2^{10} cache lines, with 2^4 bytes of data per cache line. If the cache is used to store blocks for a byte addressable memory of size 2^{30} bytes, the space required for storing the tags in bytes is _____
28. Consider a combinational block which takes 4-bits input (say ABCD) and results two times circular right shifted version of input as output. The minimum number of gates required to implement this logic is _____
29. Given memory partition of 100K, 500K, 200K, 300K and 600K in order, if we have processes needing memory of 212K, 417K, 112K and 405K respectively, which of the following memory allocation technique(s) will be suitable to allocate memory for all the processes?
I. First Fit
II. Best Fit
III. Worst Fit
a. II only
b. I and II
c. II and III
d. All three
30. Consider the page reference string given as follows:-
1 2 4 2 3 5 3 4 3 1 6 3 2 1 2 1 2 3 5 4
The number of page faults caused by optimal page replacement policy using pure demand paging for a memory with 4 frames is _____

31. Let us initialize counting semaphore X to 5. Assume that processes P_i , $i = 1$ to 15 are coded as follows.

```
while -1
{
    P x
    {
        critical section
    }
    V x
}
```

and suppose that P_{16} is coded as follows:

```
while 1
{
    V x
    {
        critical section
    }
    P x
}
```

The number of processes can be in the critical section atmost at any point of time is _____

32. Consider a simple graph G with k components. If each component has n_1, n_2, \dots, n_k vertices, then maximum number of edges in G is

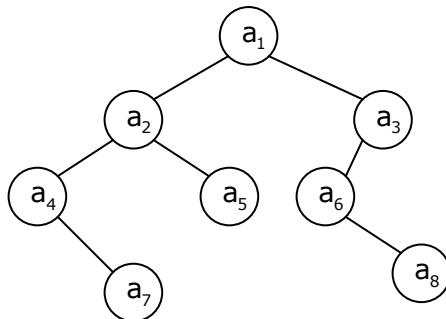
(A) $\left(\frac{n}{2}\right)$ where $n \leq \sum_{i=1}^k n_i$

(B) $\left(\frac{n}{2}\right)-k$ where $n = \sum_{i=1}^k n_i$

(C) $\sum_{i=1}^k n_i c_2$

(D) $\left(\frac{n}{2}\right)+k$ where $n = \sum_{i=1}^k n_i$

33. An operation swap tree takes a binary tree and swaps the left and right children of each node starting from root node. Consider the following binary tree given below.



What is post order traversal of the tree after applying swap operation?

- | | |
|---|---|
| (A) a ₇ a ₄ a ₅ a ₂ a ₈ a ₆ a ₃ a ₁ | (B) a ₈ a ₆ a ₃ a ₅ a ₇ a ₄ a ₂ a ₁ |
| (C) a ₇ a ₄ a ₅ a ₃ a ₈ a ₆ a ₂ a ₁ | (D) a ₇ a ₅ a ₄ a ₃ a ₈ a ₆ a ₂ a ₁ |
34. The asymptotic behavior of polynomial in 'n' of the form $f(n) = \sum_{i=0}^m a_i n^i$ where $a_m > 0$ is
- | | | | |
|-------------|----------------------|---------------|-------------------|
| (A) O log m | (B) O n ^m | (C) O n log m | (D) None of these |
|-------------|----------------------|---------------|-------------------|
35. What will be the output of following program?

```

int main()
{
    enum colorcode {red, yellow=10, green, blue=5, indigo=9, violet};
    print f ("%d %d %d %d %d", red, yellow, green, blue, indigo, violet);
    return 0;
}
  
```

- | | |
|---------------------|--------------------|
| (A) 10 10 11 5 9 10 | (B) 0 1 2 3 4 5 |
| (C) 0 10 1 5 9 2 | (D) 0 10 11 5 9 10 |

36. Match the following:-

1. Insertion in the middle of an array	A. O(1)
2. Deletion of a node in middle of a linked list	B. O (logn)
3. Deletion of head of linked list	C. O(n)
4. Search of the ith element of a linked list	D. O(n^2)

40. The transitions of a pushdown automata accepting L are given below:

$$\delta \ q_0, 0, Z_0 = q_0, 0Z_0$$

$$\delta \ q_0, 0, 0 = q_0, 00$$

$$\delta \ q_0, 1, 1 = q_0, 11$$

$$\delta \ q_0, 1, 0 = q_0, 10$$

$$\delta \ q_0, 2, 1 = q_1, \epsilon$$

$$\delta \ q_1, 2, 0 = q_1, \epsilon$$

$$\delta \ q_1, 2, 1 = q_1, \epsilon$$

$$\delta \ q_1, \epsilon, Z_0 = q_f, \epsilon$$

Find the language L that the above PDA accepts by final state q_f where Z_0 is start symbol?

(A) Language $L = 0^n 1^m 2^{m+n} | m, n \geq 1$

(B) Language $L = 0^n 1^n 2^{2n} | n \geq 1$

(C) Language $L = 0^n 1^m 2^p | n, m, p \geq 0$

(D) Language $L = 0^n 1^n 2^n | n \geq 0$

41. For the regular expression $0^* 10+110\ 0+1^*$, the number of non-final states and number of states where for every input it loops back to same state, are respectively, in the minimized DFA possible ?

(A) 4, 2 (B) 4, 4 (C) 4, 3 (D) 3, 4

42. Consider the following regular languages given below:

L_1 : Languages that accepts strings over $\Sigma = a, b$, such that length of string is greater than 1, but multiple of 3.

L_2 : Languages that accepts strings over $\Sigma = a, b$, such that every string contains atmost 2 a's and atmost 2 b's.

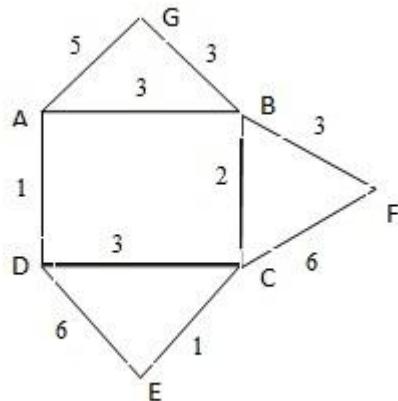
L_3 : Languages that corresponds to following regular expression R

$$R = 10 + 0 + 11\ 0^* 1 \text{ over } \Sigma = [0, 1].$$

Let the number of states in the minimized DFA of each of it be n_1, n_2, n_3 respectively. Then which of the following is true?

(A) $n_1 = n_3 < n_2$ (B) $n_1 < n_3 < n_2$ (C) $n_3 < n_1 < n_2$ (D) None of these

43. Consider the following subnet. Distance vector routing is used, and the following vectors have just come in to router C: from B: (3, 0, 6, 5, 3, 8, 3); from D: (1, 5, 3, 0, 8, 6, 3); from E: (4, 3, 1, 1, 0, 4, 6); and from F: (3, 8, 3, 6, 4, 0, 9). The measured delays to B, D, E and F are 2, 3, 1 and 6, respectively. What is C's new routing table?



- (A) (4, 2, 0, 2, 1, 5, 5) (B) (4, 4, 0, 3, 1, 6, 5)
 (C) (5, 4, 0, 3, 5, 6, 6) (D) (5, 2, 0, 2, 5, 5, 5)

44. Consider a relation R(ABCD) with FD's { $A \rightarrow B$, $A \rightarrow C$, $BC \rightarrow D$ }. Answer the following:
 (i) What is the highest normal form of this relation?
 (ii) Does this relation have any redundancy in it?

a) 3NF, NO b) 2NF, NO c) 3NF, YES d) 2NF, YES

45. If A is a 4-rowed square matrix such that $|A| = 4$, then $\text{adj}(\text{adj } A)$ is equal to
 (A) 2A (B) 4A (C) 8A (D) 16A

46. Three identical dice are rolled. The probability that the same number will not appear on each of them is
 (A) $\frac{1}{216}$ (B) $\frac{215}{216}$ (C) $\frac{1}{108}$ (D) $\frac{71}{72}$

47. If $\lim_{x \rightarrow 0} \left(\frac{\sin x - a \sin 2x}{\tan^3 x} \right)$ is finite, then value of a is
 (A) 0 (B) 1 (C) $\frac{1}{2}$ (D) -2

Common Data Questions: 48 & 49

Suppose it is given that births in a hospital 'A' occur randomly at an average rate of 1.8 births per hour.

48. The probability that we observe 5 births in a given interval of 2 hours is _____

Suppose it is given that births in a hospital 'A' occur randomly at an average rate of 1.8 births per hour.

49. Suppose there is another hospital B, where birth occur randomly at an average rate of 3.1 births per hour.

The probability that we observe 6 births in total from the two hospitals in a given 1 hour period is _____

Common Data Questions: 50 & 51

An Ethernet LAN has transmission delay of 10ms and propagation delay from one station to another is 2ms. The system is operating on a 5kbps bandwidth.

50. The channel efficiency in percentage is _____

An Ethernet LAN has transmission delay of 10ms and propagation delay from one station to another is 2ms. The system is operating on a 5kbps bandwidth.

51. What is the minimum frame length?

(A) 20 bit (B) 30 bit (C) 40 bit (D) 50 bit

Statement for Linked Answer Questions: 52 & 53

Given below are some transaction schedules that involve three transactions $T_1 - T_2 - T_3$

Schedule 1

$T_2 : R_x, T_2 : R_y, T_1 : W_x, T_3 : W_y, T_3 : W_z, T_2 : W_z,$
 $T_1 : R_z, T_2 : W_y$

Schedule 2

$T_2 : R_x, T_2 : W_y, T_3 : R_y, T_3 : W_x, T_1 : W_y, T_3 : R_x,$
 $T_1 : R_y, T_2 : W_y$

Schedule 3

$T_1 : R_x, T_2 : R_y, T_3 : W_y, T_2 : R_z, T_3 : R_z, T_1 : W_z,$
 $T_1 : W_y, T_2 : W_y$

Schedule 4

$T_1 : R_x, T_3 : W_y, T_2 : R_z, T_3 : R_z, T_1 : W_y, T_2 : W_x,$
 $T_1 : R_y, T_2 : W_z$

52. Which of the above given schedules is conflict serializable?
 (A) Schedule 1 (B) Schedule 2 (C) Schedule 3 (D) Schedule 4

Given below are some transaction schedules that involve three transactions $T_1 - T_2 - T_3$

$T_1 - T_2 - T_3$

Schedule 1

$T_2 : R_x, T_2 : R_y, T_1 : W_x, T_3 : W_y, T_3 : W_z, T_2 : W_z,$
 $T_1 : R_z, T_2 : W_y$

Schedule 2

$T_2 : R_x, T_2 : W_y, T_3 : R_y, T_3 : W_x, T_1 : W_y, T_3 : R_x,$
 $T_1 : R_y, T_2 : W_y$

Schedule 3

$T_1 : R_x, T_2 : R_y, T_3 : W_y, T_2 : R_z, T_3 : R_z, T_1 : W_z,$
 $T_1 : W_y, T_2 : W_y$

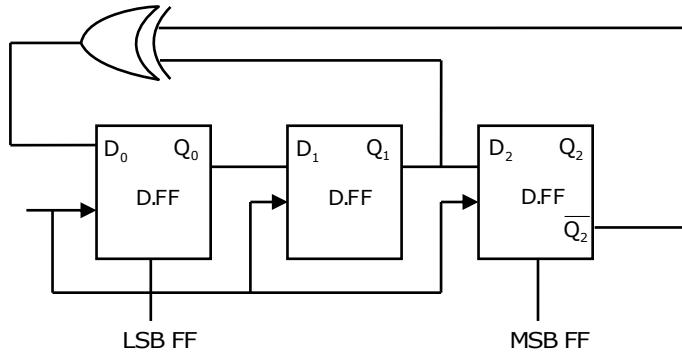
Schedule 4

$T_1 : R_x, T_3 : W_y, T_2 : R_z, T_3 : R_z, T_1 : W_y, T_2 : W_x,$
 $T_1 : R_y, T_2 : W_z$

53. For the conflict serializable schedule found in the previous question, the equivalent serial schedule possible is
 (A) $T_3 - T_1 - T_2$ (B) $T_2 - T_1 - T_3$ (C) $T_3 - T_2 - T_1$ (D) None of these

Statement for Linked Answer Questions: 54 & 55

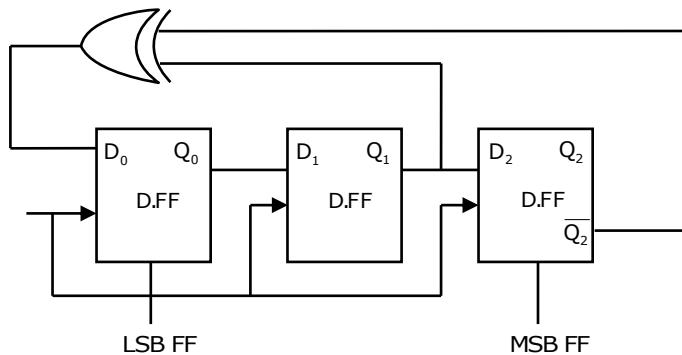
Consider the following circuit:



54. The above circuit is

(A) mod-7 counter (B) mod-8 counter (C) mod-5 counter (D) mod-6 counter

Consider the following circuit:



55. If the initial state of the counter is $Q_2Q_1Q_0 = 001$, the state after 76_{10} clocks is

(A) 001 (B) 000 (C) 011 (D) 110

Q. No. 56 – 60 Carry One Mark Each

Choose a pair that has most similar relationship to the given pair:

Fill in the blanks:

Choose the appropriate synonym for the given words given below:

58. Copiousness
(A) profusion (B) consent (C) concent (D) enthusiasm

Choose the odd one out:

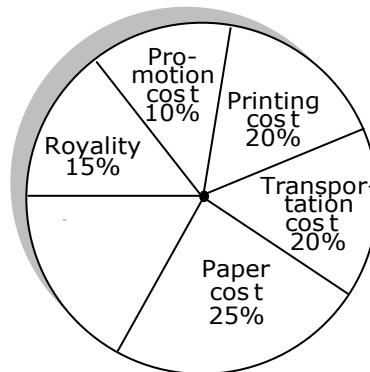
59. (A) quake (B) shudder (C) totter (D) titfer

60. # means < , ^ means > and \$ means =
If $P \# Q$, $R ^ S$ and $Q \$ R$, then which of the following statement is definitely true ?
(A) $P \# R$ (B) $P \# S$ (C) $P \$ Q$ (D) None of these

Q. No. 61 – 65 Carry Two Marks Each

64. Out of six coins, four coins are tossed simultaneously; in how many coins, there outcomes will almost three of the coins turn up as a head?
(A) 30 (B) 42 (C) 50 (D) can't be found

65. Consider the below data for various expenditures (in %) in publishing a book:



Price of book is marked 20% above CP. If marked price of book is Rs.180, then what is the cost of paper using in singly copy of book?

- (A) 37.5 (B) 36 (C) 40 (D) 42.75