Q. No. 1 – 25 Carry One Mark Each

1. Suppose a set A contains n elements and set B contains m elements then how many non-empty binary relations are possible from A to B?
   (A) $2^{m\times n}$ (B) $2^{m\times n}-1$ (C) m^n-1 (D) n^m-1

2. Let $\varnothing$ be an empty set and $P(\varnothing)$ be a power set of $\varnothing$ then what is the cardinality of $P(P(P(\varnothing)))$?
   (A) 0 (B) 4 (C) 1 (D) 2

3. Which of the following statements is/are true?
   (P) Intersection of two reflexive relations is reflexive.
   (Q) Intersection of two anti-symmetric relations is asymmetric relation.
   (A) P only (B) Q only
   (C) Both P and Q (D) Neither P nor Q

4. Consider the following IP address and subnet mask respectively 192.168.0.1 and 255.255.255.248. The number of hosts in each subnet is _____.

5. The number of states in minimal FA equivalent to the following regular grammar is
   $S \rightarrow 0S|1S|0A$
   $A \rightarrow 1B$
   $B \rightarrow 0C$
   $C \rightarrow \in$
   (A) 3 (B) 4 (C) 5 (D) None of these

6. Which of the following strings is not contained in the language represented by the regular expression $a^*(ab)^*(1+0)^*$?
   (A) abab000 (B) aabb0 (C) aaaab1110 (D) aaabab

7. Consider the following schedule:

T_1	T_2
R(A)	
R(B)	
R(C)	
	R(A)
	R(B)
	P:_____
Q:_____	
	R(C)

The possible values of P & Q for which the above schedule is allowed under Thomas write rule but not under basic timestamp ordering protocol if timestamp (T_2) > timestamp (T_1)

(A) W(B), W(C) (B) W(A), W(A) (C) Both (A) & (B) (D) None of these

8. Consider the following tables:

Table_1

A	B
a	aa
b	bb
c	cc

Table_2

A	B	C
a	a	a
b	a	null

Select * from Table_1 as t_1 where t_1.A >= all (select t_2.B from Table_2 as t_2 where t_2.B >= 'b');

The number of rows in the resultant table after executing the above query is____

9. Which of the following is not a valid subnet mask if 134.87.8.113 and 134.87.8.121 belong to the same network?

(A) 255.255.0.0 (B) 255.255.255.0
(C) 255.255.255.248 (D) 255.255.255.192

10. The number of keys required in symmetric key cryptography for 5 users to communicate each other is _____.

11. What will be printed if we execute the following C program?

```
void main ()
{
    int x = 5;
    printf("%d  %d  %d", x, x++,++x);
}
```

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

12. The function rec is defined as follows:

$$\text{rec (n)} = \begin{cases} 1 & \text{if } n = 1 \\ (n-1) + \text{rec}(n-1) & \text{if } n > 1 \end{cases}$$

The value of rec (20) is _____.

13. Match the following:

(1)	Multistage graph	(P)	Divide and conquer
(2)	Convex hull	(Q)	Depth first search
(3)	Bi-connected components	(R)	Greedy method
(4)	Knapsack problem	(S)	Dynamic programming
(5)	All pairs shortest path		

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

14. Following are the two lists: List – A is different security services and List – B is the security attacks.

List – A	List – B
1) Integrity	a) Fabrication
2) Authentication	b) Denial of service
3) Non-Repudiation	c) Modification

Match the appropriate security attack on the security service.

(A) 1-a, 2-b, 3-c (B) 1-c, 2-b, 3-a (C) 1-c, 2-a, 3-b (D) 1-c, 2-a, 3-c

15. Rotations performed while inserting elements 10, 20, 70, 35, 40 in sequence to create an AVL tree are

(A) 2 – left, 1 – right (B) 1 – left, 2 – right
(C) 2 – left (D) 2-right

16. Which of the following is context free language?

L_1 = complement of $\{a^i b^j c^k \mid i \neq j \text{ and } j \neq k\}$

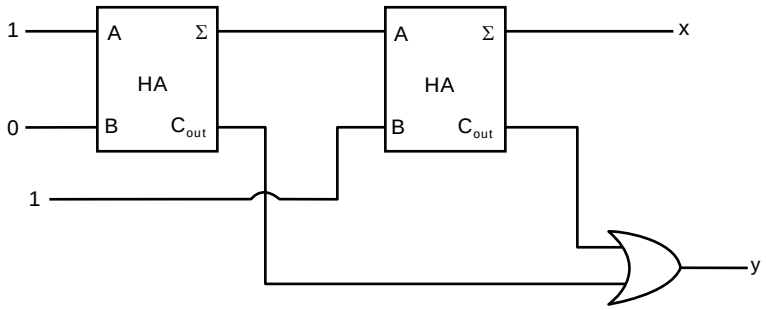
$L_2 = \{ww / w \in (0,1)^*\}$

$L_3 = \{1^{n!} \mid n \geq 0\}$

$L_4 = \{0^n 1^n \; 0^n 1^n \mid n \geq 0\}$

(A) L_1 only (B) L_1 and L_2 only
(C) L_1 and L_4 only (D) none of the given languages

17. Consider the following circuit:



Determine the value of x and y.

(A) x = 0, y = 0 (B) x = 0, y = 1 (C) x = 1, y = 0 (D) x = 1, y = 1

18. Consider a relation R(ABCDE) with FD set $F = \{A \to B, B \to C, C \to D\}$.

The number of super keys of R is _____.

19. The range of 6 bit integer in 2's complement notation is

(A) -31 to 31 (B)-32 to 31 (C)-63 to 63 (D) -64 to 63

20. The characteristic expression for a new AB-flip-flop is given below

$Q_{n+1}(A, B, Q_n) = \overline{A}\,\overline{Q_n} + B Q_n$. Identify the correct statement.

(A) if $A = 0, B = 0$ then flip flop resets

(B) if $A = 0, B = 1$ then flip flop resets

(C) if $A = 1, B = 0$ then flip flop retains the last value

(D) if $A = 0, B = 0$ then toggles

21. Determine the minimum number of states required in DFA to accept the strings over $\{0,1\}$ whose length is atmost n (n>0) and strings start with 0.

(A) n states (B) n+1 states (C) n+2 states (D) n^2 states

22. Consider a disk drive with following specifications:

Number of surfaces = 16

Number of tracks/surface = 256

Number of sectors/track = 512

Number of bytes/sector = 1024

The number of bits required to specify particular track in the disk is_____.

23. If a simple graph G with n vertices is isomorphic to its complement $\overline{G}$, then which of the following can be value of n?

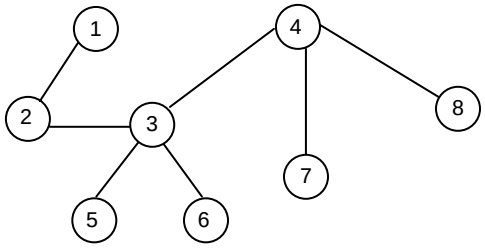
(A) 10 (B) 9 (C) 11 (D) 15

24. The number of stationary points of the following function is

$f(t) = 4t^3 + 15t^2 - 18t + 6$ is

(A) 0 (B) 1 (C) 2 (D) 3

25. The number of articulation points and Bi-connected components for the following graph are respectively



(A) 4, 5 (B) 3, 4 (C) 3, 7 (D) 4, 4

Q. No. 26 – 55 Carry Two Marks Each

26. Consider a pipeline for five stages.

IF: Instruction fetch

ID: Instruction decoder

EX: Execution

MA: Memory Access

WB: Write Back

The IF, ID, MA, WB stages take two clock each to complete the operation. The No. of clock cycles for the execution stage depends on the type of instruction the addition & subtraction instruction needs 3 clock cycles; MUL instruction requires 4 clock cycle. The number of clock cycles taken to complete the following program (assuming data dependency is resolved by stall cycles) is _____.

I_1 : Add r_1, r_2, r_3; $r_1 \leftarrow r_2 + r_3$

I_2 : Sub r_4, r_5, r_6; $r_4 \leftarrow r_5 - r_6$

I_3 : MUL r_8, r_2, r_1; $r_8 \leftarrow r_2 * r_1$

27. Consider the following code segment:

p = x * y + q; r = x * y * s; t = x * y + u; v = x * y

The number of multiplications saved after eliminating common sub expressions in the above code is _____.

28. Which of the following statement is false in the context of the allocation methods?

(A) Contiguous file allocation leads to external fragmentation.

(B) In Indexed file allocation, for each file one block is used as an index to store block pointers.

(C) Linked allocation supports Random access to disk blocks.

(D) Linked allocation does not exhibit external fragmentation.

29. A pure Demand-paging system has six free frames and running three processes P1,P2,P3. Frames are allocated to processes in an equal way. The Reference string is given using following notation:

Request ij means $\rightarrow$ i th process and jth page

Ex: 12 means process 1's 2nd page.

The Reference string is as follows:

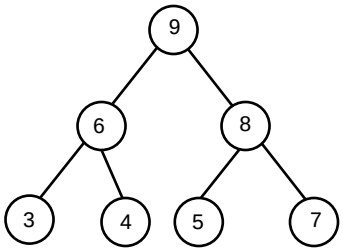
12,13,22,23,21,12,14,12,31,32,33,32,33,32,12,21

If the LRU algorithm is used and local replacement policy is employed then the number of page faults generated is _____.

30. What is the value of $\binom{n}{0}+\binom{n}{1}+\binom{n}{2}+\binom{n}{3}+.....+\binom{n}{n}$?

(A) n^2 (B) 2^{n-1} (C) 2^n (D) 2^n-1

31. Consider the following max-heap as given below:



The number of swaps required to convert the given max heap into a min heap is _____.

32. A hash table of length 7 uses open addressing with hash function $h(k) = k \bmod 7$ and linear probing for resolving collisions. After inserting 6 values in an empty hash table, the table is shown below.

0	49
1	35
2	28
3	16
4	
5	75
6	89

Which of the following insertion sequences can't result in the above table?

(A) 49, 35, 28, 75, 16, 89 (B) 75, 49, 35, 89, 28, 16

(C) 49, 35, 75, 89, 28, 16 (D) 49, 28, 35, 16, 75, 89

33. The cost of optimal binary search tree for the identifier set (a_1, a_2, a_3) = (do, if, while) with p(1) = 0.3, p(2) = 0.2, p(3) = 0.15, q (0) = 0.05, q(1) = 0.15, q(2) = 0.1, q(3) = 0.05 is

(A) 1.8 (B) 1.65 (C) 1.95 (D) 2.1

34. A company has two designs kp1 and kp2 for a synchronous pipeline processor. kp1 has 5 pipeline stages with execution times of 3 ns, 4 ns, 3 ns, 2 ns, 4 ns while the design kp2 has 6 pipeline stage with 3 ns each (execution time). The time (in ns) that can be saved by kp2 over kp1 for executing 1000 instructions is _____.

35. Consider the following set of FDs on a relation R(ABCDE):

$F1 = \{A \to B, AB \to C, D \to AC, D \to E\}$

$F2 = \{A \to BC, D \to AE\}$

Which of the following is true regarding F1 and F2?

(A) F1 is equivalent to F2

(B) F2 covers F1 but F1 doesn't cover F2

(C) F1 covers F2 but F2 doesn't cover F1

(D) None of these

36. For hierarchical routing with 4800 routers, what should be the optimal size of the routing table in terms of total number of entries? (Hierarchical routing is three-layer hierarchy with clusters, regions, and routers).

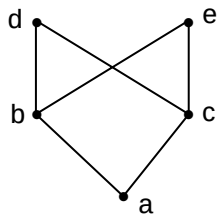
Hypothesis: - The solution with k-clusters of k-regions of k-routers is close to optimal

(A) 51 (B) 65 (C) 40 (D) 45

37. Suppose you use any arbitrary transposition scheme to encrypt a plain text of length n. How many bits does an attacker require to break your code using a lookup table approach?

(A) $n!$ (B) $\lceil \log_2 n \rceil$ (C) $\lceil n^2 \log_2 n \rceil$ (D) $\lceil \log_2 n! \rceil$

38. Consider the following hasse diagram representation of a poset:



Which of the following is true regarding the above poset?

(A) it is a lattice

(B) it is a join-semi lattice but not meet-semi lattice

(C) it is a meet-semi lattice but not join-semi lattice

(D) it is not a semi lattice

39. Consider the following program segment.

```
Procedure main
begin
   Var  a = 15; b = 30;
   change (b, b, a);
   print (a, b);
end
procedure change (a, b, c)
begin
      b = a + 10;
      a = c + 20;
      c = a + b;
end
```

What is the output of above procedure if parameters are passed by reference?

(A) 70 35 (B) 35 70 (C) 15 30 (D) 70 40

40. Match the following statements with true (T) / false (F)

S_1 : Complement of a CFL need not be recursive

S_2 : If L is recursive then L^+ is also recursive

S_3 : If L1 is recursive and L2 is recursive enumerable then L2-L1 is need not be recursive enumerable

S_4 : Recursive sets are closed under complementation and substitution

(A)

S_1	T
S_2	F
S_3	T
S_4	F

(B)

S_1	T
S_2	F
S_3	F
S_4	T

(C)

S_1	F
S_2	T
S_3	T
S_4	F

(D)

S_1	F
S_2	T
S_3	F
S_4	F

41. A Uni Processor system has two resources of type A and B which are shared by four processes. There are 8 units of each resource type. Let "current" indicate the resources allocated to each process and "Need" indicate the remaining number of resources required by each process for completion. If there exist a safe sequence, then which process will complete last?

	Current			Need	
	A	B		A	B
P_0	2	1	P_0	6	2
P_1	1	2	P_1	2	4
P_2	0	2	P_2	3	2
P_3	1	0	P_3	5	6

(A) P_1 (B) P_0

(C) P_3 (D) No safe sequence exists

42. Let in a test there are 5 questions (True-False type). The probability of guessing each question correctly by the student is 30%. What is the probability of getting more than 3 correct answers?

(A) 0.031 (B) 0.023 (C) 0.056 (D) 0.05

43. Consider a binary channel which is having one input and one output. Initially input is reproduced at output, this will continue until two consecutive 0's are received. From then onwards output is bitwise complement of input. Complementation continuous until it receives 2 consecutive 1's, after wards it repeats its behaviour from initial state. The minimum number of states to simulate the behaviour of binary channel is_____.

44. Evaluate the following subtraction.

$(C012.25)_{16} - (10111001110.101)_2$

(A) $(135103.412)_8$ (B) $(564411.412)_8$ (C) $(564411.205)_8$ (D) $(135103.205)_8$

45. The recurrence relation obtained by applying Newton Raphson method on function f(x) is $x_{n+1} = x_n(2 - tx_n)$

The iteration formula can be used to compute

(A) square of t (B) reciprocal of t

(C) square root of t (D) reciprocal of t^2

46. Match the following.

1. SMTP	P. Multiport Repeater
2. HUB	Q. TCP
3. SWITCH	R. CIDR
4. IPV6	S. Multiport Bridge

(A) P-3, Q-1, R-4, S-2 (B) P-2, Q-1, R-4, S-3

(C) P-2, Q-4, R-1, S-3 (D) P-3, Q-4, R-1, S-2

47. Match the following two lists. The conditions on the language $L = \{a^i b^j c^k\}$ is given in list I and respective grammar is given in list II.

List I	List II
A: k=i+j	G_1 : $S \to aSc / B$, $B \to aBb / \varepsilon$
B: k=i+2j	G_2 : $S \to aSc / B$, $B \to bBcc / \varepsilon$
C: i=j+k	G_3 : $S \to aSc / B$, $B \to bBc / \varepsilon$

(A) $A : G_1, B : G_2, C : G_3$ (B) $A : G_1, B : G_3, C : G_2$

(C) $A : G_3, B : G_2, C : G_1$ (D) $A : G_3, B : G_1, C : G_2$

Common Data Questions: 48 & 49

Suppose a set $A = \{x/x \in N \text{ and } x < 9\}$ and set $B = \{x/x + 5 = 8 \text{ and } x \in N\}$.

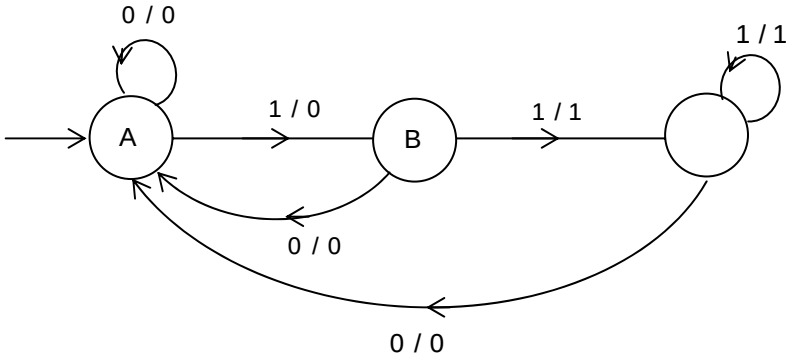
48. How many one to one functions are possible from set B to set A?
(A) 8 (B) 8! (C) 1 (D) Not possible

Suppose a set $A = \{x/x \in N \text{ and } x < 9\}$ and set $B = \{x/x + 5 = 8 \text{ and } x \in N\}$.

49. How many onto functions are possible from set A to set B?
(A) 8 (B) 8! (C) 1 (D) Not possible

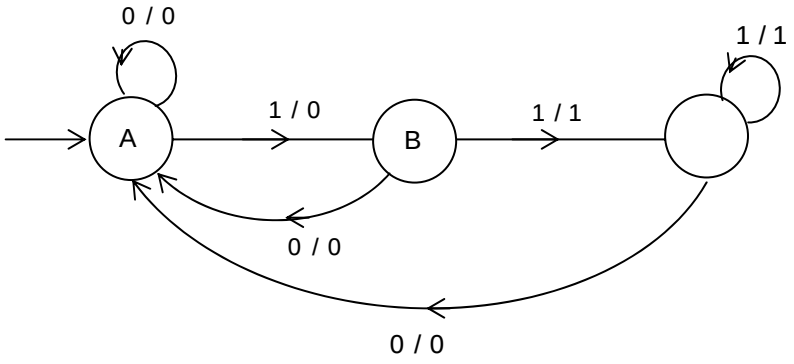
Common Data Questions: 50 & 51

Consider the given mealy machine



50. The given mealy machine
(A) increments the given pattern by one
(B) decrements the given pattern by one
(C) generates the output 1 if string ends with 11
(D) finds the 2's complement

Consider the given mealy machine



51. What is the number of states present in the equivalent minimized moore machine for the above mealy machine?
(A) 3 (B) 4 (C) 5 (D) 6

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

Statement for Linked Answer Questions: 52 & 53

Consider a semi detached software project having an estimated size of 10 KLOC. Following table shows the values of coefficients for three project types.

Software Project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.38
Semi Detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.2	2.5	0.32

52. Find the effort in person-months.

(A) 35 (B) 39.55 (C) 40 (D) 45

Consider a semi detached software project having an estimated size of 10 KLOC. Following table shows the values of coefficients for three project types.

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53. Find the duration for development of above project in months.

(A) 10 (B) 9 (C) 11 (D) 12

Statement for Linked Answer Questions: 54 & 55

Consider a disk with block size of 1024 bytes. A block pointer is 6 bytes long. A file has 30,000 employee records of fixed length and each record has 100 bytes. Assume that an un-spanned organization is used to store records and SSN takes 9 bytes. Suppose that file is not ordered by the key field SSN and we want to construct a secondary index on SSN.

54. Find the number of blocks required for first level index.

(A) 440 (B) 300 (C) 442 (D) 446

Consider a disk with block size of 1024 bytes. A block pointer is 6 bytes long. A file has 30,000 employee records of fixed length and each record has 100 bytes. Assume that an un-spanned organization is used to store records and SSN takes 9 bytes. Suppose that file is not ordered by the key field SSN and we want to construct a secondary index on SSN.

55. Find the number of block accesses required to retrieve a record using first level secondary index.

(A) 9 (B) 10 (C) 8 (C) none of these

Q. No. 56 – 60 Carry One Mark Each

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

56. **ANARCHIST: GOVERNMENT::**

(A) legislator : taxation (B) abolitionist : slavery

(C) jurist : law (D) suffragist : voting

Choose the appropriate antonym for the bold word given below:

57. **CATHOLIC:**

(A) narrow (B) soft (C) trivial (D) calm

Consider each answer choice carefully and decide which completes the sentence with a logically satisfying meaning.

58. Data concerning the effects on a small population of high concentrations of a potentially hazardous chemical are frequently used to _____ the effects on a large population of lower amounts of the same chemical.

(A) verify (B) redress (C) predict (D) realize

59. **Select the best alternative for the underlined part:**

Currently 93,250,000 billion barrels a year, world consumption of oil is rising at a rate of 3 percent annually.

(A) world consumption of oil is rising at a rate of

(B) the world is consuming oil at an increasing rate of

(C) the world's oil is being consumed at the increasing rate of

(D) the rise in the rate of the world's oil consumption is

60. A card is drawn from a pack of 52 cards. The probability of getting a queen of club or a king of heart is

(A) $\frac{3}{26}$ (B) $\frac{1}{26}$ (C) $\frac{2}{13}$ (D) $\frac{1}{13}$

Q. No. 61 – 65 Carry Two Marks Each

61. False currency is being supplied to India through buses that run between India and Pakistan.

Find out the course of action to be taken.

(A) The govt. should ban the buses

(B) The govt. should change the currency

(C) The govt. should strengthen the vigilance

(D) Indian govt. should warn the Pakistan govt.

62. What is 2777^{th} term in the series 1 2 3 4 5 6 7 8 9 10 11 12 13 14.....?

(A) 9 (B) 3 (C) 7 (D) 6

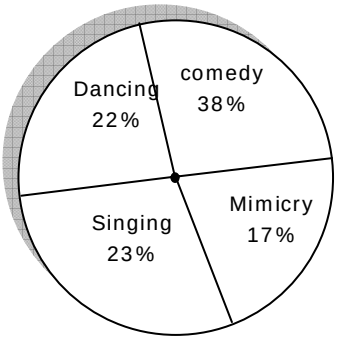
63. Which of the following numbers will completely divide $\left(4^{71}+4^{72}+4^{73}+4^{74}\right)$

(A) 3 (B) 10 (C) 11 (D) 13

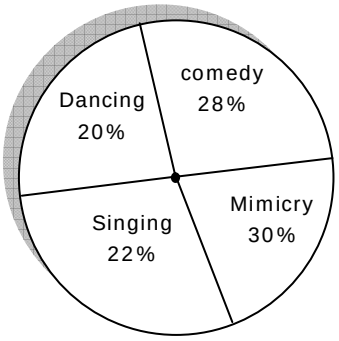
64. Six bells commence tolling together and toll at interval of 2, 4, 6, 8, 10 and 12 seconds respectively. In 30 minutes, how many times do they toll together?
(A) 15 (B) 16 (C) 20 (D) 13

65. Percentage of employees participated in different activities in Eduworld:

Total No. of Employees = 8000



Total No. of Females= 3000



What is the ratio of the number of male employees to number of female employees participated in dancing?
(A) 15:29 (B) 29:15 (C) 4:1 (D) 83:30