

# TarGATE'11

## Computer Science & Engineering

Your Roll Number: .....

Test ID: 

2	2	0	4
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Duration: 3 Hours

Maximum Marks: 100

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### Read the following instructions carefully:

1. Write your roll number, your name and name of the examination centre at the specified locations of the ORS.
2. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.
3. All the questions in this question paper are of objective type.
4. Questions must be answered on Objective Response Sheet (ORS) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. **Each question has only one correct answer.** In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as a wrong answer.
5. This question paper contains 65 objective type questions comprising of 55 Technical questions and 10 General Aptitude questions. Q.1 to Q.25 and Q. 56 to Q. 60 carry **one** mark each. Q.26 to Q.55 and Q. 61 to Q. 65 carry **two** marks each.
6. The questions pairs (48, 49) and (50, 51) are common data questions
7. The questions pairs (52, 53) and (54, 55) are questions with linked answers. The answer to the second question of the above pairs will depend on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.
8. Un-attempted questions will carry zero marks.
9. **NEGATIVE MARKING:** For Q.1 to Q.25 and Q. 56 to Q. 60, 1/3<sup>rd</sup> mark will be deducted for each wrong answer. For Q. 26 to Q.51 and Q. 61 to Q. 65, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. For the pairs of questions with linked answers, there will be negative marks only for wrong answer to the first question, i.e. for Q.52 and Q.54, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.
10. Calculator without data connectivity is allowed in the examination hall.
11. Charts, graph sheets or tables are NOT allowed in the examination hall.
12. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.

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The screenshot displays the eTutor software interface. On the left, a sidebar lists various topics under the 'GATEFORUM Engineering Success' logo. The main window shows a handwritten lecture titled 'Numerical Solution of Ordinary Differential Equation of first order'. The lecture includes the differential equation  $\frac{dy}{dx} = f(x, y)$  labeled (1), the initial condition  $y(x_0) = y_0$  labeled (2), and the phrase 'Initial value problem'. Below this, it mentions '[x<sub>0</sub>, x<sub>1</sub>] Lipschitz'. The interface also features a top navigation bar with icons and a status bar at the bottom.

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Compiler Design  
Computer Networks  
CS-Common Math

- a01.Linear Algebra\_Matrices\_Ses
- a02.Linear Algebra\_Matrices\_Ses
- a03.Linear Algebra\_Matrices\_Ses
- a04.Linear Algebra\_System of Lin
- a05.Linear Algebra\_Eigen Values
- b01.Numerical Methods\_Comp. Err
- b02.Numerical Methods\_Finite Diff
- b03.Numerical Methods\_Numerical
- b04.Numerical Methods\_Solution o
- b05.Numerical Methods\_Solution o
- b06.Numerical Methods\_Numerical
- c01.Probability\_Basics\_Session1\_
- c02.Probability\_Basics\_Session2\_
- c03.Probability\_Basics\_Session3\_
- c04.Probability\_Basics\_Session4\_
- d01.Probability\_Distribution\_Sessk
- d02.Probability\_Distribution\_Sessk
- d03.Probability\_Distribution\_Sessk
- d04.Probability\_Distribution\_Sessk

CS-Maths  
Data Structure and Algorithm

Numerical Solution of Ordinary Differential Equation of first order

$$\frac{dy}{dx} = f(x, y) \quad \text{--- (1) } \checkmark$$
$$y(x_0) = y_0 \quad \text{--- (2) } \checkmark$$

Initial value problem.

$[x_0, x_1]$  Lipschitz

A typical eTutor Screen

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**Q. No. 1 – 25 Carry One Mark Each**

1. "CLI" is an example of which of the following addressing modes?  
(A) Immediate (B) Absolute (C) Implied (D) None of these
2. Which of the following control unit requires maximum hardware?  
(A) Hardwired (B) Horizontal (C) Vertical (D) Same for all
3. A computer system having 7 printers with  $m$  processes competing for them. Each process may need up to two printers. What is the maximum value of  $m$  for which the system is guaranteed to be deadlock free?  
(A) 3 (B) 4 (C) 5 (D) 6
4. Consider the following C program  
# include <stdio.h>  
void main ()  
{  
int x = 10;  
int y = 20;  
if(x=y)  
printf ("x and y are equal");  
else  
printf ("x and y are not equal");  
}  
What will be printed if we execute the above program?  
(A) x and y are equal (B) x and y are not equal  
(C) Runtime error (D) Compilation error
5. How to implement two stacks using one array  
(A) Cannot implement  
(B) Unpredictable  
(C) Two stacks at two ends of the array  
(D) None of these
6. Which of the following algorithm design techniques is used in the quick sort algorithm?  
(A) Divide and conquer (B) Greedy method  
(C) Dynamic programming (D) none of these
7. Match the following functions (List I) with the most appropriate OSI layer (List II) that carries the functions:

**List I**

- a. Dialog marking
- b. ASCII to EBCDIC conversion
- c. Reassembly of datagrams
- d. Medium access control

**List II**

- i. Data Link
- ii. Physical
- iii. Session
- iv. Transport
- v. Presentation

- (A) a - ii, b - v, c - iv, d - i      (B) a - iii, b - ii, c - iv, d - i  
(C) a - iii, b - v, c - iv, d - i      (D) a - iii, b - ii, c - i, d - iv

8. The Hamming distance between 100 and 001 is

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

9. Consider the following:

$r(R)$  : r is a relation with attributes R.

$s(S)$  : s is a relation with attributes S.

$|x|$  : denotes natural join operation.

$x$  : denotes Cartesian product operation.

Then  $r|x|s = r \times s$  if

- (A)  $R \cap S = R$       (B)  $R \cap S = S$       (C)  $R \cap S = \phi$       (D) None of these

10. Let A, B and C be non empty sets, then  $(B - A) \cup (C - A)$  is equal to

- (A) A      (B) B      (C)  $(B \cup C) - A$       (D)  $\phi$

11. The decimal number 52139 requires how many bits for representation in radix 2 number system?

- (A) 12      (B) 14      (C) 16      (D) 18

12. Assume there are 4 stages in pipeline with each stage taking 1ns, 2ns, 1ns, and 3ns. What is the speed up ratio of pipelining over non pipelining?

- (A) 1.33      (B) 1.66      (C) 2      (D) 2.33

13. Total number of constant functions from set of 6 elements to a set of 8 elements is

- (A) 6      (B) 8      (C) 14      (D)  $8^6$

14. If the sum of degrees of all vertices in a graph is 20, how many edges are there in the graph?

- (A) 10      (B) 20      (C) 25      (D) Data insufficient

15.  $S \rightarrow aSb$   $S \rightarrow aS$   $S \rightarrow bS$   $S \rightarrow a$   $S \rightarrow b$ . The language generated by the above grammar is

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

16. Which one of the following language is not context free?

- (A)  $\{a^n b^n c^m d^m \mid n, m \geq 1\}$       (B)  $\{a^n b^m c^m d^n \mid n, m \geq 1\}$   
(C)  $\{a^i b^{2i} c^j d^{2j} \mid i, j \geq 1\}$       (D)  $\{a^i b^j c^i d^j \mid i = j\}$

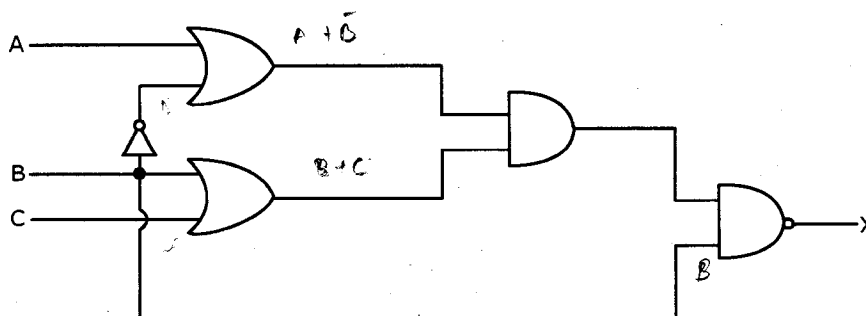
17. To implement

$$F = A\bar{B} + AB\bar{C} + ABCD + ABC\bar{D}$$

Using only two input NAND gates, the minimum number of gates required is

- (A) 8 (B) 0 (C) 2 (D) 4

18. The output X of the logic circuit shown in the figure below is



- (A)  $\overline{A + BC}$  (B)  $\overline{B + C}$  (C)  $\overline{A + B}$  (D)  $\overline{AB + C}$

19. What is the number of elements in minimum vertex cover of wheel graph  $W_n$  (with  $n+1$  nodes) where  $n=5$ ?

- (A) 3 (B) 4 (C) 5 (D) 6

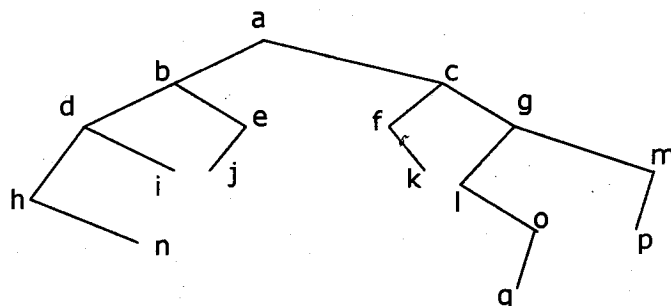
20. How many numbers that are greater than 3000 formed by the digits 3, 5, 6, 7, 8, 9 (without repetition)

- (A) 360 (B) 720 (C) 1024 (D) 1800

21. If  $\int_a^b f(x)dx$  numerically integrated by Simpson's Rule, then in any pair of consecutive sub-intervals by which of the following curves, the curve  $y=f(x)$  is approximated.

- (A) Straight line (B) Parabola (C) Circle (D) Ellipse

22. The inorder traversal of following graph is



- (A) a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q (B) h,n,d,j,e,i,b,a,f,k,c,l,q,o,g,p,m  
(C) h,n,d,i,b,j,e,a,f,k,c,l,q,o,g,p,m (D) None of these

The time complexity of Floyd-Warshall algorithm is

- (A)  $O(n^2)$  (B)  $O(n^3)$  (C)  $O(n^2 \log n)$  (D)  $O(n^4)$

24. For merging two sorted lists of size  $m$  and  $n$  into a sorted list of size  $m+n$ , the number of comparisons required in the worst case is

- (A)  $\max(m, n)$  (B)  $m+n$  (C)  $m+n-1$  (D)  $m \times n$

25. HTTP status code 500-599 indicates

- (A) An error on the server (B) Information message  
(C) An error on client (D) An error in web browser

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

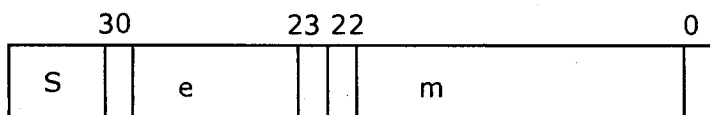
26. Consider the following format of three address instruction with 4-bit op-code and three 4-bit addresses.

Op-code	Address 1	Address 2	Address 3
---------	-----------	-----------	-----------

If there are 15 such three address instructions, then using expanding op-code technique, how many (maximum) two-address instructions can be encoded?

- (A) 1 (B) 12 (C) 16 (D) None of these

27. A floating point number can be represented as  $\pm 1.m \times b^e$  where  $m$ : mantissa;  $e$ : exponent;  $b$ : base (radix) of the exponent.



The given figure represents a floating point number having  $m=23$  bits,  $e=8$  bits, and  $s(\text{sign bit})=1$  bit.

Assuming  $b=2$ , if  $1.75_{10}$  is to be represented in the above format then what will be stored as  $e(8 \text{ bits})$  if bias  $= 2^{e-1} - 1$  and representation is normalized.

- (A) 10000010 (B) 00000001 (C) 01111111 (D) 10000001

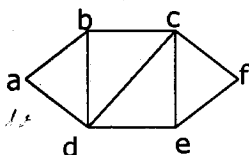
28. Given a set  $A = \{1, 2, 3, 4, 5, 6\}$  and binary relation

$R$  on  $A = \{(1, 1), (1, 3), (3, 1), (2, 2), (3, 3), (4, 4), (5, 5)\}$ . Minimum number of elements needed to add in  $R$  to make it equivalence relation is

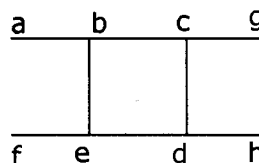
- (A) 1 (B) 2 (C) 3 (D) 4

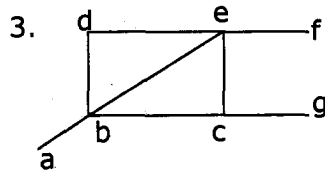
29. Which of the following graph has Hamiltonian path?

1.



2.



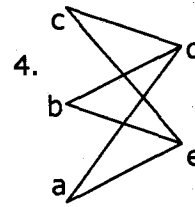


(A) 1,2

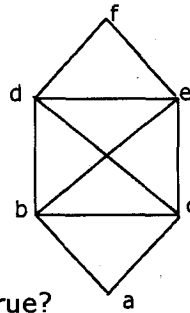
(B) 2,3

(C) 3,4

(D) 1,4



30. Consider the partial order relationship given by the Hasse diagram:



Which of the following is true?

(A) It is lattice

(B) It is not lattice as a, c does not have least upper bound

(C) It is not lattice as b, c does not have least upper bound

(D) It is not lattice as a, d does not have least upper bound

31.

Consider the system of equation

$$2x + 3y + 5z = 30$$

$$4x + 6y + 10z = 40$$

$$x + y - z = 2$$

The above system has

(A) No solution

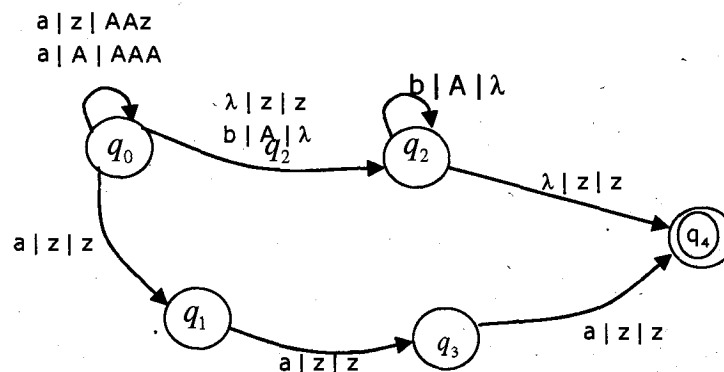
(B) a unique solution

(C) More than one but finite solutions

(D) an infinite number of solutions

32.

Consider the following PDA



The language recognized by the PDA is

(A)  $a^n b^m$   $n \geq 1$ ,  $m \geq 1$ ,  $m=2n$

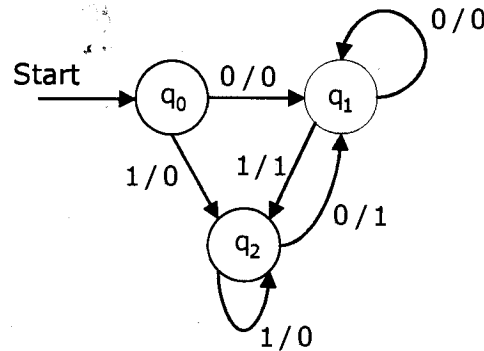
(B)  $a^n b^m + a^3$   $n \geq 1$ ,  $m=2n$

(C)  $a^n b^m + a^3$   $n \geq 0$ ,  $m=2n$

(D)  $a^n b^m$   $n, m \geq 0$ ,  $m=2n$

33. How many strings of length  $\leq 4$  does the following regular expression accept?  
 $(a + b)^* aa(a + b)^*$   
 (A) 10 (B) 9 (C) 8 (D) 12

34. Consider the Mealy Machine given below



Which of the following is correct about the above machine?

- (A) Generates output 1 when last two symbols are same  
 (B) Generates output 1 when last two symbols are different  
 (C) Generates output 1 when string has atleast two consecutive 0's  
 (D) None of these
35. Let  $M[1, n]$  be max heap then which of the following is again max heap?
1.  $M[1, \dots, \lfloor n/2 \rfloor]$
  2.  $M[1, \dots, n-1]$
  3.  $M[n, \dots, 1]$
- (A) 1 (B) 1, 3 (C) 1, 2 (D) 1, 2, 3

36. We want to calculate the number of nodes in binary tree with the following code

```

int Calculate_Nodes(struct node *node)
{
    if (node == null) return 0;
    X: return -----
}
    
```

What should X be?

- (A)  $\text{Calculate\_Nodes}(\text{node} \rightarrow \text{left}) + \text{Calculate\_Nodes}(\text{node} \rightarrow \text{right})$   
 (B)  $\text{Calculate\_Nodes}(\text{node} \rightarrow \text{left}) + \text{Calculate\_Nodes}(\text{node} \rightarrow \text{right}) + 1$   
 (C)  $\text{Calculate\_Nodes}(\text{node} \rightarrow \text{right}) + 1$   
 (D)  $\text{Calculate\_Nodes}(\text{node} \rightarrow \text{left}) + 1$



37. Let A and B be two arbitrary sets, consider the following statements:

$$S_1: P(A \cup B) = P(A) \cup P(B)$$

$$S_2: P(A \cap B) = P(A) \cap P(B)$$

Where  $P(x)$  denotes power set of  $x$ , then which of the above statement(s) is/are true?

- (A)  $S_1$  only                      (B)  $S_2$  only                      (C) both                      (D) none of these

38.

The number of accidents occurring in a city in a day is a Poisson variate with mean 0.8. Find the probability that on a randomly selected day there are accidents.

- (A) 0.551                      (B) 0.449                      (C) 0.78                      (D) 0.39

39.

Which of the following is true for bipartite graph?

- (A) It is always connected  
(B) Its chromatic number is less than 2  
(C) Independence number  $\geq \frac{V}{2}$   
(D) It has odd cycle

40.

Consider a relation

$R(A, B, C, D)$  with FD

$A \rightarrow BCD$

$BC \rightarrow AD$

$D \rightarrow B$

The highest normal form achieved by R.

- (A) 1NF                      (B) 2NF                      (C) 3NF                      (D) BCNF

41.

Consider the relation schema

Parts (pno, pname)

Supplier (sid, sname)

SP(sid, pno, qty)

The SQL query which displays all the part names having more than one supplier is

- (A) Select distinct P.pname from Parts P, SP a, SP b where a.pno = b.pno and a.sid = b.sid and a.pno = P.pno  
(B) Select distinct P.pname from Parts P, SP a, SP b where a.pno = b.pno and a.sid < > b.sid and P.pno = a.pno  
(C) Cannot be determined  
(D) None of these

42. Set  $F$  of functional dependencies for relation schema  $R(A, B, C, D, E)$ .

$A \rightarrow BC$

$CD \rightarrow E$

$B \rightarrow D$

$E \rightarrow A$

Determine the number of candidate keys for  $R$ .

- (A) 2 (B) 3 (C) 4 (D) 5

43. Choose advantages of object oriented methodology

(a) OO methodology closely represents problem domain

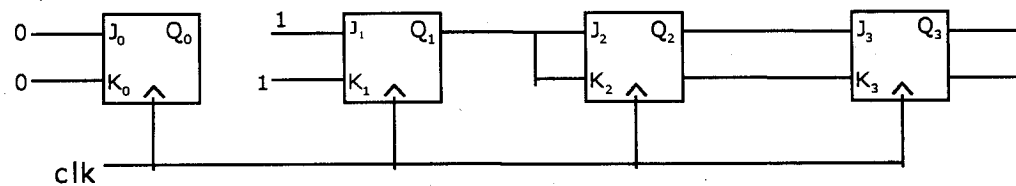
(b) Object in the system is immune to requirement change. Therefore allows changes more easily

(c) OOM designs do not encourage more re-use ✓

(d) Existing modules can be used effectively, thereby reducing development cost and cycle time

- (A) a, b, c (B) a, b, d (C) a, b, c, d (D) a, c, d

44. For the digital circuit shown in the given figure, the output  $Q_3Q_2Q_1Q_0 = 0001$  initially. After a clock pulse appear, the output  $Q_3Q_2Q_1Q_0$  will be



- (A) 0001 (B) 0011 (C) 0111 (D) 1111

45. Which one of the following is/ are True?

(A) The total number key's required for a set of  $n$ -individuals to communicate using public key cryptosystem is  $(2n + 2)$

(B) Total keys required for a set of  $n$ -individuals to communicate using secret key cryptography is  $\frac{n(n+1)}{2}$

(C) Both A and B are correct

(D) None of these

46. A certain computer provides its users with a virtual-memory space of  $2^{32}$  bytes. The computer has  $2^{18}$  bytes of physical memory. The virtual memory is implemented by paging, and the page size is 4096 bytes. A user process generates the virtual address 11223456. Which of the following bit combination are used as the displacement?

(A) 0100 0101 0110

(B) 0010 0011 0100 0101 0110

(C) 0001 0001 0010 0010 0011

(D) 0001 0001 0010

47.

Consider the following CFGs:

Grammar  $G_1$

$S \rightarrow A$

$A \rightarrow \epsilon$

$A \rightarrow bA$

Grammar  $G_2$

$S \rightarrow A$

$A \rightarrow \epsilon$

$A \rightarrow bAb$

Grammar  $G_3$

$S \rightarrow A$

$A \rightarrow \epsilon$

$A \rightarrow Abb$

$S$  : start symbol

$S, A$  : non - terminals

$b$  : terminal symbol

Which of the following is true?

(A)  $G_1, G_2$  are LL(1) but not  $G_3$

(B)  $G_1$  is LL(1) but not  $G_2$  and  $G_3$

(C)  $G_2, G_3$  are LL(1) but not  $G_1$

(D) All are LL(1)

### Common Data Questions: 48 & 49

Consider the following Arithmetic expression.

$$S = (x + y) * (w - z)$$

Assume that the number of clock cycles required for the execution of instructions in any of the CPU organization is as follows.

ADD and SUB instructions take 1 clock cycle each, MUL instruction takes 2 clock cycles for execution. All other type of instructions takes 1 clock cycle each

48. How many clock cycles are required to evaluate the given Arithmetic expression using single Accumulator CPU organization?

(A) 7

(B) 8

(C) 9

(D) 10

49. How many clock cycles are required to evaluate the given Arithmetic expression using General Register CPU-organization with two Address instructions?

(A) 7

(B) 8

(C) 9

(D) 10

### Common Data Questions: 50 & 51

The elements are added in the following order in a max heap 2,9,3,5,10,20,6 maintaining max heap property after every insertion.

50.

Calculate the number of interchanges in heapifying

(A) 4

(B) 5

(C) 6

(D) 17

51. The number of non leaf nodes in the above max heap is

(A) 3

(B) 4

(C) 5

(D) None of these

**Linked Answer Questions: Q.52 to Q.55 Carry Two Marks Each**
**Statement for Linked Answer Questions: 52 & 53**

Consider the following Gantt chart illustrating the execution of the processes P1, P2, P3, P4 and P5, all of which are assumed to be arrived at time 0, using FCFS and SJF scheduling algorithm. All the times are given in milliseconds.

Algorithm	Process order	Waiting time				
		P1	P2	P3	P4	P5
FCFS	12345	0	10	11	13	14
SJF	24351	9	0	2	1	4

52. What is the burst time of process P5?  
 (A) 2ms (B) 3ms (C) 4ms (D) 5ms
53. What is the average waiting time if algorithm used is Round-robin (quantum=1) and process order is 12345?  
 (A) 4.2ms (B) 5.4ms (C) 6.3ms (D) 3.9ms

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

An organization assigned with a class – B IP network of 176.75.0.0. They wish to divide it into different subnet works with exactly 4000 hosts in each sub network

54. What should be the subnet mask (suggestible) for the above requirement?  
 (A) 255.255.240.0 (B) 255.255.224.0  
 (C) 255.255.192.0 (D) 255.255.248.0
55. How many subnetworks are possible for the correct subnet mask above?  
 (A) 8 (B) 16 (C) 32 (D) 14

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

56. If a, b and c are positive integers satisfying the equation  $a + b + c + ab + bc + ca + abc = 384$ , then find the value of abc.  
 (A) 120 (B) 240 (C) 140 (D) 160

**Directions for Question 57: In the given question, a related pair of words is followed by four lettered pairs of words. Click on the lettered pair that best expresses a relationship similar to that expressed in the original pair.**

57. **PROCTOR: SUPERVISE::**  
 (A) trafficker: control (B) pedagogue: instigate  
 (C) messiah :protect (D) infiltrator: distill

**Directions for Question 58:** The following question presents a sentence, which is underlined. Beneath the sentence you will find four ways of phrasing the underlined part. The first of these repeats the original; the other three are different. If you think the original is best, choose the first answer; otherwise choose one of the others:

58. To capitalize on particular trends in a particular geography like sports, entertainment and telecom and to develop fixed strategies, cyber fraudsters seem to be thinking beyond financial transactions.
- (A) To capitalize on particular trends in a particular geography like sports, entertainment and telecom and to develop fixed strategies, cyber fraudsters seem to be thinking beyond financial transactions
- (B) Cyber fraudsters seem to be thinking beyond financial transactions and are developing fixed strategies to capitalize on particular trends in a particular geography like sports, entertainment and telecom
- (C) Cyber fraudsters seem to think beyond financial transactions and fixed strategies and develop and to capitalize on particular trends in a particular geography like sports, entertainment and telecom
- (D) Like sports, entertainment and telecom, cyber fraudsters seem to be thinking beyond financial transactions and are developing fixed strategies to capitalize on particular trends in a particular geography

**Directions for Question 59:** Choose the answer key corresponding to the word with a meaning most nearly similar to the meaning of word in capital letters.

59. **STOLID**
- (A) impassive      (B) rigid      (C) candid      (D) explicit

**Directions for Question 60:** The given sentence below has two blanks; each blank indicates that something has been omitted. Beneath the sentence are four lettered words. Choose the word for each blank that best fits the meaning of the sentence as a whole:

60. While there are many experts who still hold to buy-and-hold strategy, others point to some of the more \_\_\_\_\_ stock market crashes of the past as \_\_\_\_\_ that investors can literally lose everything they had gained in a bull market to the impact of the bear market.
- (A) unassuming----- foothold      (B) unpredictable----- assets
- (C) self-evident----- statistics      (D) catastrophic ----- proof

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

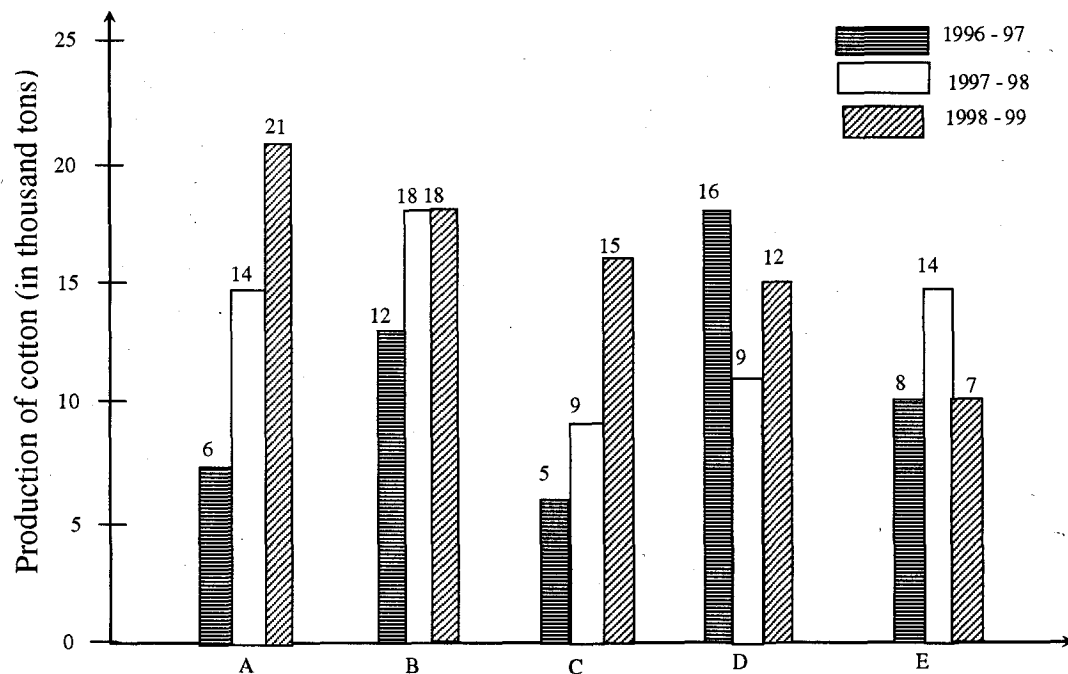
**Directions for Question 61:** In the question given below is given a statement followed by three assumptions numbered I, II, and III. You have to consider the statement and the following assumptions, decide which of the assumptions is implicit in the statement and choose your answer accordingly.

61. **Statement** : Unable to manage with the present income Chaman Lal has decided to venture into real estate business.
- Assumptions** : I. Real estate business is risk-free.
- II. The present business he is in is not lucrative.
- III. Real estate business offers high profits to all investors.

- (A) Only II is implicit  
(B) Only II and III are implicit  
(C) None is implicit  
(D) All are implicit
62. P, Q and R can do a piece of work in 30 days, 60 days and  $r$  days respectively. If  $30 \leq r \leq 60$ , then which of the following cannot be the number of days taken by Q and R together to complete the work?  
(A) 20 (B) 25 (C) 27 (D) 31
63. A bird is flying at 15kmph between engines of two trains of length 1000m each and travelling towards each other with speeds 40km and 60km. When the distance between the engines is 350km the bird was started to fly. Find the distance travelled by the bird, until the trains crossed each other  
(A) 48.8km (B) 50.2km (C) 52.8km (D) 63.4km
64. If  $\frac{p}{q} + \frac{q}{r} + \frac{r}{s} + \frac{s}{t} + \frac{t}{p} = \frac{29}{7}$ , where  $p, q, r, s$  and  $t$  are positive numbers, then  
(A)  $p + q + r + s = 14\frac{2}{3}$  (B)  $p - q + r - s = 9\frac{2}{3}$   
(C)  $p + q + r + s = 11\frac{2}{3}$  (D) Such numbers does not exist

**Information for Question 65:**

Production of cotton (in thousand tons) in five states during three years is shown below



65. The combined production of state E for all the years together is approximately what percent of the combined production of state A?  
(A) 60% (B) 65% (C) 70% (D) 75%

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### Answer Keys

1	C	2	A	3	D	4	A	5	C	6	A	7	C
8	C	9	C	10	C	11	C	12	D	13	B	14	A
15	A	16	D	17	B	18	C	19	B	20	D	21	B
22	C	23	B	24	C	25	A	26	C	27	C	28	A
29	D	30	C	31	A	32	C	33	D	34	B	35	C
36	B	37	B	38	A	39	C	40	C	41	B	42	C
43	B	44	B	45	D	46	A	47	B	48	B	49	A
50	C	51	A	52	D	53	B	54	A	55	B	56	B
57	C	58	B	59	A	60	D	61	A	62	D	63	C
64	D	65	C										

### Explanations:

1. CLI : Clear the interrupt flag is an op-code that indicates the address of its operand.
3.  $mx2 < m+7 \Rightarrow m < 7$
4. '=' is assignment operator;  $x = y$  will assign 20 to x.  
Here if condition is satisfied so 'x and y are equal' is printed
5. The stack will grow in opposite directions. When the two stacks collide and there is no room in the array, the stack will overflow
11.  $k = \text{digit} = ? \Rightarrow r = \text{radix} = 2$ ;  $P = \text{number} = 52139 \Rightarrow K = \lceil \log_2(p+1) \rceil = \lceil \log_2(52139+1) \rceil = 16$
12. Cycles per instruction-pipeline =  $\max(1, 2, 1, 3) = 3$   
Cycles per instruction - non pipeline =  $1+2+1+3=7 \Rightarrow \text{speed up ratio} = \frac{7}{3} = 2.33$
14. The sum of the degrees of all vertices in a graph is twice the number of edges in the graph.  
Number of edges = 10
15. The language generated is  $(a+b)^+$ , so it is regular, Type3
17.  $F = A\bar{B} + A\bar{B}C + ABCD + ABC\bar{D} = A\bar{B} + A\bar{B}C + ABC(D + \bar{D})$   
 $= A\bar{B} + A\bar{B}C + ABC = A\bar{B} + AB(C + \bar{C}) = A\bar{B} + AB = A(B + \bar{B}) = A$
20. 4 digit numbers that are greater than 3000 =  $6p_4$   
5 digit numbers that are greater than 3000 =  $6p_5$   
6 digit numbers that are greater than 3000 =  $6!$ ; Total = 1800
24. We have to compare each element and last element does not require any comparison.
26. 4-bit op-code can at most encode 16 three address instructions. If there are 15 such three address instructions, then one of unused op-code (1111) can encode at most 16 two address instructions.

1111	Op-code	Address 1	Address 2
------	---------	-----------	-----------

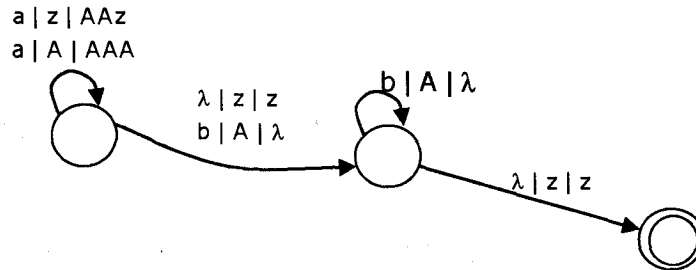
$$= 1 \times 2^4 = 16$$



27.  $1.75_{10} = 1.11 \times 2^0$ ; Bias = 127  $\Rightarrow (0 + 127)_{10} = 01111111_2$

28. It requires (6,6) to be added to make it equivalence relation

32. The first path will produce



$a^n b^m$   $m=2n$  with  $n, m$  greater than or equal to zero and other path will produce  $= a^3$

33. aabb, aaaa, aaab, aaba, abaa, baaa, baab, bbaa, aaa, baa, aab, aa

35. 1,2 a subset starting from 1 of max heap is max heap

37.  $A = \{1\}$   $B = \{2\} \Rightarrow P(A) = \{\phi, \{1\}\}$ ;  $P(B) = \{\phi, \{2\}\}$

$P(A \cup B) = \{\phi, \{1\}, \{2\}, \{1, 2\}\}$  So  $S_1$  is false

$A = \{1, 2\}$   $B = \{2, 3\} \Rightarrow P(A \cap B) = P(\{2\}) = \{\phi, \{2\}\}$

$P(A) = \{\phi, \{1\}, \{2\}, \{1, 2\}\}$   $P(B) = \{\phi, \{2\}, \{3\}, \{2, 3\}\} \Rightarrow P(A) \cap P(B) = \{\phi, \{2\}\}$

38.  $\lambda = 0.8$ ;  $P(X=k) = \frac{e^{-0.8} (0.8)^k}{k!}$

$P[\text{no accidents}] = P[X=0] = P(0) = \frac{e^{-0.8} (0.8)^0}{0!} = 0.449$

$P[\text{accidents occur}] = 1 - 0.449 = 0.551$

39. For any bipartite graph with  $V$  Vertices, one side will have at least  $\frac{V}{2}$  vertex

40. A, BC, and CD are keys so FD  $D \rightarrow B$  violates BCNF definition  
Hence highest normal form is 3 nf

42. Candidate keys are A, BC, CD, E

$J_0 K_0 = 00$   $Q_{0(n+1)} = Q_n = 1$   
 $J_1 K_1 = 11$   $Q_{1(n+1)} = \overline{Q_n} = 1$   
 $J_2 K_2 = Q_1 = 00$   $Q_{2(n+1)} = Q_n = 0$   
 $J_3 K_3 = Q_2 Q_1 = 00$   
 $Q_3 Q_2 Q_1 Q_0 = 0011$

45. Secret key =  $\frac{n(n-1)}{2}$ ; Public key cryptography =  $2n$

46. The virtual address in binary form is  
0001 0001 0010 0010 0011 0100 0101 0110

Since the page size is  $2^{12}$ , the number of pages is  $2^{20}$ . Therefore the low-order 12 bits "0100 0101 0110" are used as the displacement into the page, while the remaining 20 bits "0001 0001 0010 0010 0011" are used as index into the page table.

47. There is no multiple entries in LL(1) parse table of  $G_1$   $\therefore G_1$  is LL(1).

$G_2$  is not LL(1) since b predicts both  $A \rightarrow \epsilon$  and  $A \rightarrow bAb$

$G_3$  is not LL(1) since it is left recursive.

48. 

LDA X	;AC $\leftarrow$ M[X]	1 cycle
ADD Y	;AC $\leftarrow$ AC + M[Y]	1 cycle
STA T	;M[T] $\leftarrow$ AC	1 cycle
LDA W	;AC $\leftarrow$ M[W]	1 cycle
SUB Z	;AC $\leftarrow$ AC - M[Z]	1 cycle
MUL T	;AC $\leftarrow$ AC * M[T]	2 cycle
STA S	;M[S] $\leftarrow$ AC	1 cycle

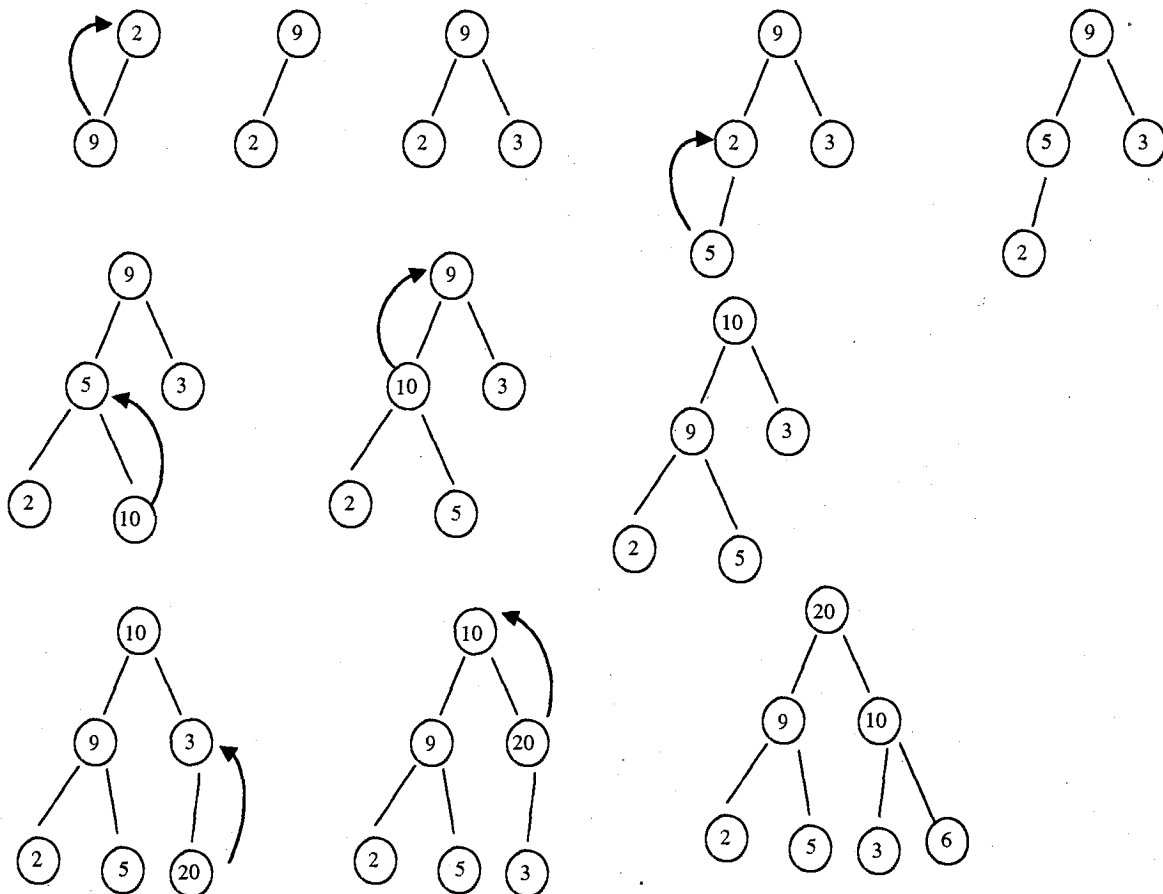
-----  
Total 8 cycles

49. 

MOV R <sub>1</sub> , X	;R <sub>1</sub> $\leftarrow$ M[X]	1 cycle
ADD R <sub>1</sub> , Y	;R <sub>1</sub> $\leftarrow$ R <sub>1</sub> + M[Y]	1 cycle
MOV R <sub>2</sub> , W	;R <sub>2</sub> $\leftarrow$ M[W]	1 cycle
SUB R <sub>2</sub> , Z	;R <sub>2</sub> $\leftarrow$ R <sub>2</sub> - M[Z]	1 cycle
MUL R <sub>1</sub> , R <sub>2</sub>	;R <sub>1</sub> $\leftarrow$ R <sub>1</sub> * R <sub>2</sub>	2 cycle
MOV S, R <sub>1</sub>	;M[S] $\leftarrow$ R <sub>1</sub>	1 cycle

-----  
Total 7 cycles

- 50.



53.

P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>3</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>5</sub>	P <sub>1</sub>	P <sub>5</sub>	P <sub>1</sub> ...
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14		

$$P_1 = 0 + 4 + 2 + 1 + 1 + 1 = 9$$

$$P_2 = 1$$

$$P_3 = 2 + 3 = 5$$

$$P_4 = 3$$

$$P_5 = 4 + 2 + 1 + 1 + 1 = 9$$

$$\text{Average} = \frac{9+1+5+3+9}{5} = \frac{27}{5} = 5.4$$

54. We should have 12 bits in the host part  
So it should be 255.255.240.0

55.  $2^4 = 16$

56. Given that,

$$a + b + c + ab + bc + ca + abc = 384$$

Adding 1 on both sides, we have

$$a + b + c + ab + bc + ca + abc + 1 = 385$$

$$1 + a + b + ab + c + ac + bc + abc = 385$$

$$(1+a) + b(1+a) + c(1+a) + bc(1+a) = 385$$

$$(a+1)(b+1)(c+1) = 5 \times 7 \times 11$$

$$\Rightarrow a=4, b=6 \text{ and } c=10 \text{ (Since 5, 7 and 11 are prime numbers)} \Rightarrow abc = 240$$

57. The function of proctor is to supervise and the function of messiah is to protect.

58. In all other choices, the meaning is distorted.

59. STOLID means insensitive

60. The trigger 'while' shows a contrast between those who are optimistic and those who are not. Others are irrelevant.

61. We have no information about the new business and since Chaman Lal is making losses, the present one must be not lucrative.

62.

P	Q	R
30 days	60 days	r days

(i) Let  $r = 30$  days

$$\text{The part of the work done by Q and R in 1 day} = \frac{1}{60} + \frac{1}{30} = \frac{1+2}{60} = \frac{1}{20}$$

$\therefore$  They can complete in 20 days.

(ii) Let  $r = 60$  days

$$\text{The part of the work done by Q and R in 1 day} = \frac{1}{60} + \frac{1}{60} = \frac{1}{30}$$

$\therefore$  The can complete it in 30 days.

$\therefore$  The time taken to complete the work by Q and R will lie between 20 and 30 (including 20 and 30)

63. The speed of trains is 40kmph and 60kmph

The length of each train = 1000m = 1km

$$\text{Time taken to cross each other} = \frac{\text{Length of Trains} + \text{Distance between the Trains}}{\text{Relative Speed}} = \frac{(350 + 2)\text{km}}{(40 + 60)\text{kmph}} =$$

3.52 hours

The speed of the bird = 15kmph

The distance travelled by the bird in 3.52 hours =  $3.52 \times 15 = 52.8\text{km}$

64. Given that p, q, r, s and t are positive

We know that  $AM \geq GM$

$$\therefore \frac{\frac{p}{q} + \frac{q}{r} + \frac{r}{s} + \frac{s}{t} + \frac{t}{p}}{5} \geq \sqrt[5]{\left(\frac{p}{q}\right)\left(\frac{q}{r}\right)\left(\frac{r}{s}\right)\left(\frac{s}{t}\right)\left(\frac{t}{p}\right)}$$

$$\frac{p}{q} + \frac{q}{r} + \frac{r}{s} + \frac{s}{t} + \frac{t}{p} \geq 5$$

The minimum value of  $\frac{p}{q} + \frac{q}{r} + \frac{r}{s} + \frac{s}{t} + \frac{t}{p}$  must be 5, where as it is given as

$$\frac{29}{7} = 4.14, \text{ which is not possible}$$

Hence no such numbers exists

65. Combined production of state E =  $(8 + 14 + 7) \times 1000 = 29000$  tons

Combined production of state A =  $(8 + 14 + 21) \times 1000 = 41000$  tons

$$\text{Required percentage} = \frac{29}{41} \times 100 = 70\% \text{ (approximately)}$$

# TarGATE'11

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Your Roll Number: .....

Test ID: 

2	2	0	5
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Duration: 3 Hours

Maximum Marks: 100

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### Read the following instructions carefully:

1. Write your roll number, your name and name of the examination centre at the specified locations of the ORS.
2. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.
3. All the questions in this question paper are of objective type.
4. Questions must be answered on Objective Response Sheet (ORS) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. **Each question has only one correct answer.** In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as a wrong answer.
5. This question paper contains 65 objective type questions comprising of 55 Technical questions and 10 General Aptitude questions. Q.1 to Q.25 and Q. 56 to Q. 60 carry **one** mark each. Q.26 to Q.55 and Q. 61 to Q. 65 carry **two** marks each.
6. The questions pairs (48, 49) and (50, 51) are common data questions.
7. The questions pairs (52, 53) and (54, 55) are questions with linked answers. The answer to the second question of the above pairs will depend on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.
8. Un-attempted questions will carry zero marks.
9. **NEGATIVE MARKING:** For Q.1 to Q.25 and Q. 56 to Q. 60, 1/3<sup>rd</sup> mark will be deducted for each wrong answer. For Q. 26 to Q.51 and Q. 61 to Q. 65, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. For the pairs of questions with linked answers, there will be negative marks only for wrong answer to the first question, i.e. for Q.52 and Q.54, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.
10. Calculator without data connectivity is allowed in the examination hall.
11. Charts, graph sheets or tables are NOT allowed in the examination hall.
12. Rough work can be done on the question paper itself.

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**Q. No. 1 – 25 Carry One Mark Each**

1. If root node is considered to be at depth 1; then in worst case a right-skewed binary tree of depth  $k$  requires how many locations in sequential representation?  
(A)  $2^k$  (B)  $2^k - 1$  (C)  $2^{k-1} - 1$  (D)  $2^{k-1} + 1$
2. Three numbers 5, 6, 7 are to be inserted into an AVL tree and these numbers can be inserted in any order. How many different AVL trees can be obtained?  
(A) 1 (B) 3 (C) 5 (D) 8
3. The Newton Raphson method is used to find the root of the equation  $3x^{1/3} = 0$ , using initial estimate  $x_0 = 0.1$ ; the method  
(A) is convergent and converges to 0 (B) is divergent to  $\infty$   
(C) oscillates (D) none of these
4. The symmetric difference of the sets  $S = \{1, 2, 3, 4, 5\}$  and  $T = \{4, 5, 6, 7, 8\}$  is  
(A)  $\{4, 5\}$  (B)  $\emptyset$   
(C)  $\{1, 2, 3, 4, 5, 6, 7, 8\}$  (D)  $\{1, 2, 3, 6, 7, 8\}$
5. Given function is  $F(a,b,c,d) = \sum m(0,4,5,6,7,9,10,12,13,15)$ . Calculate the number of prime implicants of the function.  
(A) 4 (B) 5 (C) 6 (D) 7
6. Given memory is as follows:  
Suppose we have the instruction LDA 500 (LDA loads content of memory location to accumulator(AC)). What would be loaded into the AC if the addressing mode for the operand is direct and indirect respectively?  

500	600
---	---
600	700
---	---
700	400
---	---
800	1000
---	---
900	500

  
(A) 500, 700  
(B) 600, 700  
(C) 500, 600  
(D) 700, 400
7. Which of the following is not true regarding service provided by TCP?  
(A) TCP guarantees delivery of all data  
(B) TCP service is connection oriented  
(C) TCP guarantees that a sending process is permitted to transmit data at any rate  
(D) TCP does not provide any delay guarantee i.e., how long the data may take to get to destination

8. A connected graph that has  $p$  vertices and exactly  $p - 1$  edges  
 (A) can not contain a cycle (B) must contain at least one cycle  
 (C) can contain at most two cycles (D) none of these
9. What is the probability that the total of two dice will be greater than equal to 8, given that the first die is 4?  
 (A)  $\frac{1}{2}$  (B)  $\frac{1}{3}$  (C)  $\frac{2}{3}$  (D)  $\frac{2}{5}$
10. Translate the following statement in English.  

$$\neg \forall x (B(x) \vee \exists y (F(x, y) \wedge B(y)))$$
 Where,  $B(x)$ :  $x$  rides bicycle and  
 $F(x, y)$ :  $x$  and  $y$  are friends.  
 The universe for  $x$  and  $y$  is all students in the school.  
 (A) All students of the school ride bicycle and are friends of each other  
 (B) Every student in the school rides bicycle and has at least one friend who rides bicycle  
 (C) Every student in the school rides bicycle or has a friend who rides a bicycle  
 (D) None of these
11. Consider the following grammar:  
 $S \rightarrow SS$   
 $S \rightarrow 0$   
 $S \rightarrow \epsilon$   
 Which of the following is true related to the given grammar?  
 (i) It is ambiguous (ii) It is left recursive  
 (iii) It is LL (1) (iv) It accepts  $0^+$   
 (A) iii only (B) iii & iv (C) i & ii (D) i, ii & iv
12. Which of the following language is/are context free?  
 $L_1 = \{a^i b^j a^i b^j : i, j \geq 0\}$   
 $L_2 = \{w \in \{0, 1\}^* : \text{the length of } w \text{ is odd and its middle symbol is } 1\}$   
 (A)  $L_1$  only (B)  $L_2$  only  
 (C) Both  $L_1$  and  $L_2$  (D) Neither  $L_1$  nor  $L_2$
13. In a glass factory, fifty percent of the glasses produced are defective. A sample of 10 glasses is selected at random. What is the probability that exactly 2 glasses will be defective?  
 (A)  $\left(\frac{1}{2}\right)^{10}$  (B)  $\frac{1}{2^{10}}$  (C)  $\frac{45}{2^{10}}$  (D)  $\frac{3}{7}$



14. Which of the following language on the input alphabet  $\{0, 1\}$  is/are regular?  
 L1: Non-empty string with the last symbol equal the first symbol.  
 L2: Odd length strings with the first symbol equal the middle symbol.  
 (A)  $L_1$  only (B)  $L_2$  only (C) Both  $L_1, L_2$  (D) Neither  $L_1$  nor  $L_2$

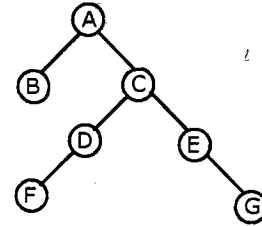
15. The tree as shown in figure is traversed postorder and each element is pushed onto a character stack  $s$  as it is encountered. The following code segment is then executed

for (int  $i = 1$ ;  $i \leq 5$ ;  $i++$ )

cha = s.pop( );

What value is contained in the variable "cha" after the segment is executed?

- (A) F (B) D (C) G (D) B



16. In a particular schedule, transaction  $T_2$  reads a value previously written by transaction  $T_1$  and transaction  $T_3$  reads a value previously written by  $T_2$ . Which of the following ensure the schedule to be cascadeless schedule?

- (A)  $T_1$  commits before read operation of  $T_2$  and  $T_2$  commits before read operation of  $T_3$   
 (B)  $T_1$  commits before  $T_2$  and  $T_2$  commits before  $T_3$   
 (C)  $T_1$  commits before write operation of  $T_2$  and  $T_2$  commits before write operation of  $T_3$   
 (D)  $T_1$  commits at last and  $T_2$  and  $T_3$  can commit in any order

17. For relation  $R(ABCDE)$ , the given FD's are  $A \rightarrow BC$ ,  $BC \rightarrow E$  and  $E \rightarrow DA$ . Similarly  $S$  be a relation with attributes  $ABCDE$  and with FD's  $A \rightarrow BC$ ,  $B \rightarrow E$  and  $E \rightarrow DA$ . Which among  $R$  and  $S$  are in BCNF?

- (A)  $R$  only (B)  $S$  only (C) Both (D) Neither

18. The memory unit a computer has 512 K words of 32 bits each. The computer has instruction format, with 4 fields: an opcode field; a mode field to specify one of 7 addressing modes; a register address field to specify one of 60 registers; and a memory address field. If an instruction is 32 bits long, how large is the opcode field?

- (A) 4 bits (B) 5 bits (C) 6 bits (D) 8 bits

19. Match the following:

List - I		List - II	
(a)	Accumulator	(i)	Holds instruction to be executed
(b)	Instruction register	(ii)	Holds the data CPU needs to process
(c)	Program counter	(iii)	Holds interrupt signals
(d)	Flag register	(iv)	Holds address of next instruction to be executed

- (A) a - i, b - ii, c - iv, d - iii (B) a - ii, b - i, c - iii, d - iv  
 (C) a - ii, b - iv, c - i, d - iii (D) a - ii, b - i, c - iv, d - iii

20. The inverse of the matrix  $M = \begin{bmatrix} 2 & 1 & 3 \\ 0 & -1 & 2 \\ 4 & 3 & 1 \end{bmatrix}$  is the matrix

$$M^{-1} = \frac{1}{6} \begin{bmatrix} -7 & 8 & a \\ 8 & -10 & -4 \\ 4 & b & -2 \end{bmatrix} \text{ where}$$

- (A)  $a = 5; b = -2$  (B)  $a = 2; b = -3$  (C)  $a = 3; b = 2$  (D)  $a = 5; b = -1$

21. Let  $G$  be the set of all  $2 \times 2$  real matrices, trace of which is 0, and  $+$  denotes the operation of matrix addition.

Then the algebraic structure  $(G, +)$  is

- (A) A groupoid only (B) A semi group only  
(C) A monoid only (D) A group

22. Which of the following statement is true?

- (A) Post Correspondence Problem is undecidable over the strings in alphabet for any integer  
(B) Halting problem of Turing machine is decidable  
(C) Modified PCP is decidable  
(D) None of these

23. Which of the following is false?

- (A) Travelling salesman problem is NP complete  
(B) Graph coloring problem is NP complete  
(C) Hamiltonian path problem is NP complete  
(D) None of these

24. Test plan involves

- (A) Test cases (B) DFD  
(C) Testing methodologies (D) None of these

25. What type of protocol is HTTP?

- (A) Stateless (B) Stateful (C) Semistateful (D) None of these

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

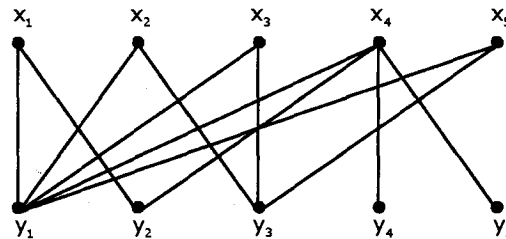
26. Find  $k$  so that the matrix

$$A = \begin{bmatrix} k & 1 & 2 \\ 1 & 2 & k \\ 1 & 2 & 3 \end{bmatrix} \text{ has eigen value } \lambda = 1$$

- (A)  $\frac{1}{2}$  (B)  $-\frac{1}{2}$  (C) 0 (D) 1

27. A sequential circuit has one input and one output. In the input sequence whenever a pattern 010 or 0001 is detected, the output becomes 1 when the last symbol of the pattern is received. Otherwise, the output equals to 0. What will be the minimum number of states of the equivalent state diagram of this synchronous sequential circuit?  
(A) 4 (B) 5 (C) 6 (D) 7
28. A computer has 32-bit instructions and 12-bit address. Suppose there are 251 two-address instructions. How many 1-address instructions can be formulated?  
(A) 20480 (B) 24576 (C) 4096 (D) 131072
29. Let  $K$  indistinguishable balls are successively distributed (allocated) into  $n$  distinguishable urns, of infinite (unlimited) capacity. The number of different distributions is  
(A)  $\binom{n+k-1}{n}$  (B)  $\binom{n}{k}$  (C)  $\binom{n+k+1}{k+1}$  (D)  $\binom{n+k-1}{k}$

30. Consider the following graph:



- The size of minimum vertex cover and maximum matching are respectively,  
(A) 4, 5 (B) 5, 4 (C) 4, 4 (D) 5, 5
31. Consider the following C-program:  

```
#include <stdio.h>
void main( )
{
    int a;
    int b;
    int c;
    printf("Enter the numbers");
    scanf("%3d %3d %3d", &a,&b,&c);
    printf("%d %d %d",a,b,c);
}
```

 If entered data items are,  
 9876 5432 1  
 What will be the output?  
 (A) 987 543 1 (B) 987 654 321  
 (C) 987 543 garbage value (D) 987 6 543

32. Let  $G$  be  $r$ -regular graph where  $r$  is odd. Then which of the following statements is/are true?  
 S1:  $G$  has an odd number of vertices  
 S2:  $G$  has an even number of vertices  
 S3: Number of edges in  $G$  is multiple of  $r$   
 (A) S1 and S3 (B) S2 only (C) S2 and S3 (D) All

33. Determine the probability of four 4's in six tosses of an unbiased die.  
 (A) 0.5 (B) 0.003 (C) 0.004 (D) 0.008

34. Match the following:

Application		Application layer protocols		Underlying transport protocol	
(a)	Email	(p)	TELNET	(m)	TCP
(b)	File transfer	(q)	FTP	(n)	UDP
(c)	Web	(r)	SMTP		
(d)	Remote terminal access	(s)	HTTP		

- (A) a-r-m  
 b-q-m  
 c-s-n  
 d-p-m
- (B) a-r-m  
 b-q-m  
 c-s-m  
 d-p-m
- (C) a-q-m  
 b-p-n  
 c-r-n  
 d-s-m
- (D) a-r-m  
 b-q-m  
 c-s-n  
 d-p-n

35. Consider the grammar:  $S \rightarrow ABA$   
 $A \rightarrow Bc \mid dA \mid \epsilon$   
 $B \rightarrow eA$   
 Which of the following is true related to given grammar?  
 i.  $\text{First}(S) \cap \text{Follow}(S) = \phi$   
 ii.  $\text{First}(A) \cap \text{Follow}(A) = \phi$   
 iii.  $\text{First}(B) \cap \text{Follow}(B) = \phi$   
 (A) i only (B) i & ii (C) ii & iii (D) iii only

36. Consider the following syntax directed definition:

<u>Production</u>	<u>Semantic Rules</u>
$L \rightarrow E \text{ return}$	$\text{print}(\text{Eval})$
$E \rightarrow E + T$	$\text{Eval} = E1.\text{val} * T.\text{val}$
$E \rightarrow T$	$\text{Eval} = T.\text{val}$

$T \rightarrow T * F$	$T.val = T1.val + F.val$
$T \rightarrow F$	$T.val = F.val$
$F \rightarrow (E)$	$F.val = Eval$
$F \rightarrow \text{digit}$	$F.val = \text{digit.lexval}$

Symbols E, T, and F are associated with a synthesized attribute 'val'.

The token 'digit' has a synthesized attribute 'lexval' (it is assumed that it is evaluated by the lexical analyzer).

What will be printed for the input string 5+3\*4?

- (A) 17                      (B) 60                      (C) 35                      (D) 28

37. Determine the minimum number of states of a DFA that recognizes the language over the alphabet  $\{a, b\}$  consisting of all the strings that contain at least two 'a's and at least three 'b's.
- (A) 6                      (B) 12                      (C) 13                      (D) 15
38. Which of the following regular expression represents the language over the alphabet  $\Sigma = \{a\}$  containing strings whose length is either a multiple of 2 or a multiple of 3?
- (A)  $((aa)|(aaa))^*$     (B)  $((aa)|(aaa))^+$     (C)  $(aa)^*|(aaa)^*$     (D)  $(aa+aaa)^*$
39. Which of the following problems is/are undecidable?  
Whether the language accepted by a Turing Machine is
- (i) Empty                      (ii) Finite                      (iii) Regular                      (iv) Context free
- (A) (i) & (iii) only    (B) ii only                      (C) (i) & (iv) only    (D) All
40. Suppose in a system processes arrive at an average of five processes per minute. Each arrived process requires an average of 10 seconds of service time. Assuming the CPU is with a single processor, estimate the fraction of time the CPU is busy.
- (A) 75%                      (B) 83.3%                      (C) 81.5%                      (D) 80%
41. The size of a process is 17 kilo bytes. The paging system divides the process into pages of size 4k bytes each. Then which one of the following is TRUE?
- (A) In the above paging system there is an internal fragmentation of 1 k Bytes.
- (B) There is no internal fragmentation
- (C) There is an internal fragmentation of 3 k bytes
- (D) None of these
42. We have a stack S containing at least two data items, and we use an additional data structure S' to reverse its data order. Separately consider a queue Q containing at least two data items, and we use an additional empty data structure Q' to reverse the order of its data.

That means after  $\{S \rightarrow S' \text{ (transfer all items from } S \text{ to } S') \text{ and } S' \rightarrow S\}$  and  $\{Q \rightarrow Q' \text{ and } Q' \rightarrow Q\}$ , the order of all elements of  $S$  and  $Q$  are reversed.

What are  $S'$  and  $Q'$  are most likely to be?

- (A)  $S'$  is a queue,  $Q'$  is a queue      (B)  $S'$  is a stack,  $Q'$  is a queue  
(C)  $S'$  is a queue,  $Q'$  is a stack      (D)  $S'$  is a stack,  $Q'$  is a stack

43. What is the output of the following program?

```
Queue q = new Queue( );
Stack s = new Stack( );
s.push(new Integer(5));
s.push(new Integer(6));
s.push(new Integer(7));
q.enqueue(s.pop());
q.enqueue(new Integer(5));
q.enqueue (new Integer(6));
System.out.print (q.dequeue( ));
s.push(q.dequeue( ));
System.out.print(s.pop( ));
System.out.print(s.pop( ));
```

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

44. Given a hash table with size = 11, hash function  $h(\text{key}) = \text{key} \% 11$ , where collisions are resolved using linear probing; following operations are performed sequentially:

Insert (17)  
Insert (37)  
Insert (59)  
Insert (70)  
Delete (59)  
Insert (16)

What is the number of collisions while doing insert operation on the hash table?

- (A) 3      (B) 4      (C) 5      (D) 6

45. Which of the following lists of numbers produce the most balanced tree, when inserted, in the order given, into a binary search tree?

- (A) 2, 5, 1, 4, 0, 3      (B) 5, 1, 2, 6, 3, 4  
(C) 2, 4, 7, 5, 8, 11      (D) 6, 4, 1, 8, 10, 5

46. Which of the following is not a function of the network layer protocol i.e., Internet Protocol?

- (a) Determining network layer addressing  
(b) Determining the route of a datagram follows from source to destination  
(c) Taking decision of fragmenting the datagram

- (A) a only      (B) b only      (C) c only      (D) None of these

47. Given is schedule I as:

T <sub>1</sub>	T <sub>2</sub>
R(A)	
W(A)	
R(B)	
W(B)	
	R(A)
	W(A)
	R(B)
	W(B)

Here A and B are data items and T<sub>1</sub> and T<sub>2</sub> are the transactions. R(X) and W(X) denote the action reading and writing of data item respectively.

Next consider following schedule II and schedule III as:

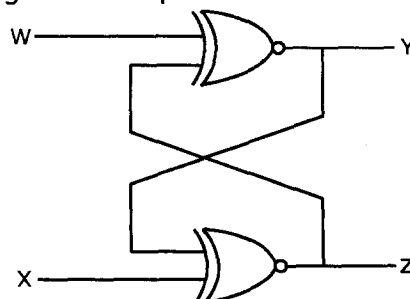
Schedule II		Schedule III	
T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>
R(A)			R(A)
W(A)			W(A)
	R(A)	R(A)	
	W(A)	W(A)	
R(B)			R(B)
W(B)			W(B)
	R(B)	R(B)	
	W(B)	W(B)	

Which of the following is true?

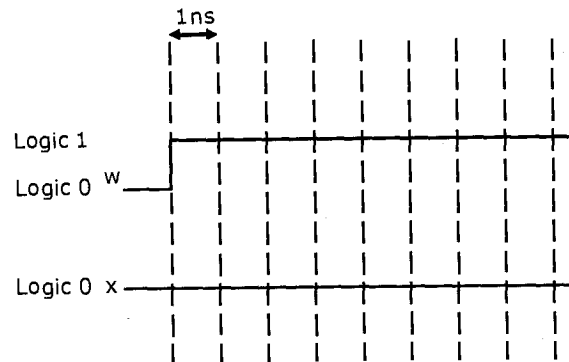
- (A) Schedule I is view equivalent to schedule II and to schedule III
- (B) Schedule I is view equivalent to schedule II but not to schedule III
- (C) Schedule I is view equivalent to schedule III but not to schedule II
- (D) Schedule I is not view equivalent to schedule II or schedule III

### Common Data Questions: 48 & 49

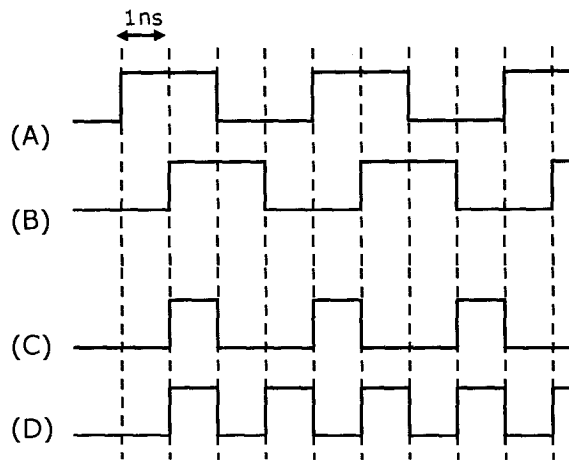
Consider the following cross-coupled EX-NOR circuits with inputs w,x and outputs y and z.



Propagation delay of EX-NOR gate is 1 ns, and initial values for the circuit nodes are  $w = 0, x = 0, y = 0, z = 1$ . The circuit behavior is to be determined when  $w = 1$  and  $x = 0$  i.e.



48. The timing diagram of  $y$  is



49. Which of the following is true with respect to timing diagram of  $z$ ?
- (A)  $z$  oscillates with period of 2 ns      (B)  $z$  oscillates with period of 4 ns  
(C)  $z$  oscillates with period of 8 ns      (D)  $z$  doesn't oscillate

### Common Data Questions: 50 & 51

A system has four process P1, P2, P3, P4; resources R1 (2 units) and resources R2 (3 units)

Given:

P1 request 1 unit of R1 and 2 units of R2

P2 holds 2 units of R1 and 1 unit of R2

P3 holds 1 unit of R2

P4 requests 1 unit of R1

50. Which of the process can not complete before completion of P2?
- (A) P1 only      (B) P4 only      (C) P1 and P4      (D) P1, P3, P4

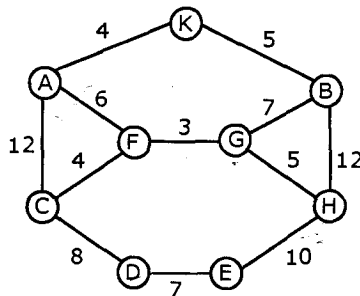


51. What is the minimum extra requirement of resource R1 or R2 to make the system dead lock free?
- (A) 1 unit of R1 only                      (B) 2 units of R1 only  
(C) 1 unit of both R1 and R2              (D) none of these

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

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

Depth first search (DFS) algorithm is to be applied on the given graph:



52. Assuming it starts at node A and that the adjacency lists are in alphabetical order, in which of the following order nodes will be visited?
- (A) A, C, D, E, H, B, G, F, K              (B) A, K, B, G, F, C, D, E, H  
(C) A, F, G, H, E, D, C, B, K              (D) A, C, D, E, H, B, K, F, G
53. What is the weight of the resulting depth first spanning tree?
- (A) 48 units              (B) 64 units              (C) 58 units              (D) 42 units

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

Consider the set  $S = \{1, 2, 3, 4, 5, 6\}$ .

54. Which of the following form partition of S?
- (A)  $A_1 = \{1, 2, 3\}$ ,  $A_2 = \{3, 4, 5\}$  and  $A_3 = \{5, 6\}$   
(B)  $A_1 = \{2, 4\}$ ,  $A_2 = \{1, 5, 6\}$  and  $A_3 = \{1, 3\}$   
(C)  $A_1 = \{1, 3\}$ ,  $A_2 = \{4, 5\}$  and  $A_3 = \{6\}$   
(D)  $A_1 = \{1, 2, 3\}$ ,  $A_2 = \{4, 5\}$  and  $A_3 = \{6\}$
55. What is the cardinality of the equivalence relation induced by the above partition?
- (A) 22              (B) 36              (C) 16              (D) 14

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

56. A, B and C worked for 15 days, 17 days, 10 days and earned Rs.47,000. The ratio of the efficiencies of A, B and C is 3 : 5 : 7 .If they worked for 8 days, 6 days and 5 days respectively, then which of the following is true?
- (A) B gets Rs.1410 more than A                      (B) C gets Rs.1175 more than B  
(C) C gets Rs.2585 more than A                      (D) All of these

**Directions for Question 57: The given sentence below has two blanks; each blank indicates that something has been omitted. Beneath the sentence are four lettered words. Choose the word for each blank that best fits the meaning of the sentence as a whole:**

57. Coyotes (the American Jackal), have managed to \_\_\_\_\_ much serious scrutiny by being exquisitely \_\_\_\_\_, so much so that even dedicated coyote scientists can struggle to find ways to lay eyes on them, not to mention hands.
- (A) procrastinate -----sluggish                      (B) elude-----wary  
(C) mislead-----coy                      (D) redefine-----adamant

**Directions for Question 58: Read the given sentence to find out whether there is any grammatical error in it. The error, if any will be in one part of the sentence. The letter of that part is the answer. If there is no error, the answer is 'D'. (Ignore the errors of punctuation, if any).**

58. What the finding does not settle is/  
A  
how to define exactly what these animals are/  
B  
or for that matter what to call them/  
C  
No Error  
D

**Directions for Question 59: In the given question, there are two statements P and Q followed by two conclusions numbered I and II. Decide which of the given conclusions logically follows from the two given statements, disregarding commonly known facts.**

59. **Statements**  
P: All accounts officers are suspicious.  
Q: Some accounts officers are trusting.
- Conclusions**  
I. All trusting accounts officers are suspicious.  
II. All suspicious accounts officers are trusting.
- (A) Only conclusion I follows                      (B) Conclusion II follows  
(C) Neither I nor II follows                      (D) Both I and II follow

**Directions for Question 60:** From the four lettered words, select that word which best completes the analogy existing among the first two words.

60. OBSCURE: MURKY::BARREN:?
- (A) sterile                      (B) temperate                      (C) reconciliatory                      (D) coincidental

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

**Directions for Question 61:** Study the given information carefully and answer the question that follows:

61. In a circus, the clown poses to another clown the following question: You watch the Sunrise and I do the opposite. I am now going to perform a feat in which my head will be down and legs will be up, whereas my face will be opposite to you. Tell me quickly where my right hand will be
- (A) North                      (B) East                      (C) South                      (D) West
62. If A: 2, 5, 8, ..... 302 and  
B: 3, 5, 7, ..... 303,  
The number of common terms of A and B is
- (A) 53                      (B) 52                      (C) 51                      (D) 50
63. Speeds of two persons A and B are in the ratio of 4:5. If A starts 5 seconds earlier than B in a 500m race, B can complete the race 20 seconds earlier than A. What is the distance between A and B when B completes the race?
- (A) 80 meters                      (B) 60 meters                      (C) 40 meters                      (D) 90 meters
64. Find the LCM of  $(4567^{2010} + 1)$  and  $(4567^{2010} - 1)$
- (A)  $\frac{4567^{4020} - 1}{2}$                       (B)  $\frac{4567^{2010} + 1}{2}$   
(C)  $4567^{2010}$                       (D)  $4567^{4020}$
65. If  $|a| < 1$ , then find the value of  $5 + 10a + 15a^2 + 20a^3 + \dots \infty$
- (A)  $\frac{5}{1-a^2}$                       (B)  $\frac{5}{1+a}$                       (C)  $\frac{5}{1-a}$                       (D)  $\frac{5}{(1-a)^2}$

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**Answer Keys**

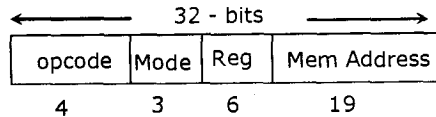
1	B	2	A	3	C	4	D	5	C	6	B	7	C
8	A	9	A	10	C	11	C	12	B	13	C	14	A
15	B	16	A	17	C	18	A	19	D	20	A	21	D
22	A	23	D	24	A	25	A	26	A	27	B	28	A
29	D	30	C	31	D	32	C	33	D	34	B	35	A
36	C	37	B	38	C	39	D	40	B	41	C	42	C
43	A	44	B	45	D	46	D	47	B	48	B	49	B
50	C	51	D	52	A	53	B	54	D	55	D	56	D
57	B	58	D	59	C	60	A	61	C	62	D	63	A
64	A	65	D										

**Explanations:-**

3.  $x_{n+1} = x_n - \frac{3x_n^{1/3}}{x_n^{-2/3}} = x_n - 3x_n = -2x_n$   
 $x_0 = 0.1, x_1 = -0.2, x_2 = 0.4, x_3 = -0.8, \dots \therefore$  The method fails to converge.
5.  $\overline{abcd}, \overline{acd}, \overline{ab}, \overline{bc}, \overline{bd}, \overline{acd}$
6. Direct :  $M[500] = 600$  Indirect:  $M[600] = 700$
7. TCP doesn't guarantee on the rate of delivery of data since sending rate is regulated by TCP congestion control.
9. Let A: event that first die is 4  
 B: event that sum of two dice is greater than equal to 8  
 $P(A) = \frac{1}{6}$   
 $P(A \text{ and } B) = \frac{3}{36} = \frac{1}{12}$   
 $\therefore P(B/A) = \frac{P(A \text{ and } B)}{P(A)} = \frac{1}{12} \times \frac{6}{1} = \frac{1}{2}$
11. The grammar is not LL(1) because the grammar is ambiguous and left recursive.  
 The regular expression for the language accepted by the grammar is  $0^*$ .
12.  $L_1$  is not context free but  $L_2$  is context free, and its equivalent CFG is  
 $S \rightarrow ASA \mid 1$  or  $S \rightarrow 0S0 \mid 1S1 \mid 1S0 \mid 0S1 \mid 1$   
 $A \rightarrow 0 \mid 1$
13.  $p(2 \text{ defective glasses}) = {}^{10}C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^8 = \frac{45}{2^{10}}$
14. Regular expression for  $L_1$  is  $(1(0 \mid 1)^* 1) \mid (0(0 \mid 1)^* 0)$
15. Post order is BFDGECA, fifth element from top = D
16. In cascadeless schedule for each pair of transactions  $T_i$  and  $T_j$ , if  $T_j$  reads a value of data item previously written by  $T_i$ , then  $T_i$  must commit before read operation of  $T_j$ .

17. R has keys: A, E, BC S has keys: A, B, E

18. Opcode field =  $[32 - (3 + 6 + 19)] = 4$  bits



21. Identity matrix is  $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ ; Inverse of matrix M is  $M^{-1}$ .

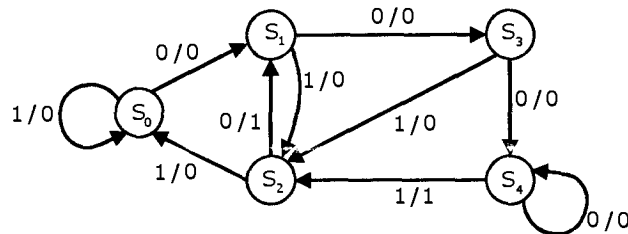
25. HTTP is stateless protocol

26. To have Eigen value  $\lambda = 1$  we must have  $|A - I| = 0$

$$\Rightarrow \begin{vmatrix} k-1 & 1 & 2 \\ 1 & 1 & k \\ 1 & 2 & 2 \end{vmatrix} = 2k^2 - 5k + 2 = (2k-1)(k-2) = 0$$

So,  $k = 1/2$  or  $k = 2$  will suffice

27.



28. Two addresses take up 24 bits and 8-bits are left for opcode. Bit pattern 00000000(0) through 11111010(250) are used for 251 two-address instructions. There are 5 bit patterns left for one address instructions.

00000000 xxxxxxxxxxxx xxxxxxxxxxxx } 251, 2-address instructions  
11111010 xxxxxxxxxxxx xxxxxxxxxxxx }

11111011 000000000000 xxxxxxxxxxxx }  $2^{12}$   
11111011 111111111111 xxxxxxxxxxxx }  $2^{12}$   
11111100 000000000000 xxxxxxxxxxxx }  $2^{12}$   
11111100 111111111111 xxxxxxxxxxxx }  $2^{12}$   
... }  $5 * 2^{12}$ , 1-address instructions  
11111111 000000000000 xxxxxxxxxxxx }  $2^{12}$   
11111111 111111111111 xxxxxxxxxxxx }  $2^{12}$

30. Minimum cover =  $\{x_1, x_4, y_1, y_3\}$

Maximum matching =  $\{x_1y_2, x_2y_1, x_3y_3, x_4y_4\}$

Both have size 4; in a bipartite graph the size of maximum matching equals the size of minimum cover.

31. 987 will be assigned to a; 6 will be assigned to b  
543 will be assigned to c  
Input 2 and 1 will be ignored.

32. Sum of degrees  $nr =$  even number (Handshaking lemma)

Since  $r$  is odd,  $n$  must be even.

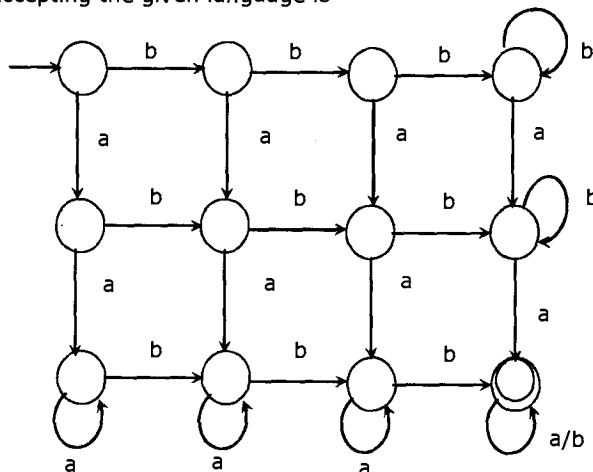
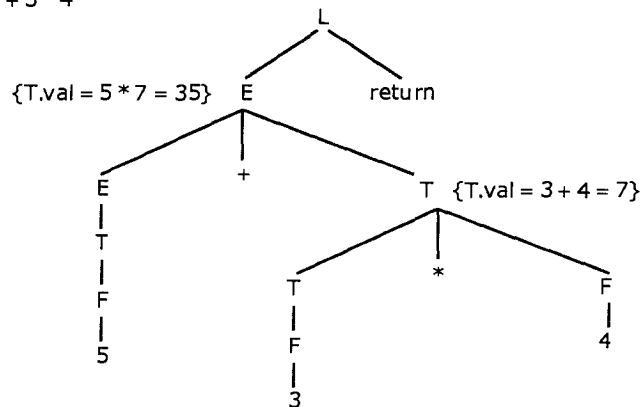
$\therefore S_2$  is true  $\Rightarrow e = \frac{nr}{2} = \frac{2Kr}{2} (\because n \text{ is even}) = k \times r = \text{multiple of } r \therefore S_3$  is true

- The probability of an event  $4, 4, 4, \bar{4}, 4, \bar{4}$  is

All events in which four 4's and two non 4's occur have the same probability. The number of such events is  ${}_6C_4 = 15$  and all these events are mutually exclusive. Hence,

$$P(\text{four 4's in six tosses}) = 15 \times \left(\frac{1}{6}\right)^4 \times \left(\frac{5}{6}\right)^2 = 0.008$$

	First	Follow
S	d, e	\$
A	e, d, $\epsilon$	e, \$, c, d
B	e	c, d, e, \$



40. Arrival rate = 5 process/min. i.e. on an average a new process arrives every 12 seconds.  
 $\Rightarrow$  Every process stays for 12 seconds with the CPU; Service time = 10 seconds  
 $\therefore$  Fraction of time CPU is busy =  $\frac{\text{service time}}{\text{staying time}} = \frac{10}{12} \approx 83.3\%$

44. 17 is inserted into slot 6; 37 is inserted into slot 4

				37		17				
0	1	2	3	4	5	6	7	8	9	10

$$h(59) = 4, \text{ collision } \therefore h(59) = [h(59) + d] \% m = [4 + 1] \% 11 = 5 \quad (d = 1)$$

$\therefore$  59 is inserted into slot 5

$$h(70) = 4, \text{ collision } \therefore h(70) = [4 + 1] \% 11 = 5, \text{ again collision}$$

$$\therefore h(70) = [4 + 2] \% 11 = 6, \text{ again collision}$$

$$d = 3, h(70) = [4 + 3] \% 11 = 7$$

$\therefore$  70 is inserted into slot 7

				37	59	17	70			
0	1	2	3	4	5	6	7	8	9	10

Delete (59):

$H(59) = 4$ , but slot 4 is occupied by 37. Search sequentially until slot 5 and delete 59.

Insert (16):

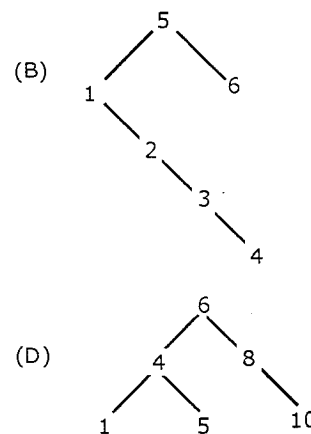
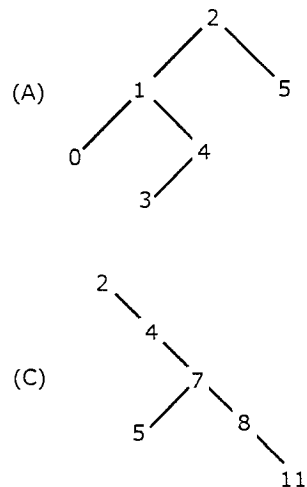
$$h(16) = 5$$

16 is inserted into slot 5

Final hash table content

				37	16	17	70			
0	1	2	3	4	5	6	7	8	9	10

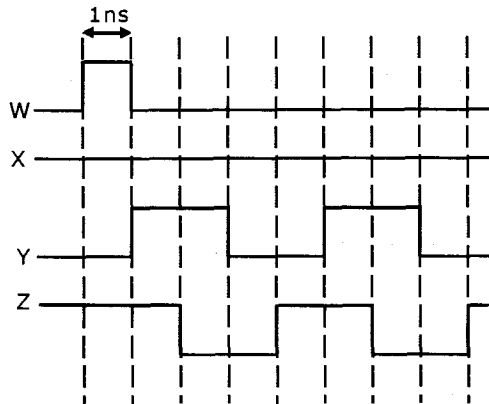
- 45.



46. All are functions of IP protocol.
47. Schedule I is view equivalent to schedule II as values of A and B read by  $T_2$  are produced by  $T_1$  in both case.  
 But schedule I is not view equivalent to schedule III as in schedule I, values of A or B read by  $T_2$  are produced by  $T_1$  which is not followed in schedule III.

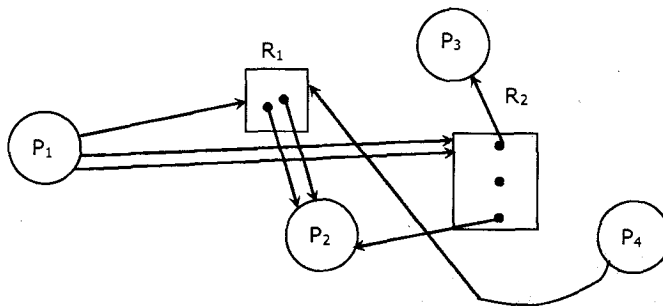


48,49.



y and z both oscillates with a period of 4 ns

50.

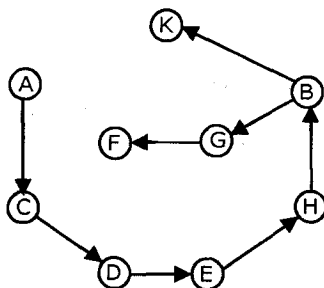


$P_1$  and  $P_4$  cannot complete since the resources are with  $P_2$

51. No extra resources are required since the system is not deadlocked. processes could complete is  $P_2, P_4, P_3, P_1$

One of the order in which

52.



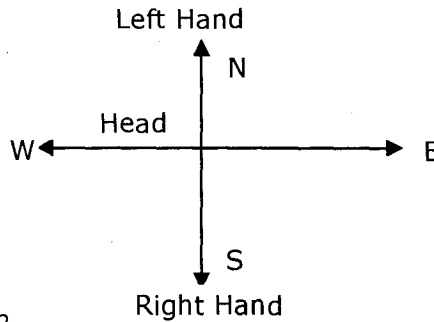
54,55. In induced equivalence relation is  $R = \{(1,1), (2,2), (3,3), (1,2), (1,3), (2,1), (2,3), (3,1), (3,2)\} \cup \{(4,4), (5,5), (4,5), (5,4)\} \cup \{(6,6)\}$   
 $n(R) = 14$

56. Ratio of efficiencies of A, B and C is 3 : 5 : 7  
Now,  $3x(15) + 5x(17) + 7x(10) = 47000 \Rightarrow 45x + 85x + 70x = 47000 \Rightarrow 200x = 47000 \Rightarrow x = 235$   
Amount obtained by A for 8 days =  $8(3x) = 24(235)$   
Amount obtained by B for 6 days =  $6(5x) = 30(235)$   
Amount obtained by C for 5 days =  $5(7x) = 35(235)$   
(i) The difference between the amounts of A and B =  $6(235) = \text{Rs. } 1410$   
(ii) The difference between the amount of B and C =  $5(235) = \text{Rs. } 1175$   
(iii) The difference between the amount of A and C =  $11(235) = \text{Rs. } 2585$

57. The clue in the question is even the dedicated scientists have failed to do research on coyotes. It means, the animals must be careful enough to avoid or escape the scientists.

59. The second premise is particular. If one premise is particular, the conclusion must also be particular. Here, both the conclusions are general or universal (denoted by all). Hence no conclusion follows.

60. The words in each pair are synonyms.
61. The posture of the man is as shown. He faces the west. Clearly, the clown's right hand points toward the south.



62. A : 22, 5, 8, 11, ..... 302  
B : 3, 5, 7, 9, 11, ..... 303  
Common terms are 5, 11, 17 .....  
a = 5, d = 6  
Let us assume that there are n common terms  
 $\therefore a + (n-1)d \leq 302 \Rightarrow 5 + (n-1)6 \leq 302$   
 $\Rightarrow (n-1)6 \leq 297 \Rightarrow (n-1)6 \leq 49.5 \Rightarrow n \leq 50.2$   
There are 50 common terms
63. Let the time taken by B to complete the race is t seconds.  
Let the time taken by A to complete the race is (t+25) seconds.  
Let the speeds of A and B be 4x and 5x respectively  
A covers 500 meters in t seconds with a speed 4x m/s  
 $\therefore 500 = 4x(t+25)$  ..... (1)  
B covers 500 meters in t seconds with a speed 5x m/s  
 $\therefore 500 = 5x \times t$  ..... (2)  
From (1) and (2), we have  
 $4x(t+25) = 5x \times t \Rightarrow t = 100$   
 $\therefore x = 1$  m/s  
 $\Rightarrow$  Speed of A = 4 m/s and speed of B = 5 m/s  
Distance between A and B when B complete the race is equal to distance traveled by A in 20 s  
 $\therefore$  Distance =  $4 \times 20 = 80$  meters
64. The units digit of  $(4567)^{2010}$  is same as the units digit of  $7^{2010}$   
Now the units digit of  $7^{(4 \times 502 + 2)}$  is 9 (Since units digit of  $7^2$  is 9)  
 $\therefore 4567^{2010} - 1$  and  $4567^{2010} + 1$  ends with 8 and 0  
We can say that they are consecutive even numbers  
If a and b are two consecutive even numbers then their LCM is  $\frac{1}{2}ab$   
 $\therefore$  The LCM is  $\frac{(4567^{2010} - 1)(4567^{2010} + 1)}{2} = \frac{(4567^{4020} - 1)}{2}$
65. Given  $|a| < 1$   
Let  $S = 5 + 10a + 15a^2 + 20a^3 + \dots \infty$   
Now,  $r = \frac{10a}{5} = 2a$   
Given,  $|a| < 1$ , then 2a may be  $< 1$  or  $> 1$   
Hence, we cannot find sum to infinity here  
In order to convert into G.P., we go through the following steps  
 $Sa = 5a + 10a^2 + 15a^3 + \dots$   
 $S - Sa = 5 + 5a + 5a^2 + 5a^3 + \dots$   
 $S(1-a) = \frac{5}{1-a}, S = \frac{5}{(1-a)^2} \quad \left( \because S_{\infty} = \frac{a}{1-r} \right)$

# TarGATE'11

## Computer Science & Engineering

Your Roll Number: .....

Test ID: 

2	2	0	6
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Duration: 3 Hours

Maximum Marks: 100

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### Read the following instructions carefully:

1. Write your roll number, your name and name of the examination centre at the specified locations of the ORS.
2. Using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your paper code.
3. All the questions in this question paper are of objective type.
4. Questions must be answered on Objective Response Sheet (ORS) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number on the left hand side of the ORS. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as a wrong answer.
5. This question paper contains 65 objective type questions comprising of 55 Technical questions and 10 General Aptitude questions. Q.1 to Q.25 and Q. 56 to Q. 60 carry one mark each. Q.26 to Q.55 and Q. 61 to Q. 65 carry two marks each.
6. The questions pairs (48, 49) and (50, 51) are common data questions
7. The questions pairs (52, 53) and (54, 55) are questions with linked answers. The answer to the second question of the above pairs will depend on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is un-attempted, then the answer to the second question in the pair will not be evaluated.
8. Un-attempted questions will carry zero marks.
9. **NEGATIVE MARKING:** For Q.1 to Q.25 and Q. 56 to Q. 60, 1/3<sup>rd</sup> mark will be deducted for each wrong answer. For Q. 26 to Q.51 and Q. 61 to Q. 65, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. For the pairs of questions with linked answers, there will be negative marks only for wrong answer to the first question, i.e. for Q.52 and Q.54, 2/3<sup>rd</sup> mark will be deducted for each wrong answer. There is no negative marking for Q.53 and Q.55.
10. Calculator without data connectivity is allowed in the examination hall.
11. Charts, graph sheets or tables are NOT allowed in the examination hall.
12. Rough work can be done on the question paper itself. Additionally blank pages are given at the end of the question paper for rough work.

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The screenshot displays the eTutor web interface. On the left is a navigation menu with categories: Compiler Design, Computer Networks, CS-Common Math, CS-Maths, and Data Structure and Algorithm. Under CS-Common Math, a list of topics is shown, including Linear Algebra and Numerical Methods. The main content area on the right shows a handwritten lecture slide titled "Numerical Solution of Ordinary Differential Equation of first order". The slide contains the differential equation  $\frac{dy}{dx} = f(x, y)$  labeled (1), the initial condition  $y(x_0) = y_0$  labeled (2), and the text "Initial value problem." and "[x<sub>0</sub>, x<sub>1</sub>] Lipschitz". The interface also shows a top bar with "TUTOR Welcome CS" and various icons.

A typical eTutor Screen

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**Q. No. 1 – 25 Carry One Mark Each**

1. Consider an array  $[a_1 a_2 \dots a_n]$  of size  $n$ . The resultant array after swapping the alternate elements of array is  $[a_2 a_1 a_4 a_3 a_6 a_5 a_8 a_7 \dots a_n a_{n-1}]$ . The temporary storage required to perform the above operation will be  
(A)  $O(n)$  (B)  $O(1)$  (C)  $O(n^2)$  (D)  $O(\log n)$
2. Consider the following program  

```
#include<stdio.h>
main()
{
float a ;
int x = 6, y = 5;
a = x/y;
print("Value of a = %f\n", a);
return 0;
}
```

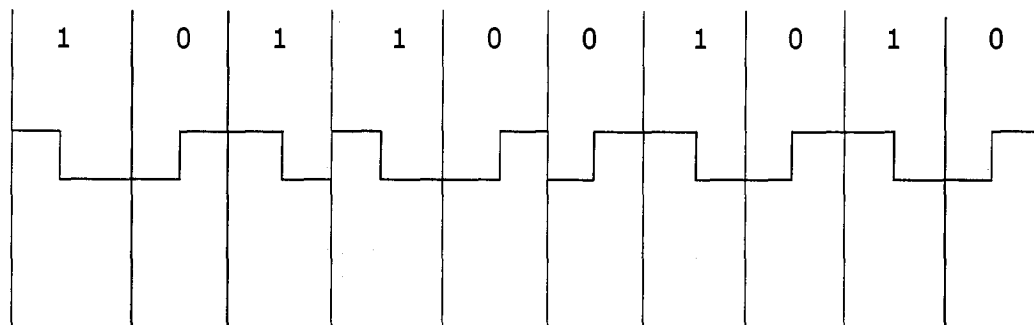
The output of the above program is  
(A) 1.200000 (B) 1.000000 (C) 1 (D) None of these
3. Which of the following queue is implemented using arrays when limited memory space is there and static implementation is required so that one can optimally utilize the allocated memory space?  
(A) Dequeue (B) Circular queue (C) Priority queues (D) none of these
4. If  $A$  is an orthogonal matrix, then  $|A|$  is  
(A) 0 (B) -1 (C) 1 (D)  $\pm 1$
5. How many labelled simple graphs are possible with  $n$  vertices?  
(A)  $2^{n/2}$  (B)  $2^n$  (C)  $2^{n(n-1)/2}$  (D)  $n^2$
6. In a football championship, 153 matches were played. Every team played one match with each other. The number of teams participating in the championship is  
(A) 17 (B) 18 (C) 9 (D) none of these
7. The octal value of hexadecimal number AB123 is  
(A)  $(2540443)_8$  (B)  $(2540423)_8$  (C)  $(2530443)_8$  (D)  $(2440443)_8$
8. Determine the number of clock cycles required to process 200 tasks in a six – segment pipeline. (Assume there were no stalls), each segment takes 1 cycle.  
(A) 1200 cycles (B) 206 cycles (C) 207 cycles (D) 205 cycles

9. Which of the following statement is correct?  
 (A) Regular languages are closed under infinite union  
 (B) Context free languages are closed under intersection  
 (C) Regular languages are closed under substitution  
 (D) Context free languages are not closed under substitution
10. Given two regular expressions  
 $r = (0^*1^*)^*$  and  $s = 0^* + 1^* + 0^*1 + 10^*$   
 What is the length of the smallest string that is present in language corresponding to regular expression 'r' and not present in the language corresponding to regular expression 's'?  
 (A) 5 (B) 4 (C) 3 (D) 2
11. Remove the left-recursion from the following grammar:  
 $E \rightarrow Ea \mid Eb \mid a \mid b$   
 (A)  $E \rightarrow aE' \mid bE' ; E' \rightarrow aE' \mid bE' \mid \epsilon$  (B)  $E \rightarrow aE' \mid bE' ; E' \rightarrow aE \mid bE \mid \epsilon$   
 (C)  $E \rightarrow aE' \mid bE' \mid \epsilon ; E' \rightarrow aE' \mid bE' \mid \epsilon$  (D) None of these
12. Which of the following statement(s) is/are true?  
 $S_1$ : Right recursion is needed for termination in predictive parsers.  
 $S_2$ : Left recursion requires more stack space than right recursion.  
 $S_3$ : Left recursion works fine in bottom-up parsers.  
 (A)  $S_1$  and  $S_2$  (B)  $S_1$  and  $S_3$  (C)  $S_2$  and  $S_3$  (D)  $S_1, S_2$  and  $S_3$
13. Average case performance of shell sort is  
 (A)  $O(n \log^2 n)$  (B) depends on gap sequence  
 (C)  $O(n)$  (D)  $O(n \log n)$
14. Consider the following program fragment.  

```
{
char w1[210];
printf("enter text");
scanf("%s",&w1);
printf("%s",w1);
}
```

 What is the output of the program if we enter Good Morning?  
 (A) Good Morning (B) GoodMorning (C) Good (D) None of these
15. For sorting contiguous list of records, quick sort may be preferred over merge sort because  
 (A) It does not require extra space for auxiliary storage  
 (B) It requires less time always  
 (C) It requires more programming effort  
 (D) Some programming languages does not support recursion

16. A system call is  
 (A) The interface between the operating system and the hardware  
 (B) The interface between the operating system and the process  
 (C) The interface between the hardware and the user programs  
 (D) All of these
17. Which of the following statement(s) is/are true?  
 S<sub>1</sub>: FIFO algorithm yields the lowest page-fault rate compared to LRU algorithm in general.  
 S<sub>2</sub>: Optimal algorithm yields the lowest page-fault rate compared to FIFO algorithm in general.  
 S<sub>3</sub>: Optimal algorithm yields the lowest page-fault rate compared to LRU algorithm in general.  
 S<sub>4</sub>: Both Optimal and LRU algorithms yields the same page-fault rate in general.  
 (A) S<sub>1</sub> and S<sub>2</sub>      (B) S<sub>2</sub> and S<sub>3</sub>      (C) S<sub>1</sub> and S<sub>4</sub>      (D) S<sub>1</sub>, S<sub>2</sub> and S<sub>3</sub>
18. Match the following two lists:
- | List-I                     | List - II              |
|----------------------------|------------------------|
| P. Distance vector routing | 1. Shortest path first |
| Q. Link - state routing    | 2. large topology      |
| R. Flooding                | 3. Split-Horizon hack  |
| S. Hierarchical routing    | 4. Duplicate packets   |
| (A) P-1,Q-2,R-3,S-4        | (B) P-3,Q-1,R-4,S-2    |
| (C) P-2,Q-3,R-1,S-4        | (D) None of these      |
19. Consider the following encoding scheme of the binary bit stream.



- Which one of the following is correct about the above encoding?
- (A) It is normal binary encoding scheme  
 (B) It is differential Manchester encoding scheme  
 (C) It is Manchester encoding scheme  
 (D) None of these

20. The prefix expression for the following is  
 $((2 + 3) * 4 + (5 * (6 + 7) * 8) + 9)$   
 (A)  $++*+234**5+6789$  (B)  $++*+2345++5*6789$   
 (C)  $+*++234**5+6789$  (D)  $+*+*234++5*6789$
21. In which of the following order any given set of numbers should be inserted in binary search tree to get inorder and postorder traversal same?  
 (A) Increasing order (B) Decreasing order  
 (C) Not possible (D) Any order
22. What is the order of the following recurrence relation?  
 $a_{n-1} + a_{n-2} = 5a_n$   
 (A) 1 (B) 2 (C) 3 (D) 4
23. What is the independence number of  $w_n$  ( $n \geq 3$ ) with  $n+1$  vertices?  
 (A)  $n$  (B)  $\left\lfloor \frac{n}{2} \right\rfloor$  (C) 1 (D) none
24. Total number of subsets of even cardinality of set A is 32. What is cardinality of A?  
 (A) 4 (B) 5 (C) 6 (D) 7
25. Match the following lists:
- | List – I                       | List – II                     |
|--------------------------------|-------------------------------|
| P. DMA                         | 1. Priority Interrupt         |
| Q. Processor status word (PSW) | 2. I/O Transfer               |
| R. Daisy chaining              | 3. CPU                        |
| S. Handshaking                 | 4. Asynchronous Data transfer |
| (A) P-1, Q-3, R-4, S-2         | (B) P-2, Q-3, R-1, S-4        |
| (C) P-2, Q-1, R-3, S-4         | (D) P-4, Q-3, R-1, S-2        |

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

26. Consider the binary relations R and S on non-empty set A. Both R and S are reflexive. Which of the following is true?
- |                            |                            |
|----------------------------|----------------------------|
| 1. $R \cup S$ is reflexive | 2. $R \cap S$ is reflexive |
| 3. $R - S$ is reflexive    | 4. $R - S$ is irreflexive  |
| 5. $S - R$ is reflexive    | 6. $S - R$ is irreflexive  |
| (A) 1,2,4,6                | (B) 1,2,3,5                |
| (C) All                    | (D) None of these          |



27. Let  $f$  be a function from  $A$  to  $B$  and  $f^{-1}$  exist. Let  $S$  and  $T$  be subsets of  $B$ . Which of the following is true?

1.  $f^{-1}(S \cup T) = f^{-1}(S) \cup f^{-1}(T)$

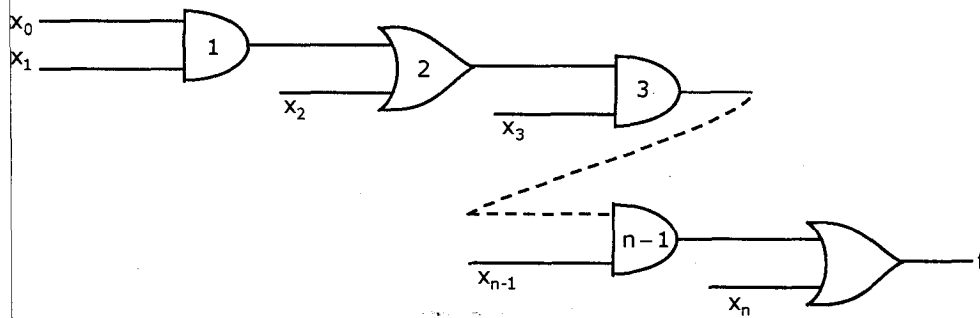
2.  $f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)$

- (A) 1 (B) 2 (C) both (D) none of these

28. A coin is tossed five times. Probability of getting at least 2 heads and 1 tail is

- (A)  $\frac{25}{32}$  (B)  $\frac{27}{32}$  (C)  $\frac{5}{6}$  (D)  $\frac{11}{16}$

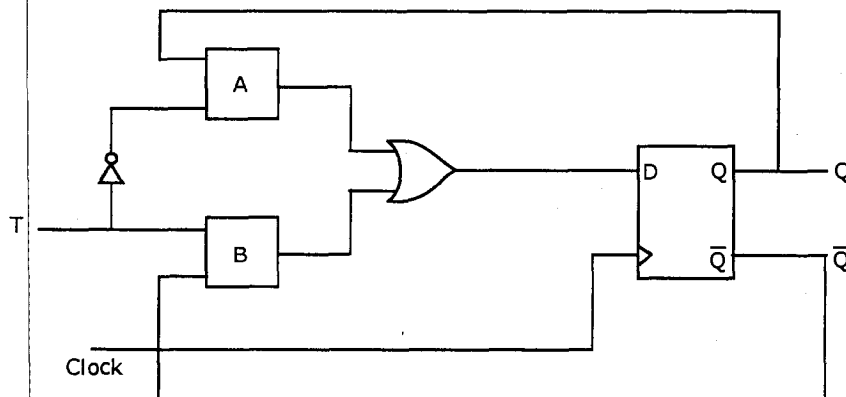
29. In the given network of AND and OR gates



$f$  can be written as

- (A)  $x_0x_1x_2...x_n + x_1x_2...x_n + x_2x_3...x_n...x_n$   
(B)  $x_0x_1 + x_2x_3 + ... + x_{n-1}x_n$   
(C)  $x_0 + x_1 + x_2 + ... + x_n$   
(D)  $x_0x_1x_3...x_{n-1} + x_2x_3x_5...x_{n-1} + ... + x_{n-2}x_{n-1} + x_n$

30. What should  $A$  and  $B$  be in order to make this circuit behave like a T-flip flop?



- (A) A – And  
B – And (B) A – Nand  
B – Nand (C) A – And  
B – OR (D) A – NOR  
B – OR

31. Consider the following PDA transmissions

1.  $\delta(q_0, a, z_0) \rightarrow (q_0, Xz_0)$
2.  $\delta(q_0, a, X) \rightarrow (q_0, X)$
3.  $\delta(q_0, b, X) \rightarrow (q_1, \epsilon)$
4.  $\delta(q_1, b, z_0) \rightarrow (q_1, z_0)$
5.  $\delta(q_1, \epsilon, z_0) \rightarrow (q_1, \epsilon)$

Where  $Q = \{q_0, q_1\}$ ,  $\Sigma = \{a, b\}$ ,  $\Gamma = \{z_0, X\}$ ,  $\delta, q_0, z_0, F = \{\phi\}$

What is the language accepted by the above push down machine?

- (A)  $L = \{a^n b^n \mid n \geq 1\}$  (B)  $L = \{a^n b^m \mid n, m \geq 1\}$   
 (C)  $L = \{a^n b^m \mid n \neq m\}$  (D)  $L = \{a^n b^m \mid n = 2m\}$

32. Consider the following string of characters.

5,4,3,2,5,6,7,8,9,3,2,4,1,2,3

In a data link layer, character count method is used for framing, then the above message can be divided into how many frames?

- (A) 4 (B) 5 (C) 3 (D) 6

33. Suppose, a host has the following IP configuration:

IP address: 195.65.2.125, mask: 255.255.255.0

Default gateway: 195.65.2.1

DNS server1: 195.65.2.200, DNS server 2 : 200.120.190.14

Suppose host want to login to IP address 205.75.33.4; Which of the following scenario is / are possible with respect to ARP?

- (A) ARP query for 195.65.2.1 (B) ARP query for 200.120.190.14  
 (C) ARP query for 195.65.2.200 (D) Both (A) and (C) are possible

34. Which of the following statement(s) is/are true about LALR(1) parsers?

$S_1$ : LALR(1) parsers have same number of states as SLR(1) parsers (core LR(0) items are the same).

$S_2$ : LALR derived from LR with no shift-reduce conflict will also have no shift-reduce conflict.

$S_3$ : LALR may create reduce-reduce conflict not in LR from which LALR is derived.

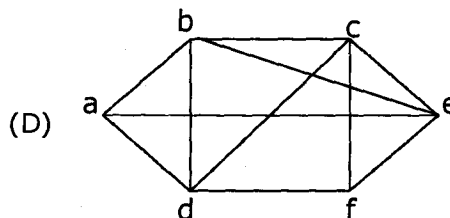
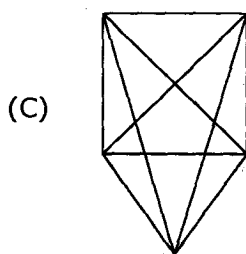
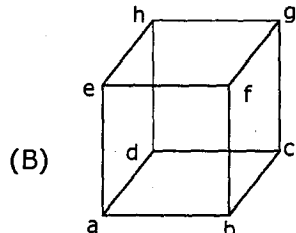
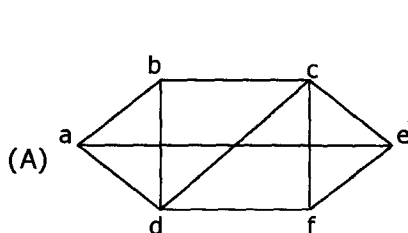
- (A)  $S_1$  and  $S_2$  (B)  $S_1$  and  $S_3$  (C)  $S_2$  and  $S_3$  (D)  $S_1, S_2$  and  $S_3$

35. The Eigen vector corresponding to the least Eigen value of

$$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix} \text{ is}$$

- (A)  $\begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$  (B)  $\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}$  (C)  $\begin{bmatrix} -2 \\ 1 \\ 3 \end{bmatrix}$  (D)  $\begin{bmatrix} 6 \\ 3 \\ 3 \end{bmatrix}$

36. Which of the following graph is Euler?



37. There are 12 intermediate stations between places A and B. In how many ways can a train made to stop at 4 times of 12 intermediate stations, out of which 2 are not consecutive?

(A) 126

(B)  ${}^9C_3$

(C)  ${}^9P_5$

(D)  ${}^9P_3$

38. In a simple graph G with 'n' vertices and k-components maximum number of edges in G is

(A)  $\binom{n}{2}$

(B)  $\binom{n}{2} - k$

(C)  $\binom{n}{2} + k$

(D)  $\frac{(n-k)(n-k+1)}{2}$

39. The minimum number of edges in a connected cycle graph on 'n' vertices is

(A)  $n - 1$

(B)  $n$

(C)  $n + 1$

(D) None of these

40. For full m-ary tree of height h has l leaves with

(A)  $l < m^h$

(B)  $l \leq m^h$

(C)  $l > m^h$

(D)  $l \geq m^h$

41. A priority queue is implemented as a max heap. Initially the level order traversal of 5 elements of heap is

70, 50, 30, 20, 10

The new elements 3, 49 are inserted in heap, the level order traversal after insertion.

(A) 70, 50, 49, 30, 20, 10, 3

(B) 70, 50, 49, 3, 10, 20, 30

(C) 70, 50, 49, 10, 20, 3, 30

(D) 70, 50, 49, 20, 10, 3, 30

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

56. Number of factors of 420 of the form  $5n+2 (n \geq 0)$  is  
(A) 2 (B) 3 (C) 5 (D) 4

**Directions for Question 57: Read the given sentence to find out whether there is any grammatical error in it. The error, if any will be in one part of the sentence. The letter of that part is the answer. If there is no error, the answer is 'D'. (Ignore the errors of punctuation, if any).**

57. Since September 7th when the Japanese authorities arrested  
(A)  
/the crew of a Chinese fishing boat near the islet one of the  
(B)  
/ biggest rows in years has erupted between the two countries.  
(C)  
/ (D) No Error

**Directions for Question 58: Choose the option which can be substituted for the given words/ sentence**

58. A person who runs away from justice or law  
(A) Heretic (B) Pessimist (C) Fugitive (D) Outlaw

**Directions for Question 59: The given sentence below has two blanks; each blank indicates that something has been omitted. Beneath the sentence are four lettered words. Choose the word for each blank that best fits the meaning of the sentence as a whole:**

59. Seldom does the United States look at Europe with economic envy but the past few weeks have been one of those rare phases in that concern about America's \_\_\_\_\_ recovery has been rising, just as anxieties about the euro area's economy have \_\_\_\_\_.  
(A) Inimitable ----- culminated (B) Stumbling ----- faded  
(C) Miraculous ----- restored (D) Unprecedented----- dipped

**Directions for Question 60: The following question is based on a short argument, a set of statements, or a plan of action. For the given question, select the best answer of the choices given.**

60. In a rally - 'RUN FOR HEALTH', an American is standing 17th from the left end in a row of runners and a Greek runner is standing 19<sup>th</sup> from the right end. A super star from India is standing 12<sup>th</sup> from the American toward the right and 4<sup>th</sup> from the Greek toward the right end. How many runners are there in the row?  
(A) 46 (B) 41 (C) Data insufficient (D) None

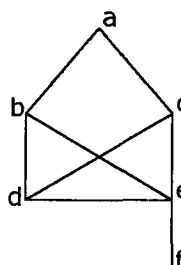
42. BFS of following graph starting from a will be

(A) a c b f d e

(B) a d e b c f

(C) a b d c e f

(D) a b c d e f



43. Consider the following statements:

$S_1$  : Indirect process communication can have more than two processes for each link.

$S_2$  : A mail box communication is nothing but a Direct communication.

Which of the above statements is/are true?

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

(B) Only  $S_1$  is true

(C) Only  $S_2$  is true

(D)  $S_1$  and  $S_2$  are false

44. Consider the following relation  $R(ABCDEF)$  with FD set

$A \rightarrow BCDEF$

$BC \rightarrow ADEF$

$B \rightarrow F$

$D \rightarrow E$

The highest normal form achieved by  $R$  is

(A) 1NF

(B) 2NF

(C) 3NF

(D) BCNF

45. Consider the following relational schema for a database describing accommodation and activities available in national parks:

Park (name, region)

Hotel (id, name, tname) tname is a foreign key into Town

Town (name, pname) pname is a foreign key into Park

Activity (pname, activity) pname is a foreign key into Park

Write an SQL to create a view called "Climbing" that contains the id, name and tname of all Hotels situated in a park where "climbing" is an available activity.

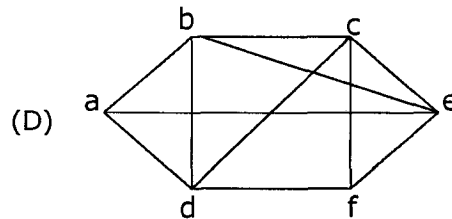
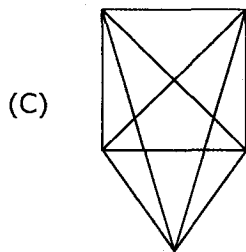
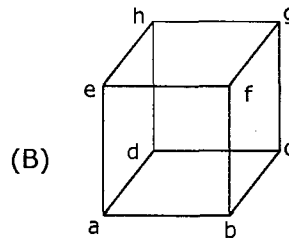
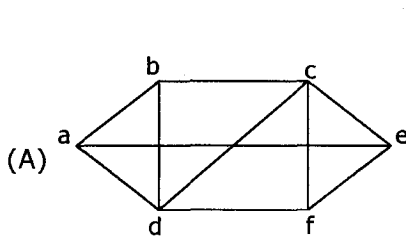
(A) CREATE VIEW Climbing AS

(SELECT h.id, h.name, h.tname

FROM Park p, Hotel h, Town t, Activity a

WHERE h.tname=t.name and a.pname=p.name and a.activity='climbing');

36. Which of the following graph is Euler?



37. There are 12 intermediate stations between places A and B. In how many ways can a train made to stop at 4 times of 12 intermediate stations, out of which 2 are not consecutive?

- (A) 126                      (B)  ${}^9C_3$                       (C)  ${}^9P_5$                       (D)  ${}^9P_3$

38. In a simple graph G with 'n' vertices and k-components maximum number of edges in G is

- (A)  $\left(\frac{n}{2}\right)$                       (B)  $\left(\frac{n}{2}\right) - k$                       (C)  $\left(\frac{n}{2}\right) + k$                       (D)  $\frac{(n-k)(n-k+1)}{2}$

39. The minimum number of edges in a connected cycle graph on 'n' vertices is

- (A)  $n - 1$                       (B)  $n$                       (C)  $n + 1$                       (D) None of these

40. For full m-ary tree of height h has l leaves with

- (A)  $l < m^h$                       (B)  $l \leq m^h$                       (C)  $l > m^h$                       (D)  $l \geq m^h$

41. A priority queue is implemented as a max heap. Initially the level order traversal of 5 elements of heap is

70, 50, 30, 20, 10

The new elements 3, 49 are inserted in heap, the level order traversal after insertion.

- (A) 70, 50, 49, 30, 20, 10, 3                      (B) 70, 50, 49, 3, 10, 20, 30  
(C) 70, 50, 49, 10, 20, 3, 30                      (D) 70, 50, 49, 20, 10, 3, 30

**Common Data Questions: 50 & 51**

A moving arm disk-storage device has the following specifications.

Number of tracks per recording surface -200

Disk – rotation speed – 2400 rev/min

Track storage capacity – 62,500bits

50. What is the data transfer rate for this device?  
(A) 6150k bytes/sec (B) 31.25k bytes/sec  
(C) 312.5k bytes/sec (D) None of these
51. What is the average number of sectors possible in each track when sector control information takes four Bytes and data area is formatted to 256 bytes?  
(A) 30sectors (B) 29sectors (C) 32sectors (D) 31sectors

**Linked Answer Questions: Q.52 to Q.55 Carry Two Marks Each****Statement for Linked Answer Questions: 52 & 53**

Consider the following input sequence 010101.....

52. What will be the regular expression to accept all the prefixes of the given sequence?  
(A)  $0(10)^*$  (B)  $0(01)^*$  (C)  $0(10)^* + (01)^*$  (D)  $0^*+(101)^*$
53. How many minimum number of states required in a DFA for accepting the correct regular expression above?  
(A) 3 (B) 2 (C) 4 (D) 5

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

A two level memory ( $M_1$   $M_2$ ) has the access times  $t_{A1} = 10^{-8}$  sec and  $t_{A2} = 10^{-3}$  sec.

54. What must be the hit ratio 'H' be in order to have the effective access time to be 65 percent of its maximum possible value?  
(A) 0.35 (B) 0.86 (C) 0.38 (D) 0.41
55. What is the effective memory access time using the correct hit ratio above when  $M_1$  has access time of 20ns and  $M_2$  has access time of 200ns.  
(A) 138ns (B) 150ns (C) 48ns (D) 144ns

- (B) CREATE VIEW Climbing AS  
(SELECT h.id, h.name, h.tname  
FROM Park p, Hotel h, Town t, Activity a  
WHERE h.tname=t.name and t.pname=p.name  
and a.activity='climbing');
- (C) CREATE VIEW Climbing AS  
(SELECT h.id, h.name, h.tname  
FROM Park p, Hotel h, Town t, Activity a  
WHERE h.tname=t.name and t.pname=p.name  
and a.pname=p.name and a.activity='climbing');
- (D) None of these

46. Suppose a schedule with two transactions  $T_1$  and  $T_2$

$T_1$	$T_2$
read(A)	
write(A)	
	read(A) commit
read(A) abort	

The above schedule is

- (A) Cascade-less schedule (B) Recoverable schedule  
(C) Irrecoverable schedule (D) None of these
47. The 40-20-40 rule suggests that the least amount of development effort be spent on
- (A) Estimation and planning (B) Analysis and design  
(C) Coding (D) Testing

### Common Data Questions: 48 & 49

List of keys (k) = 6,17,23,34, 48, 99 are inserted into the hash table by using hash function  $H=k \bmod \text{table size}$  and table size is 10. For resolving collisions linear probing is used.

48. Number of collisions occurred when we insert new element '103' is  
(A) 1 (B) 2 (C) 3 (D) 4
49. After inserting element '103', a new element 333 is inserted. The number of collisions occurred when we insert element 333 is  
(A) 6 (B) 5 (C) 7 (D) None of these



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

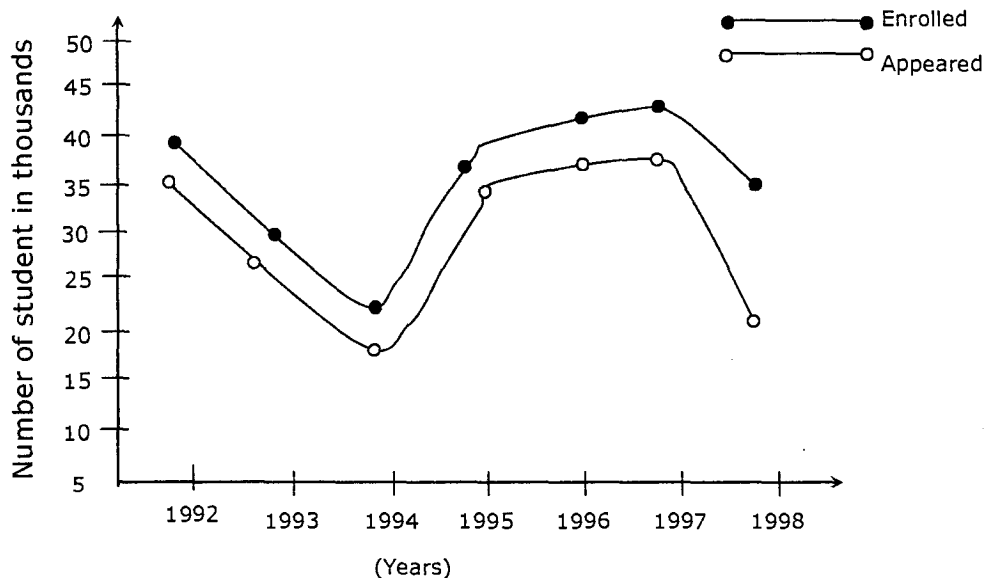
**Find the odd man out:**

61. (A) Obelisk (B) Harpsichord (C) Oboe (D) Cymbal

**Information for Question 62:**

Study the following graph and answer the question given below it.

The graph gives the number of students enrolled and Appeared (in thousands) for an Examination over the years.



62. In which of the following years, was the percentage of students appeared to enrolled is minimum?  
(A) 1992 (B) 1993 (C) 1996 (D) 1998
63. If  $\frac{a+b}{c} = \frac{b+c}{a} = \frac{c+a}{b}$ , then which of the following can be each of the fractions?  
(A)  $\frac{3}{2}$  (B)  $\frac{5}{3}$  (C) -1 (D) -2
64. In a 800m race, A beats B by 80m and in 1000m race B beats C by 200m. If in 500m race A beats C by 35sec, then find the speed of B in m/s.  
(A) 9m/s (B) 8m/s (C) 6m/s (D) 5m/s
65. There are four persons wearing different colour shirts and four gift packs of colours, same as those of the shirts. The number of ways in which the gifts, one each to a person, could be given such that a gift does not go to a person of his shirt colour is  
(A) 9 (B) 27 (C) 6 (D) 15

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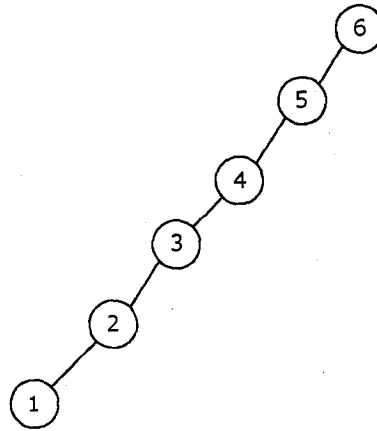
### Answer Keys

1	B	2	B	3	B	4	D	5	C	6	B	7	C
8	D	9	C	10	C	11	A	12	B	13	B	14	C
15	A	16	B	17	B	18	B	19	C	20	A	21	B
22	B	23	B	24	C	25	B	26	A	27	C	28	A
29	D	30	A	31	B	32	C	33	D	34	D	35	A
36	C	37	A	38	D	39	B	40	B	41	D	42	D
43	B	44	A	45	C	46	C	47	C	48	B	49	C
50	C	51	A	52	C	53	A	54	A	55	B	56	D
57	D	58	C	59	B	60	D	61	A	62	D	63	C
64	D	65	A										

### Explanations:-

- One temporary variable is required atmost.
- 1.000000 is printed but not 1.2 because 6 & 5 are both integers 6/5 yields integer 1. This 1 when stored in 'a' is converted into 1.000000
- Since A is orthogonal,  $A^T A = A A^T = I$   
 $|A^T A| = |A A^T| = |I| \Rightarrow |A^T| |A| = |A| |A^T| = |I|$   
 $|A|^2 = 1 \left( \because |A| = |A^T| \right) \Rightarrow |A| = \pm 1$
- Choosing a labelled graph on n vertices is equivalent to choosing  $\binom{n}{2} = n(n-1)/2$  for each of the possible edges. There will be 2 choices for each possible edge whether to include or not, which is given by the product principle as  $2 \times 2 \times \dots \times 2 = 2^{n(n-1)/2}$  choices overall.
- |      |      |      |      |      |     |     |
|------|------|------|------|------|-----|-----|
| A    | B    | 1    | 2    | 3    |     |     |
| 1010 | 1011 | 0001 | 0010 | 0011 |     |     |
| 010  | 101  | 011  | 000  | 100  | 100 | 011 |
| 2    | 5    | 3    | 0    | 4    | 4   | 3   |
- $200 + (n-1) = 200 + (6-1) = 205$
- CFL's are closed under substitution but not under intersection. Regular languages are not closed under infinite union but under finite union and substitution.
- String 010 is not present in 's' but present in 'r' whose length is 3.
- The scanf function is such that it terminates its input on the first white space. It finds only the string 'Good' which will be read into the array w1, since the blank space after Good will terminate the string
- $(*+234) + (5*678) + 9$   
 $\Rightarrow +*+234+*5*+678+9 \Rightarrow ++*+234**5+6789$

21. Decreasing order. 6, 5, 4, 3, 2,



23. Take alternate vertices of the cycle.

24. Total number of subset of set  $n$  is:

$${}^nC_0 + {}^nC_1 + {}^nC_2 + \dots + {}^nC_n = 2^n \Rightarrow {}^nC_0 \text{ is even likewise } {}^nC_2$$

$${}^nC_0 + {}^nC_2 + \dots + {}^nC_n = 2^n - ({}^nC_1 + {}^nC_3 + \dots) \text{ ----- (1)}$$

We know that

$${}^nC_0 - {}^nC_1 + {}^nC_2 - {}^nC_3 + \dots + (-1)^n {}^nC_n = 0$$

$${}^nC_0 + {}^nC_2 + \dots = {}^nC_1 + {}^nC_3 + \dots \text{ ----- (2)}$$

From (1) and (2) we have  $32 + 32 = 2^n \Rightarrow n = 6$

26.  $R = \{(1,1)(2,2)(3,3)(1,2)\}$   $S = \{(1,1)(2,2)(3,3)(1,3)\} \Rightarrow R-S = (1,2)$  irreflexive;  $S-R = (1,3)$  irreflexive

28. The following combinations are possible with the given condition  
HHTTT, HHHTT, HHHHT

$$\text{Number of ways of arranging HHTTT} = \frac{5!}{2!3!} = 10$$

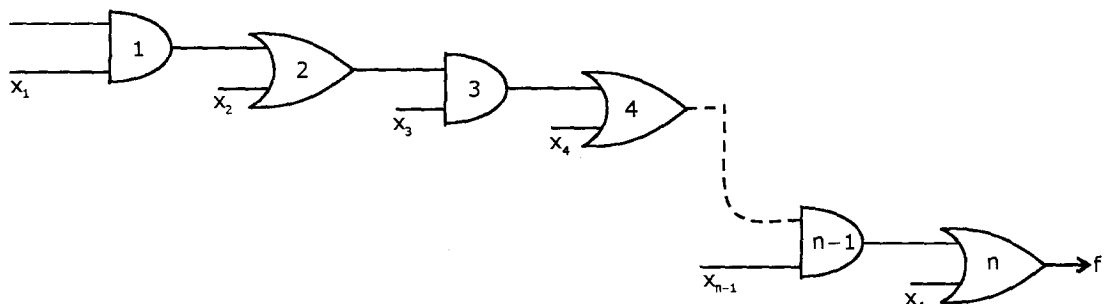
$$\text{Number of ways of arranging HHHTT} = \frac{5!}{3!2!} = 10$$

$$\text{Number of ways of arranging HHHHT} = \frac{5!}{4!} = 5$$

Therefore total number of ways =  $10 + 10 + 5 = 25$

Hence the required probability =  $\frac{25}{32}$

29. In terms of Boolean expressions,



$\%_p$  of 1 is  $x_0x_1 \Rightarrow \%_p$  of 2 is  $(x_0x_1 + x_2) \Rightarrow \%_p$  of 3 is  $(x_0x_1 + x_2)x_3 = x_0x_1x_3 + x_2x_3$

$\%_p$  of 4 is  $x_0x_1x_3 + x_2x_3 + x_4 \Rightarrow \%_p$  of 5 is  $x_0x_1x_3x_5 = x_2x_3x_5 + x_4x_5$

$\%_p$  of 6 is  $x_0x_1x_3x_5 + x_2x_3x_5 + x_4x_5x_6 \Rightarrow$  for  $n$  gates connected as shown,  $\%_p$  is

$$x_0x_1x_3 \dots x_{n-1} + x_2x_3x_5 \dots x_{n-1} + x_4x_5x_7 \dots x_{n-1} \dots + x_{n-2}x_{n-1} + x_n$$

31. It will push 'X' for first 'a' and all other a's will be bypassed. Whenever b encounters it will pop X and bypasses all other b's

32. Starting character is the head of the count.

5 4 3 2 5  
Frame 1

6 7 8 9 3 2  
Frame 2

4 1 2 3  
Frame 3

33. ARP query is for the hosts in the same network.

35.  $|A - \lambda I| = \begin{vmatrix} 6-\lambda & -2 & 2 \\ -2 & 3-\lambda & -1 \\ 2 & -1 & 3-\lambda \end{vmatrix}$

$$= (6-\lambda)\{(3-\lambda)^2 - 1\} - 2\{-2 + 2(3-\lambda)\} + 2\{2 - 2(3-\lambda)\}$$

$$= (6-\lambda)(3-\lambda-1)(3-\lambda+1) - 2(4-2\lambda) + 2(2\lambda-4)$$

$$= (2-\lambda)\{(6-\lambda)(4-\lambda) - 4 - 4\} = (2-\lambda)(\lambda^2 - 10\lambda + 16)$$

$$= (2-\lambda)(\lambda-8)(\lambda-2); \text{ Least eigen value } = 2$$

Then  $(A - \lambda I)X = 0; (A - 2I)X = 0$

$$\begin{bmatrix} 6-\lambda & -2 & 2 \\ -2 & 3-\lambda & -1 \\ 2 & -1 & 3-\lambda \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\Rightarrow \text{For } \lambda=2, \begin{bmatrix} 4 & -2 & 2 \\ -2 & 1 & -1 \\ 2 & -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{cases} 4x - 2y + 2z = 0 \\ -2x + y - z = 0 \\ 2x - y + z = 0 \end{cases} \text{ All the three equations reduce to the single equation}$$

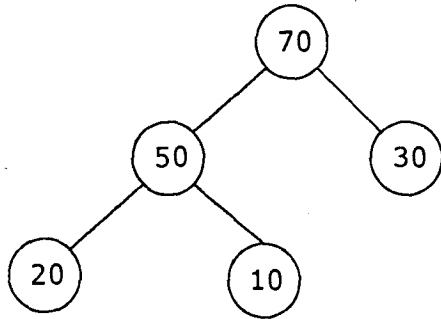
$$2x - y + z = 0; \text{ Let } x = k_1; z = k_2; y = 2k_1 + k_2$$

$$\therefore X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} k_1 \\ 2k_1 + k_2 \\ k_2 \end{bmatrix}$$

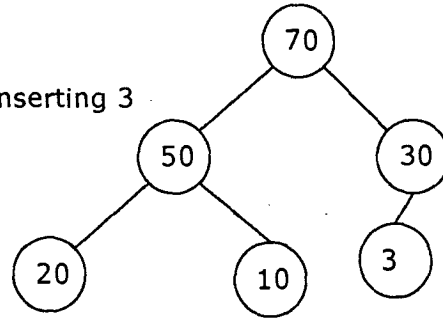
$$\text{For } k_1 = k_2 = 1, X = [1 \ 3 \ 1]^T$$

40. For full  $m$ -ary tree with  $h$  height,  $l \leq m^h$

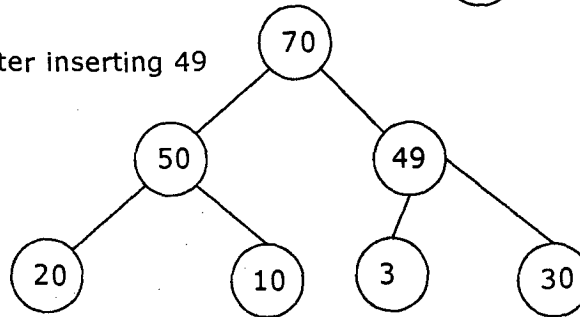
41.



After inserting 3

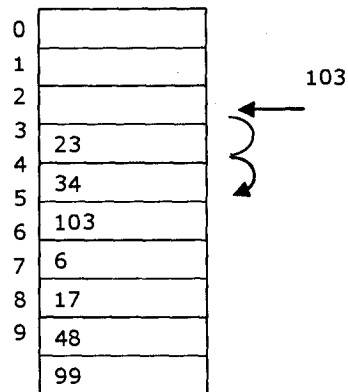


After inserting 49



44. A, BC are keys B→F violates the 2NF definition

48.



50. 1 rotation -  $\frac{1}{40}$  sec ;  $\frac{1}{40}$  sec- 62500bits

1sec- 62500 × 40bits

$= \frac{62500 \times 40}{1000 \times 8}$  k bytes

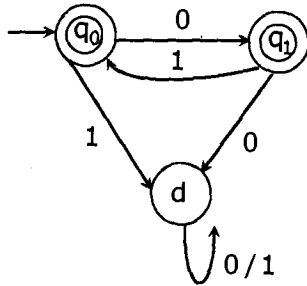
$= \frac{625}{2} = 312.5$  k bytes

51. Each sector 256 bytes + 4 bytes (control) = 260bytes

Number of sectors =  $\frac{62500}{260 \times 8} = \frac{62500}{2080} = 30.04$

52. 010101----- ; prefixes :  $\in /0/01/010/0101.....$ ; Regular expression:  $0(10)^* + (01)^*$

53. DFA is



54. Maximum possible Access =  $1000010 \text{ ns}$ ;  $\frac{65}{100} \times 1000010 = 10H + 1000010 - 1000010H$   
(All are in nano seconds) Here  $H = 0.35$

55.  $0.35 \times 20 + 0.65 \times 220 = 3.5 \times 2 + 6.5 \times 22 = 143 + 7 = 150 \text{ ns}$

56. Given number, 420 can be written as  $2^2 \times 3^1 \times 5^1 \times 7^1$   
Number of factors  $= (2+1)(1+1)(1+1)(1+1) = 24$   
Factors are 1, 2, 3, 4, 5, 6, 7, 10, 12, 14, 15, 20, 21, 25, 28, 30, 35, 42, 60, 70, 105, 140, 210, 420  
Of the above factors only 2, 7, 12 and 42 are of the form  $5n+2$

57. No error. The given sentence is in present perfect tense i.e. since---has.

59. The sentence clearly indicates the contrasting situations in the USA and in Japan. While the former is in negative state, the latter is in positive condition.

60. The Greek is 19<sup>th</sup> from the right and the super star is 4<sup>th</sup> to the right of the Greek. So, the Indian is 15<sup>th</sup> from the right end.

Thus, there are 18 runners to the left of the American; 11 runners between the American and the Indian; and 14 to the right of the Indian. So the number of runners in the row is  $= 16 + 1 + 11 + 1 + 14 = 43$ . (1-for American and 1 for Indian). I-Indian; G-Greek; A-American

\_\_\_\_\_16\_\_\_\_\_A      G ----3-----I \_\_\_\_\_14\_\_\_\_\_

\_\_\_\_\_

11

61. The others are all musical instruments; Obelisk means a tall, narrow, four-sided, tapering monument.

62. The year in which the gap between the two points is more gives the answer. By observation, gap is more in 1998

63.  $\frac{a+b}{c} = \frac{b+c}{a} = \frac{c+a}{b} = \frac{(a+b)+(b+c)+(c+a)}{c+a+b} = \frac{2(a+b+c)}{a+b+c}$

If  $a+b+c \neq 0$ , then each fraction is 2

If  $a+b+c = 0$ , then  $a+b = -c$ ,  $b+c = -a$ ,  $c+a = -b$

Now  $\frac{a+b}{c} = \frac{b+c}{a} = \frac{c+a}{b} = -1$

64.

A	B	C
800m	720m	
	1000m	800m

When A covers 800m, B covers 720m

When A covers 1000m, B covers x m (say)

$$\Rightarrow \frac{800}{1000} = \frac{720}{x} \Rightarrow x = 900\text{m} \dots (1)$$

When B covers 1000m, C covers 800m

When B covers 900m, C covers y m (say)

$$\Rightarrow \frac{1000}{900} = \frac{800}{y} \Rightarrow y = 720\text{m} \dots (2)$$

From (1) and (2)

A	B	C
1000m	900m	720m

In 1000m race, A beats C by 280m

In 500m race, A beats C by 35sec

∴ In 1000m race, A beats C by 70sec

∴ C takes 70 sec to cover 280m

$$\therefore \text{Speed of C} = \frac{280\text{m}}{70 \text{ sec}} = 4\text{m/s}$$

$$\text{Time taken by C to travel 720m} = \frac{720}{4} = 180\text{sec}$$

Time taken by B to travel 900m = 180sec

$$\therefore \text{Speed of B} = \frac{900\text{m}}{180 \text{ sec}} = 5\text{m/s}$$

65. Let the four persons be  $P_1, P_2, P_3$  and  $P_4$  and the four gifts of their corresponding colour of shirts be denoted by  $G_1, G_2, G_3$  and  $G_4$  respectively. Now  $P_1$  cannot receive  $G_1$  and as such it can be given to either of  $P_2, P_3$  or  $P_4$ . Thus  $G_1$  can be given in 3 ways under given condition.

After this has been done in any one way say  $G_1$  has been given to  $P_2$  then  $G_2, G_3, G_4$  with the given condition, (not to be given to the person of the same colour) can be given as under:

$P_2$	$P_1$	$P_3$	$P_4$
$G_1$	$G_4$	$G_2$	$G_3$
$G_1$	$G_3$	$G_4$	$G_2$
$G_1$	$G_2$	$G_4$	$G_3$

Under the above setting only, no gift will be given to person with same shirt colour.

Above gives us 3 ways corresponding to  $G_1$  being placed in  $P_2$

Hence by fundamental theorem the total number of ways of placing the balls is  $3 \times 3 = 9$ .

#### Alternate Method:

If 'n' things are arranged in a row, the number of ways in which they can, be deranged so that none of them occupies its original place is

$$n! \left( 1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \dots + (-1)^n \frac{1}{n!} \right) = \sum_{r=0}^n (-1)^r \frac{1}{r!}$$

Here  $n=4$ ,

$$\text{Hence the number of derangements} = 4! \left( 1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} \right) = 24 \left( \frac{1}{2} - \frac{1}{6} + \frac{1}{24} \right) = 9$$

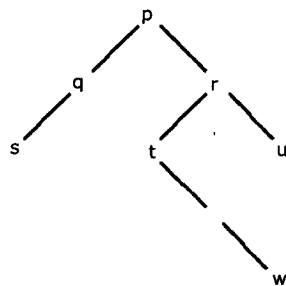


**Answer Keys**

1	C	2	B	3	D	4	C	5	A	6	B	7	A
8	D	9	D	10	A	11	C	12	B	13	C	14	D
15	C	16	C	17	C	18	A	19	B	20	D	21	B
22	C	23	B	24	C	25	C	26	A	27	B	28	B
29	B	30	A	31	D	32	B	33	B	34	C	35	A
36	A	37	C	38	C	39	C	40	B	41	C	42	B
43	B	44	C	45	A	46	A	47	D	48	D	49	B
50	C	51	D	52	B	53	B	54	A	55	A	56	A
57	A	58	A	59	C	60	C	61	C	62	C	63	D
64	C	65	B	66	C	67	B	68	B	69	B	70	C
71	C	72	D	73	D	74	C	75	B	76	C	77	B
78	A	79	B	80	A	81	B	82	B	83	C	84	D
85	C	86	B	87	A	88	A	89	B	90	A	91	B
92	D	93	D	94	B	95	C	96	C	97	B	98	C
99	C	100	C	101	C	102	B	103	A	104	A	105	C
106	D	107	D	108	C	109	B	110	A	111	B	112	C
113	B	114	A	115	C	116	C	117	D	118	D	119	A
120	C												

**Explanations:-**

4.



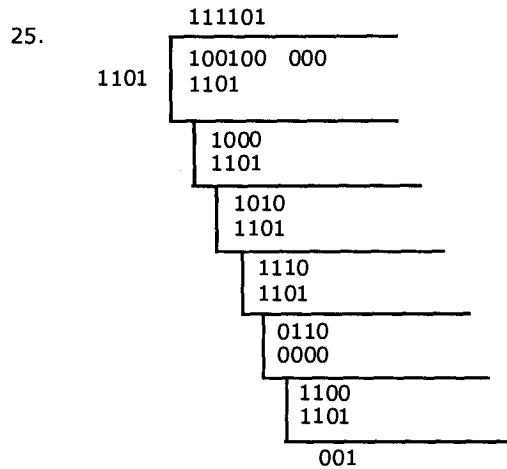
15. 11111111.11111111.11111000.00000000

Number of 0's 8. The number of hosts that can be handled by each subnet is  $2^{11}-2$ , since 0 and 1 are reserved.

22. 
$$p(x=0) = \frac{e^{-\mu} \mu^x}{x!} = \frac{e^{-1.5} 1.5^x}{0!} = 0.2231$$

23. The four children can have birthday in  $(365)^4$  ways. Since the oldest and the youngest have the same birthday, it can take place in  $365 \times 1$  ways.

$$\therefore \text{The required probability is } \frac{365 \times 1 \times 364 \times 363}{(365)^4} = .0027$$



26. 7 can be obtained in a single toss as

$\{(6,1), (5,2), (4,3), (3,4), (2,5), (1,6)\} \therefore$  in 6 ways

$\therefore$  Probability of getting 7 =  $\frac{6}{36} = \frac{1}{6}$   $\therefore$  Probability of not getting 7 =  $(1 - \frac{1}{6}) = \frac{5}{6}$

30.  $C * A = (A + B) * A = (A + B)A + (A + B)'A' = A + AB + (A'B')A'$   
 $= A + A'B' = (A + A')(A + B') = A + B'$

31. So average waiting time FIFO mode is  $\frac{0+24+27+29}{4} = \frac{80}{4} = 20\text{ms.}$

33. Logic functions are generated by 4 to 1 mux are

$$F = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C} + AB\bar{C} = \bar{A}C(B + \bar{B}) + A\bar{C}(B + \bar{B}) = \bar{A}C + A\bar{C} = A \oplus C$$

44. X: denote the number of defective items in the sample

$\therefore$  X is binomial random variable with parameters (10, .3)

$\therefore$  The required probability:

$$P(X=0) + P(X=1) + P(X=2) = \binom{10}{0}(0.3)^0(0.7)^{10} + \binom{10}{1}(0.3)^1(0.7)^9 + \binom{10}{2}(0.3)^2(0.7)^8 = .3828(\text{approx.})$$

47. In 1-d parity check we can only detect one bit error and n 2-d parity check some 4-bit errors can not be detected.

48. 23, 9, 41, 15, 30, 47, 78, 82, 94, 56

9, 23, 41, 15, 30, 47, 78, 82, 94, 56

9, 23, 15, 41, 30, 47, 78, 82, 94, 56

9, 23, 15, 30, 41, 47, 78, 82, 94, 56

9, 23, 15, 30, 41, 47, 78, 82, 56, 94

49.

		00	01	11	10
b3b2 \ b1b0	00	0	1	1	0
	01	0	1	0	0
	11	x	x	x	x
	10	0	1	x	x

55. Candidate key: B

60.  $2^{4+1} - 1 = 31$

63. 5!

64.  $(4+9)=13$  bits

65. 150ns to access the page table and 150ns to access the word in memory.

66.  $p \leftrightarrow q$  is true if two sentences p and q are both true or both false

68. L is a regular language on a set A. Then complement language of L is also regular

83.  $65,536 \Rightarrow 2^{16}$  valid address is  $2^{16} - 1$ . The limit register must have 16 bits.

84. In symmetric key cryptography, the sender and the receiver must use the same key for encryption and decryption. In asymmetric key encryption pair is used. One key is used for encryption, and the other corresponding key in the key pair is used for decryption.

87.  $P(A \cap B) = 0$ ,  $P(A \cup B) = P(A) + P(B) \Rightarrow \frac{1}{10} = 6P(A) \Rightarrow P(A) = \frac{1}{60}$

88. The logical address space =  $256 \times 2^{10} = 2^8 \times 2^{10} = 2^{18}$  : 18 bits

93. P-2, Q-1, R-3

94.  $A \rightarrow BCDE$

Prime attribute = A ← candidate key

Non prime attribute = BCDE

No partial functional dependency on key,

Hence the table is in 2NF

But in case of  $B \rightarrow C$ , neither of them are key or prime attribute.

∴ not in 3NF

95.  $T_1$        $T_2$        $T_3$
- $R(x)$
- $R(y)$
- $R(y)$
- $W(y)$
- $W(z)$
- $W(x)$
- $R(z)$
- $W(z)$
- $R(x)$
- $W(x)$

99. Initialization:  $\{A \rightarrow B, A \rightarrow C, B \rightarrow C, AB \rightarrow C\}$
- Consider  $A \rightarrow B$
- $G - \{A \rightarrow B\} = \{A \rightarrow C, B \rightarrow C, AB \rightarrow C\} = G'$ , since  $A \rightarrow B \notin G'$ ,  $A \rightarrow B$  stays
- Consider  $A \rightarrow C$
- $G - \{A \rightarrow C\} = \{A \rightarrow B, B \rightarrow C, AB \rightarrow C\} = G'$ , since  $A \rightarrow C \in G'$ ,  $A \rightarrow C$  is removed
- Hence  $G = \{A \rightarrow B, B \rightarrow C, AB \rightarrow C\}$

Consider  $B \rightarrow C$

$G - \{B \rightarrow C\} = \{A \rightarrow B, AB \rightarrow C\} = G'$ , since  $B \rightarrow C \notin G'$ ,  $B \rightarrow C$  stays

$G = \{A \rightarrow B, B \rightarrow C, AB \rightarrow C\}$

Consider  $AB \rightarrow C$

$G - \{AB \rightarrow C\} = \{A \rightarrow B, B \rightarrow C\} = G'$ , since  $AB \rightarrow C \in G'$ ,  $AB \rightarrow C$  is removed

Thus  $G = \{A \rightarrow B, B \rightarrow C\}$

101. 
$$\begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 2 \\ 2 & 2 & 0 \end{bmatrix} \xrightarrow{R_3 - 2R_1} \begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 2 \\ 0 & 2 & -4 \end{bmatrix}$$

$\downarrow (-1)R_2$

$$\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & -2 \\ 0 & 0 & 0 \end{bmatrix} \xleftarrow{R_3 - 2R_2} \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & -2 \\ 0 & 2 & -4 \end{bmatrix}$$

105. The given language cannot be a context free language as we need to store two successive infinite sequences, whereas the CFG is capable of remembering single infinite sequence.
- Hence option C is correct.

106.  $L_1 = (a+b)^* a$      $L_2 = b(a+b)^*$ ,  $L_1 \cdot L_2 = b(a+b)^* a$

108. Here the initial and the final states are one and the same.

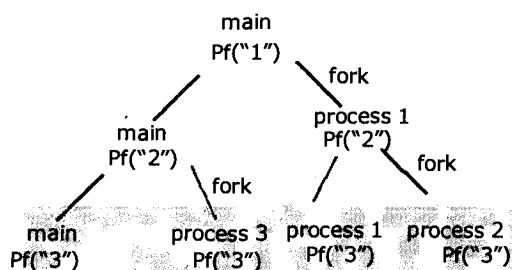
If you carefully examine the transition diagram, to move right you have to consume a 'b'. Whenever we have right, we have to move left at some stage or the other, to get back to the initial -constant final state. This implies a 'b' essentially has an associated another 'b'. Same is the case with 'a' (sin a any up/down) has a corresponding down (up).). So Every number of a's and b's has to be present.

115.

CD \ AB	00	01	11	10
00	0	x	1	0
01	x	1	0	1
11	1	1	0	x
10	0	1	1	0

118. 3600rpm  $\Rightarrow$  each rotation takes  $0.01666s = 16.66msec$ , average latency =  $\frac{1}{2}$  rotation time = 8.33msec

119.



120.

$$(x_{k+1}) = x_k - \frac{f(x_k)}{f'(x_k)} = x_k - \frac{x_k^2 - b}{2x_k} = \frac{x_k^2 + b}{2x_k}$$