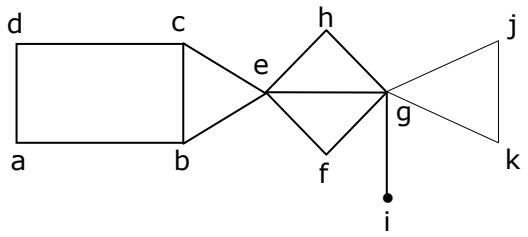
Q. No. 1 – 25 Carry One Mark Each

1. Consider the following graph:



The circuit rank of the above graph is _____

2. If X is a binomial random variable, then find the value of $\sum_{x=0}^{n} \frac{x}{n}\binom{n}{x}.p^x.q^{n-x}$

(A) $p^{nc_2}q^{\binom{n}{2}c_2}$ (B) p (C) q (D) $p^n q^{\frac{n}{2}}$

3. Let p, q and r denote the primitive statements. Find the contra-positive form of $p \to (q \to r)$ with no occurrence of the connective '→'

(A) $(\neg q \vee r) \wedge \neg p$ (B) $(\neg q \vee r) \vee \neg p$

(C) $(\neg p \vee r) \wedge \neg q$ (D) $(\neg p \wedge r) \vee \neg q$

4. In a gigabit LAN, assume that the frame size is 64 bytes. The maximum number of frames transmitted on a single line for 1ms is _____

5. Three processes which require CPU burst time 6, 2 and 3 time units respectively. All three processes arrive at time 0. If operating system uses RR_1 (Round Robing with time quantum 1 time unit) scheduling algorithm, then the number of context switches needed is(do not count context switches at time zero and at the end)_____

6. For the function given below, the minimized POS expression is

F (A, B, C) = Σ m (3) + Σ d (1, 2, 4)

(A) $\bar{A}B$ (B) B C (C) $\bar{A}\bar{C}$ (D) $\bar{A}$

7. There are two transactions, T_1 with 2 instructions and T_2 with 5 instructions. Find number of serial and concurrent schedules respectively.

(A) 2, 2 (B) 21, 21 (C) 2, 21 (D) 21, 2

8. Which of the following statements are true about recoverable and cascade less schedules?

(P) All cascadeless schedules are also recoverable schedules.

(Q) All recoverable schedules are also cascadeless schedules.

(R) All strict schedules are cascadeless and recoverable.

(S)All cascadeless and recoverable schedules are strict schedules.

(A) P and R are correct (B) P and S are correct

(C) P, R and S are correct (D) P, Q and S are correct

9. A is sending packets to B through a link using sliding window protocol. Both sender and receiver window size is 4 packets each. Size of every packet is 2000 Byte. If the data transmission time is 50 μs and throughput of the channel is 10^7 Bps, then the propagation delay in μs is _____

10. In a leaky bucket system if the output rate is 5 kB/S and input burst of 50 kB/S for 10 sec and 10 kB/S for 50 sec then the bucket size in kB is____

11. A full binary tree is a tree in which every node other than the leaves has two children. A perfect binary tree is a full binary tree in which all leaves have the same depth or same level, and in which every parent has two children. If a perfect binary tree has total n nodes, then number of internal nodes in that tree is

(A) $\left\lfloor \frac{n}{2} \right\rfloor$ (B) $\left\lceil \frac{n+1}{2} \right\rceil$ (C) $\left\lceil \frac{n}{2} \right\rceil$ (D) None of these

12. What is the value returned by function (5)?

```
int function(int n)
{
        if (n-1)
                return 2*function (n-1)+n;
        else
                return 0;
}
```

(A) 33 (B) 41 (C) 57 (D) 65

13. What is the average time complexity of finding the max element from a binary min-heap of size n?

(A) Θ (lgn) (B) Θ (n.lgn) (C) Θ (n^2) (D) Θ (n)

14. Consider an organic model software project having an estimated size of 64 KDSI. Following table shows the values of coefficients for three project types.

project Type → / coefficient ↓	Organic	Semi Detached	Embedded
a_b	2.4	2.8	3.2
b_b	1.05	1.12	1.2
c_b	2.5	2.5	2.5
d_b	0.38	0.35	0.32

Find out the cost in Person Month (PM) for organic software.

(A) 189 (B) 95 (C) 148 (D) 98

15. Consider the grammar with the following translation rules and S as the start symbol.

$S \to S_1 \# T \quad \{S.val = S_1.val \times T.val\}$

$S \to T \quad \{S.val = T.val\}$

$T \to T_1 \& F \quad \{T.val = T_1.val + F.val\}$

$T \to F \quad \{T.val = F.val\}$

$F \to num \quad \{F.val = num.lexval\}$

If the input string w= 5 # 2 & 3 # 7 & 1 then the value of S.val is _____

16. Which of the following languages is regular?

1. $L = \{bba(ba)^n a^{n-1} | n > 0\}$
2. $L = \{a^n b^n | n < 1000\}$
3. $L = \{a^n b^k | n \text{ is odd or } k \text{ is even}\}$
4. $L = \{wxw^R \mid w, x \in (0+1)^+\}$

(A) 1, 3 and 4 (B) 2, 3, 4 (C) 2, 3 (D) 1, 2, 3, 4

17. Which of the following is FALSE?

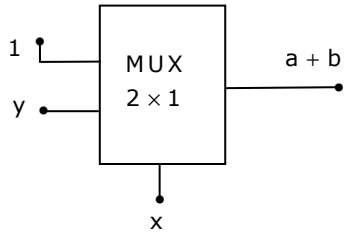
(A) $(R+S)^* S = (R^* S)^*$ (B) $(R+S)^* = (R^* + S^*)^*$

(C) $(\in + R)^* = R^*$ (D) $(R+S)T = RT + ST$

18. A program X calls three subprograms m_1, m_2, m_3. The failure probabilities of m_1, m_2, m_3 are 0.5, 0.6 and 0.4 respectively. what is the probability that X can fail?

(A) 0.76 (B) 0.88 (C) 0.82 (D) 0.12

19. What should be the values of x and y in the following MUX to produce the output given?



(A) $x = a, y = \bar{b}$ (B) $x = a, y = b$ (C) $x = \bar{a}, y = \bar{b}$ (D) $x = \bar{a}, y = b$

20. Which of the following is correct?

$F(x, y, z) = y + x.\bar{y}$

(A) $F(x, y, z) = \sum m(2, 3, 6, 7)$ (B) $F(x, y, z) = \sum m(2, 3, 4, 6, 7)$

(C) $F(x, y, z) = \sum m(2, 4, 5, 6, 7)$ (D) $F(x, y, z) = \sum m(2, 3, 4, 5, 6, 7)$

21. Which of the following multiple pattern is exactly divisible by 1111 1111 1011? Let 2's complement notation is used for representing the number.

(A) 1111 111 0000 (B) 1111 111 0010

(C) 10001 (D) 1011 0000 01

22. The requirement of memory specification is as follows:-

Size of address bus is 20 bits and size of data bus is 8 bits, available chip specification is 64 k×4.The number of memory chips required for the above memory configuration is _____

23. Which of the following grammar accepts all string with substring "01"? (consider S as the starting symbol)

(A) $S \to 0S / 1A$
$A \to 0A / 1B$
$B \to 0B / 1B / \varepsilon$

(B) $S \to 1S / 0A$
$A \to 1A / 0B$
$B \to 0B / 1B / \in$

(C) $S \to 1S / 0A$
$A \to 0A / 1B$
$B \to 0B / 1B / \in$

(D) $S \to 0S / 1A$
$A \to 0A / 1B / \in$
$B \to 0B / 1A$

24. The matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ is decomposed into product of a lower triangular matrix L and an upper triangular matrix U. The properly decomposed L and U matrices respectively are

(A) $\begin{bmatrix} 1 & 0 \\ 3 & 4 \end{bmatrix}, \begin{bmatrix} 1 & 0.5 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 \\ 3 & -2 \end{bmatrix}, \begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 \\ -3 & 2 \end{bmatrix}, \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 0 \\ 3 & -2 \end{bmatrix}, \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$

25. For a random variable X, if $V(x) = 6$, then $V(2x + 3) =$

(A) 12 (B) 24 (C) 15 (D) 13

Q. No. 26 – 51 Carry Two Marks Each

26. Consider a main memory of 2 million words and cache memory of 32 kb. Both are partitioned into 1k word blocks. The word size is 16 bits. Number of address bits required for byte addressable physical memory and number of blocks in main memory are respectively

(A) 21, 2048 (B) 22, 2048 (C) 24, 2048 (D) 24, 1024

27. A hard disk is connected to a 2 GHZ processor through a DMA controller which works in burst mode. Assume that the initial set up of a DMA transfer takes 1000 clock cycles for the processor and DMA completion requires 700 clock cycles for the processor. The hard disk has a transfer rate of 4000 KB / sec and the average block size transferred is 16KB.What fraction of the CPU time is free if the disk is transferring data?

(A) 50% (B) 0.03% (C) 95% (D) 99.97%

28. Consider a disk system with 120 cylinders .The request to access the cylinder occur in the sequence "92, 11, 42, 81, 54, 30, 67, 89".Assume that the head is currently at cylinder 40.

The total number of cylinders traversed throughout serving the above request using SSTF algorithm is _____

29. Consider the following snapshot of a system at a particular point of time:

Process	Arrival time	CPU burst (in ms)
P_1	0	5
P_2	1	1
P_3	2	2
P_4	3	3

The average response time (in ms) using FCFS scheduling is _____

30. Find the minimum and maximum number of nodes in B-Tree of order 5 of height 4. (Assume root is at level '0')

(A) 81,781 (B) 162,3124 (C) 41,156 (D) 243,1555

31. Consider the following 2 tables

R_1

A	B	C
1	2	3
1	2	4
2	1	3
3	1	3

R_2

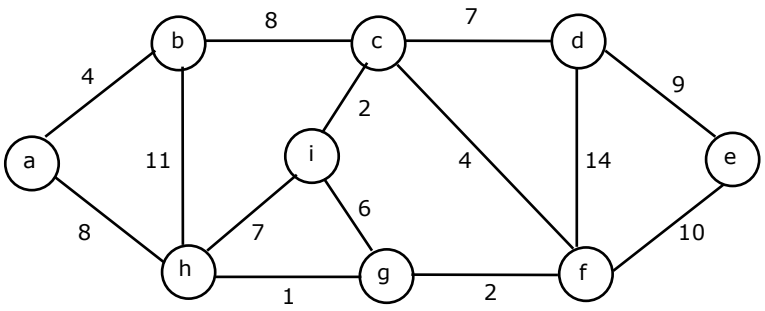
A	B	D
1	2	1
2	1	5
4	2	1
3	2	1

The number of null entries in the table

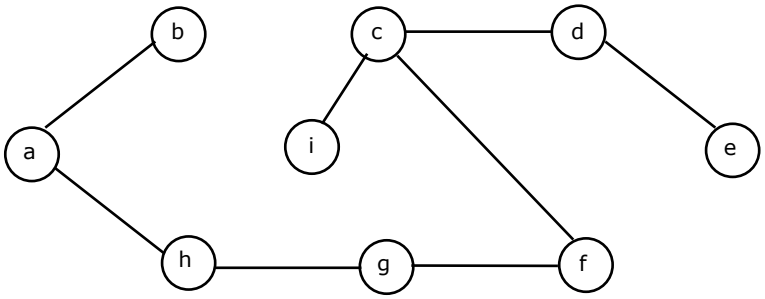
R_1 ⟗ R_2 (R_1 natural full outer join R_2) is

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

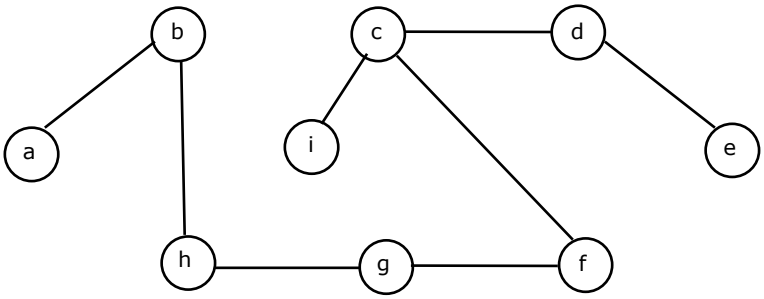
32. What is the minimum weight spanning tree for the following graph using Kruskal's algorithm?



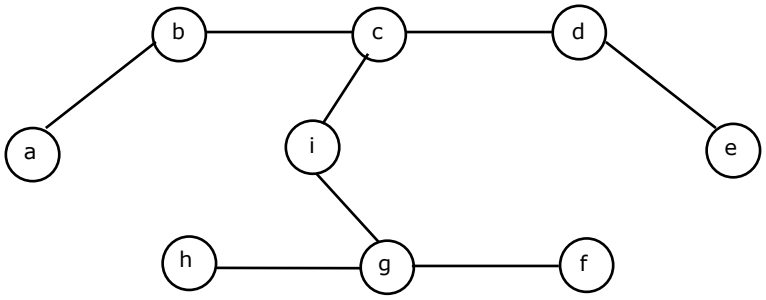
(A)



(B)



(C)



(D) None of these

33. Find total profit in the following 0/1 knapsack problem. Maximum carriable weight is 5 units. (Assume unlimited quantities of items are allowed)

Weight:	2	3	1	5
Profit :	64	81	30	25

(A) 158 (B) 145 (C) 141 (D) 150

34. Consider the following hashing scheme. Our hash function is H_1=k mod 20. When collision occurs, we repeatedly compute H_{n+1}=(H_n+4) mod 20 until collision resolves and following keys are inserted into the hash table

45, 25,10,5,9,30

The number of collisions occurred is _____

35. The time complexity of the following algorithm T(n), where n is the input size

T(n) = 1 if n <= 4

T(n) = 2 T(√n) + logn if n > 4

(A) Θ (log n) (B) Θ (n)

(C) Θ (log n)^2 (D) Θ (log n log log n)

36. There are two stations A and B connected by a 1 mbps link. The distance between A and B is 45000 km and the propagation speed is 2x10^8 m/s. If packets of size 150B are sent from A to B using Go back 127 sliding window protocol, then what will be the maximum utilization of the link ?(Ignore transmission delay)

(A) 11.4% (B) 33.87% (C) 42.56% (D) 67.73%

37. Which one of the following is/are TRUE about digital signature?

(A) Sender encrypts the data using receiver's public key for producing a digital signature

(B) Receiver decrypts using sender's public key for verification of digital signature

(C) Sender encrypts using sender's private key for producing a digital signature

(D) Both (B) and (C)

38. What is the maximum number of subnets and hosts per subnet in class C using the mask 255.255.255.0?

(A) 0, 254 (B) 1, 256 (C) 256, 254 (D) 1, 254

39. Three address code for block of a program is given as follows:

$j = s$
$x = a + j$
$i = 20$
$y = j + m$
$z = i + j$

Which of the following code is its equivalent code after applying copy propagation transformation?

(A)
$x = a + s$
$i = 20$
$y = s + m$
$z = i + j$

(B)
$j = s$
$x = a + s$
$i = 20$
$y = j + m$
$z = i + j$

(C)
$j = s$
$x = a + s$
$i = 20$
$y = j + m$
$z = i + s$

(D)
$x = a + s$
$i = 20$
$y = s + m$
$z = i + s$

40. The regular expression $(1+01)^*(0+\lambda)$ denotes the language which contains

(A) set of all strings not containing '11'
(B) set of all strings not containing '01'
(C) set of all strings not containing '00'
(D) set of all strings not containing '0'

41. The language generated by the given grammar is

$S \rightarrow aAb$
$A \rightarrow aAb / B$
$B \rightarrow CC$
$C \rightarrow bDa$
$D \rightarrow bDa / \varepsilon$

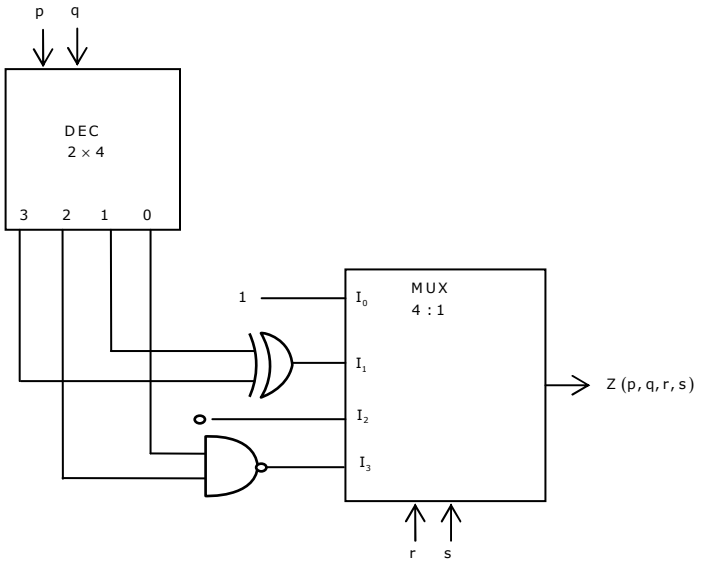
(A) $\{a^m b^n a^n b^p a^p b^m \mid m,n,p > 0\}$ (B) $\{a^m b^n a^p b^p a^n b^m \mid m,n,p > 0\}$

(C) $\{a^m b^m a^n b^n a^p b^p \mid m,n,p > 0\}$ (D) $\{a^m b^n a^m b^n a^m b^n \mid m,n, > 0\}$

42. Find the number of possible finite automaton with two states q_0 and q_1, where q_0 is always initial state over the alphabet {a, b} which accept empty language.

(A) 4 (B) 8 (C) 16 (D) 20

43. The output Z of the following circuit is



(A) $\sum m(0,4,5,7,8,11,12,13)$ (B) $\sum m(0,3,4,5,7,8,11,12,13)$

(C) $\sum m(0,3,4,5,7,8,11,12)$ (D) $\sum m(0,3,4,5,7,8,11,12,13,15)$

44. Consider the set of relations for the given SQL query:
EMP(eno, ename)
DEPT(dno,dname)
WORKS_IN(eno,dno)
Where primary keys of the relations are underlined and (eno,dno) of WORKS_IN are foreign keys referring to EMP(eno) and DEPT(dno).

```
SELECT      eno
FROM        WORKS_IN
GROUP BY    eno
HAVING      count (*) = (SELECT count(dno)
                FROM dept);
```

The above SQL query returns
(A) The eno's of employees working in at least one department
(B) The eno's of employees working in all departments
(C) The eno's of employees working in 2 (or) more departments
(D) The eno's of employees not working in any department

45. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$ then $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=$

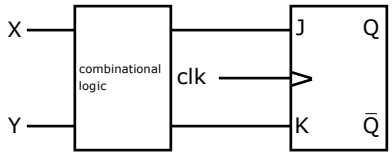
(A) 0 (B) ∞ (C) 1 (D) sin 2u

46. Consider the pair of numbers $(x_1,y_1),(x_2,y_2)$..... and so on, each x_i & y_i is a natural number. Then what should be the least number of such pairs required, so that we have some pairs (at least 2 pairs) that satisfy $(x_m - x_n)$ divisible by 7 and $(y_m - y_n)$ is divisible by 3?

(A) 8 (B) 22 (C) 21 (D) 10

47. The following truth table has to be realized with the circuit shown in the figure

X	Y	Q_{n+1}
0	0	$\bar{Q}_n$
0	1	1
1	0	Q_n
1	1	0

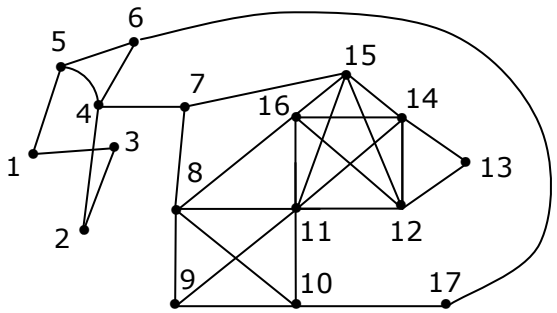


What is the output of the combinational logic circuit to the K input?

(A) XY (B) $\overline{XY}$ (C) $X \oplus Y$ (D) $\overline{X \oplus Y}$

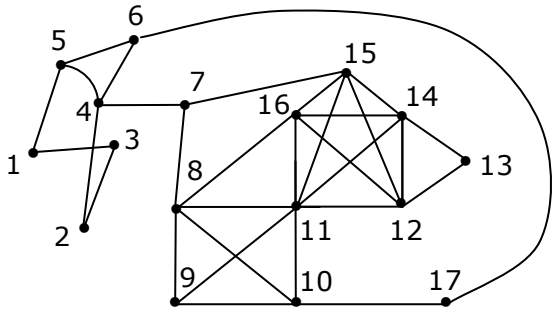
Common Data Questions: 48 & 49

Consider the following Graph:



48. The clique number W(G) of the above graph is _____

Consider the following Graph:



49. The number of vertices in the line graph of the maximum clique is___

Common Data Questions: 50 & 51

Let A[1…n] be an array of n distinct numbers. If i<j and A[i]> A[j] then the pair (i, j) is called an inversion of A

50. The maximum number of inversions in array of size n is

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

Let A[1…n] be an array of n distinct numbers. If i<j and A[i]> A[j] then the pair (i, j) is called an inversion of A

51. The running time of an efficient algorithm that counts the number of inversions on any permutations of A is___

(A) $\theta(n.\log n)$ (B) $\theta(n^2)$ (C) $\theta(n)$ (D) $\theta(\log n)$

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

Statement for Linked Answer Questions: 52 & 53

Consider the following snapshot of a system:

Process	Allocation	Max	Available
P_1	0 2 1 4	1 2 1 4	X Y 2 0
P_2	1 3 5 4	1 6 5 5	
P_3	2 0 6 4	3 0 6 4	
P_4	0 6 3 2	0 6 5 2	
P_5	1 0 1 4	2 0 1 5	

52. What is the minimum value of X and Y for which there exists a safe sequence?

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

Consider the following snapshot of a system:

Process	Allocation	Max	Available
P_1	0 2 1 4	1 2 1 4	X Y 2 0
P_2	1 3 5 4	1 6 5 5	
P_3	2 0 6 4	3 0 6 4	
P_4	0 6 3 2	0 6 5 2	
P_5	1 0 1 4	2 0 1 5	

53. By considering the above correct values of X and Y, which of the following is true?

(A) The system is in unsafe state (B) The number of safe sequences is 6

(C)The number of safe sequences is 9 (D) The number of safe sequences is 27

Statement for Linked Answer Questions: 54 & 55

Consider the disk drive with the following specification:-

16 surfaces, 1024 tracks/surface, 1024 sectors/track, 1KB/sector, rotation speed is 3000 rpm and the disk is operated in burst Mode. The processor runs at 600 MHZ and takes 300 & 900 clock cycle to initiate & complete DMA transfer respectively, if the size of transferred data is 20KB.

54. What is the size of hard disk?

(A) 16 GB (B) 8 GB (C) 16 MB (D) 8 MB

Consider the disk drive with the following specification:-

16 surfaces, 1024 tracks/surface, 1024 sectors/track, 1KB/sector, rotation speed is 3000 rpm and the disk is operated in burst Mode. The processor runs at 600 MHZ and takes 300 & 900 clock cycle to initiate & complete DMA transfer respectively, if the size of transferred data is 20KB.

55. What is the percentage of processor time consumed for the transfer operation?
(A) 0.49% (B) 17.77% (C) 97% (D)10%

Q. No. 56 – 60 Carry One Mark Each

Choose the appropriate order of the jumbled sentences given below.

56. and recognize / all of us must / the machine tool industry / in the Country/
[1] [2] [3] [4]
strategic and vital / have a deep introspection / the fact that /
[5] [6] [7]
has a very special place / from the point / interests of the nation.
[8] [9] [10]
(A) 2,4,7,8,6,9,1,10,3,5 (B) 2,6,5,8,4,3,1,7,10,9
(C) 2,3,8,9,6,7,10,4,1,5 (D) 2,6,1,7,3,8,4,9,5,10

Find the proper meaning of the word given in bold letters.

57. The company can't expect me to move my house at the **drop of a hat.**
(A) Hesitatingly (B) Abnormally (C) Immediately (D) Lately

Choose the appropriate word which gives the meaning of the sentences given:

58. A critical situation in which no progress can be made:
(A) Hullabaloo (B) Aggression (C) Histrionic (D) impasse

Fill in the blanks:

59. _____ was devastated
(A) Towns after Towns (B) Town after Towns
(C) Towns after Town (D) Town after Town

60. The difference of 2 numbers is 4245. On dividing the larger number by the smaller, we get 8 as quotient and the 45 as remainder. What is the smaller number?
(A) 700 (B) 600 (C) 240 (D) 500

Q. No. 61 – 65 Carry Two Marks Each

61. There was once a newspaper vendor who had a rude customer. Every morning the customer throw the money at the vendor. The vendor would pick up the money, smile politely and say, "Thank you sir". The vendor's assistant asked him "why are you always polite with him when he is so rude to you". The vendor replied "He can't help being rude and I can't help being polite".

YEAR	MANAGERS		TECHNICIANS	
	New	Left	New	Left
1995	760	-	1200	-
1996	280	120	272	120
1997	179	92	240	128
1998	148	88	236	96
1999	160	72	256	100
2000	193	96	288	112

What is vendor's conclusion?

(A) Strive for excellence (B) Work is worship

(C) Rebels do not realize (D) Keep faith in our own ideas

62. Anshu can lay railway track between two stations in 16 days and satish can do the same job in 20 days. With the help of Gulshan they did the job is 5 days only. Then Gulshan alone can do the job in _____ days?

(A) $10\frac{3}{7}$ (B) $11\frac{3}{7}$ (C) $7\frac{5}{11}$ (D) $14\frac{5}{11}$

63. In a group of 6 boys and 4 girls, 4 children are to be selected. In how many different ways they can be selected such that atleast 2 boys are there?

(A) 100 (B) 205 (C) 185 (D) 211

64. In a class of 120 students number 1 to 120, all even numbered students opt for physics, number divisible by 5 opt for chemistry & no divisible by 7 opt for maths. How many opt for none of three subjects?

(A) 40 (B) 35 (C) 69 (D) 41

65. Following tables shows that the number of employees added to different categories of employees in a company & also the number of employees from these who *left the company every year since foundation of company in 1995.*

What is the ratio between total number of technicians added to the company to total number of managers added to the company during the years 1996 to 2000?

(A) 313 : 240 (B) 423 : 240 (C) 323 : 240 (D) None of these