THE GATE ACADEMY
A Forum of IIT / IISc Graduates

GATE-2019
Full Length Test
Computer Science and Information Technology

Name: …….. Test ID: **CS-FLT-2019**

Duration: 3 hours Maximum marks : 100

Please read the following instructions carefully

General Instructions

1. Total duration of examination is 180 minutes (3 hours).
2. The clock will be set at the server. The countdown timer in the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You will not be required to end or submit your examination.
3. The Question Palette displayed on the right side of screen will show the status of each question using one of the following:
   a. You have not visited the question yet.
   b. You have not answered the question.
   c. You have answered the question.
   d. You have NOT answered the question, but have marked the question for review.
   e. You have answered the question, but marked it for review.

   The **Marked for Review** status for a question simply indicates that you would like to look at that question again. If a question is answered and **Marked for Review**, your answer for that question will be considered in the evaluation.

Navigating to a Question

4. To answer a question, do the following:
   a. Click on the question number in the Question Palette to go to that question directly.
   b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices namely A, B, C, D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
   c. Click on **Save and Next** to save your answer for the current question and then go to the next question.
   d. Click on **Mark for Review and Next** to save your answer for the current question, and also mark it for review, and then go to the next question.
   e. **Caution**: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on its question number without saving the answer to the previous questions.
   f. You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question

5. Procedure for answering a multiple choice (MCQ) type question:
   a. To select your answer, click on the bubble button of one of the options
   b. To deselect your chosen answer, click on the bubble button of the chosen option again or click on the clear response button
   c. To change your chosen answer, click on the bubble button of another option
   d. To save your answer, you MUST click on the **Save and Next button.**
   e. To mark the question for review, click on the **Mark for Review and Next** button. If an answer is selected for a question that is Marked for Review, that answer will be considered in the evaluation.

6. **Procedure for answering a numerical answer type question:**
   a. To enter a number as your answer, use the virtual numerical keypad
   b. A fraction (eg. −0.3 or −.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or − 932.6711 or 12.82 can be entered.
   c. To clear your answer, click on the Clear Response button
   d. To save your answer, you MUST click on the **Save and Next** button
   e. To mark a question for review, click on the **Mark for Review and Next button.** If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is Marked for Review, that answer will be considered in the evaluation.
7. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
8. Note that ONLY Questions for which answers are saved or marked for review after answering will be considered for evaluation.

Paper Specific Instructions:

9. There are a total of 65 questions carrying 100 marks. Questions are of multiple choice type or numerical answer type. A multiple choice type question will have four choices for the answer with only one correct choice. For numerical answer type questions, the answer is a number and no choices will be given. A number as the answer should be entered using the virtual keyboard on the monitor.
10. Questions Q.1 – Q.25 carry 1mark each. Questions Q.26 – Q.55 carry 2marks each.
11. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1mark each, and questions Q.61 – Q.65 carry 2marks each.
12. Questions not attempted will result in zero mark. Wrong answers for multiple choice type questions will result in NEGATIVE marks. For all 1 mark questions, ⅓ mark will be deducted for each wrong answer. For all 2 marks questions, ⅔ mark will be deducted for each wrong answer. There is no negative marking for questions of numerical answer type.
13. Physical calculator is NOT allowed. All candidates will be provided with an online scientific calculator which has to be used to answer the questions.

Full Length Test
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Q.1 - Q.25 Carry One Mark each.

1. What would be the minimum length of cable _____ [in km] for Ethernet with bandwidth of 1 Gbps, frame of size 5000 Bytes and speed of signal being $\times 10^8$ mts/sec ?

2. Match the following

I. DNS	A. To send E-Mail
II. FTP	B. To access E-Mail form Mail Box
III. HTTP	C. To upload files to remote server
IV. SMTP	D. To access data on World Wide Web
V. POP	E. To find the IP address of Email recipient

(A) I-E, II-C, III-D, IV-B, V-A
(B) I-E, II-C, III-D, IV-A, V-B
(C) I-C, II-E, III-D, IV-B, V-A
(D) I-C, II-E, III-D, IV-A, V-B

3. A relation R(ABCD) with FD's {A → B, A → C, BC → D}. Answer the following:-
What is the highest normal form of this relation?
Does this relation have any redundancy in it?
(A) 3NF, NO
(B) 2NF, NO
(C) 3NF, YES
(D) 2NF, YES

4. Consider a system with two users; user 1 has four processes A, B, C and D and user 2 has only one process E. If user 1 is entitled to twice as much CPU time as user 2 and if round robin scheduling is used then the completion time of process D [in nsec] for the following scenarios is _____ [nsec]

Process	Burst time [in nsec]
A	2
B	3
C	2
D	4
E	5

Time quantum q = 1 ns

5. Consider a Grammar as given below
A → A{B}|B
B → {A}B|a|b| ∈
Now consider a string w ∈ L(G) where w = {a}{a}{ }b.
If the grammar G is ambiguous then write 1 otherwise 0. What is the output?
(A) 0
(B) 1
(C) 2
(D) 3

6. Which one of the following is not the property of NP-complete family of problems?
   (A) If a fast algorithm could be found for one NP-complete problem then here would be fast algorithms for all of them
   (B) If it could be proved that no fast algorithm exists for one of the NP-complete problems, then there could not be a fast algorithm for any other of those problems.
   (C) It has not proved that polynomial time algorithms for these problems do not exist
   (D) None of these

7. Consider the following code for Tower of Hanoi Problem

```
void TOH (int n, int A, int B, int C)
{
   if(n > 0)
   {
      TOH(n − 1, A, C, B);
      move directly A → C;
      TOH (n − 1, B, A, C);
   }
   else
   move directly A → B;
}
```

   For n = 4, after how many function calls (including the initial call), the first move will take place?

8. The memory locations 1000, 1100 and 1200 have data values 10, 20 and 30 respectively. Further, the initial value of R_1 and R_2 registers are 1000 and 0 respectively. Consider the following sequence of two address instructions
   Add R_1, #100; Immediate addressing
   Add R_2, 100(R_1); Displacement addressing
   Add R_2, (1000); Direct addressing
   The value of R_2 after executing above sequence of instructions is _____

9. The minimised expression for the given K-map is (X: don't care)

CD \ AB	00	01	11	10
00		1	1	
01		1	X	
11	1	1	X	X
10	1		X	X

   (A) $\bar{C}B + BD + CD$
   (B) $AB + C\bar{B} + B\bar{C}$
   (C) $C\bar{B} + AC + B\bar{C}$
   (D) $\bar{C}B + CD + C\bar{B}$

10. Let P, Q, R, S be m × m matrices each with non-zero determinant
If PQRS = I, then R^{-1} is
(A) SPQ
(B) $Q^{-1}\ P^{-1}\ S^{-1}$
(C) PQS
(D) $S^{-1}P^{-1}Q^{-1}$

11. Green's theorem is used to convert
(A) Line integral to surface integral
(B) Surface integral to volume integral
(C) Line integral to volume integral
(D) None of these

12. The number of ways to distribute 4 similar books to 5 persons is _____

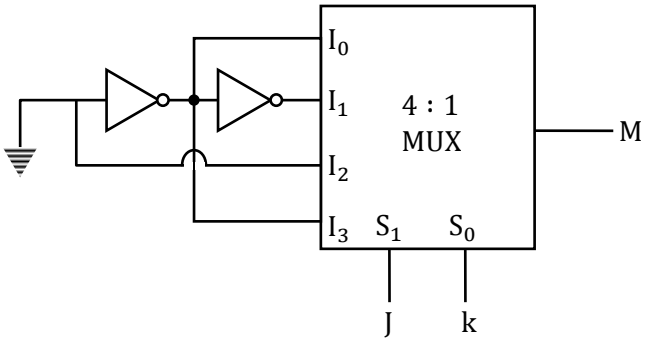
13. A non-directed simple graph contains 32 edges and all vertices of degree 2. Then the number of vertex in graph G is _____

14. Each student in arts at some college has a mathematical requirement A and a science requirement B. A poll of 140 students shows that 60 completed A, 45 completed B and 20 completed both A and B. The number of students who have neither completed A nor B is _____

15. For the matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ one of the Eigenvalue is 5 and the corresponding Eigenvector is $\begin{pmatrix} -1 \\ -2 \\ 1 \end{pmatrix}$ then one of Eigenvector of A^4 is
(A) $\begin{bmatrix} -1 \\ -2 \\ 1 \end{bmatrix}$
(B) $\begin{bmatrix} 1 \\ 16 \\ 1 \end{bmatrix}$
(C) $\begin{bmatrix} -4 \\ -8 \\ 4 \end{bmatrix}$
(D) $\begin{bmatrix} -1/4 \\ -1/2 \\ 1/4 \end{bmatrix}$

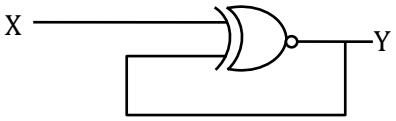
16. Consider the function $y = x^2 - 6x + 9$. The maximum value of y obtained when x varies over the interval 2 to 5 will be at _____

17. The logic function implemented by the circuit below is (ground implies a logic '1')



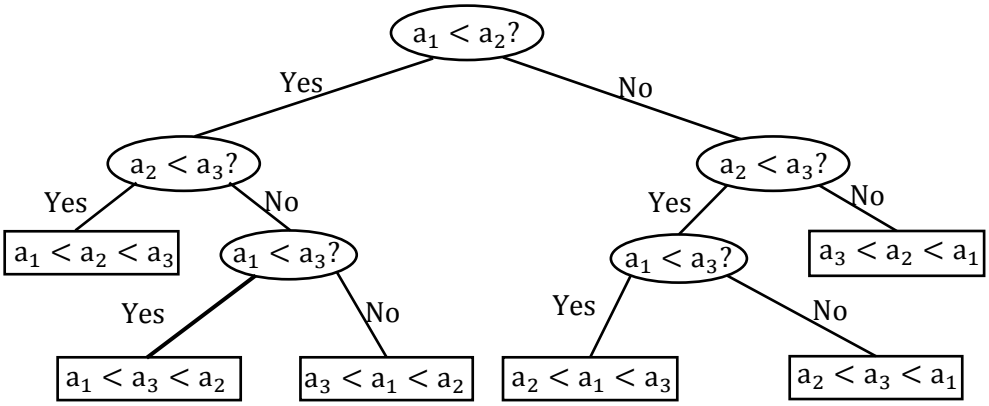
(A) M = AND (J, K)
(B) M = OR (J, K)
(C) M = X NOR (J, K)
(D) M = XOR (J, K)

18. The output 'y' after 15th clock is



(A) 1
(B) 0
(C) X
(D) $\overline{X}$

19. Given a decision Tree T for sorting n = 3 items



The average external path length $\overline{E}$ of the tree T is _____

20. Suppose a hash table has m slots and n total keys and collisions are resolved by chaining. Suppose X is a ratio of m and n i.e. X=m/n . Then an successful search, under the assumption of simple uniform hashing, takes average-case time.

(A) $\theta(1 + X)$
(B) $\theta(n * n)$
(C) $\theta(n * m)$
(D) None of these

21. Given a regular language over $\Sigma = (0, 1)$, which contains the set of strings in which every '0' is immediately followed by at least two 1's. Then regular expression corresponding to the language is

(A) $(1 + 011)^*$
(B) $0(11 + 1011 + 011)^*$
(C) $(0 + 1011)^*$
(D) $(101 + 011 + 11)^*$

22. Consider the following grammar

S → EFG
E → e|Gh|E
F → F|iE|E
G → g|j

Where S, E, F and G are non-terminals. Determine the number of elements in the set first (S) ∩ follow (E)

(A) 0
(B) 2
(C) 3
(D) 4

23. Given following segment table for a segmented memory system:

	Limit	Base
0	500	6200
1	400	3300
2	500	5800
3	1150	7100

The mapping address for a reference of 313 byte in segment 1 is _____

24. Evaluate

$$S = \sum_{r=0}^{n-1} \frac{1}{\sqrt{4n^2 - r^2}} \text{ as } n \to \infty$$

(A) $\pi/6$
(B) $\pi/3$
(C) $\pi/2$
(D) π

25. The initial window size and threshold at the beginning of slow-start phase in TCP congestion control algorithm are 4MSS and 16MSS. Assume a time out occurs after fifth transmission. What would the size of congestion window after eight transmission _____ [in MSS]

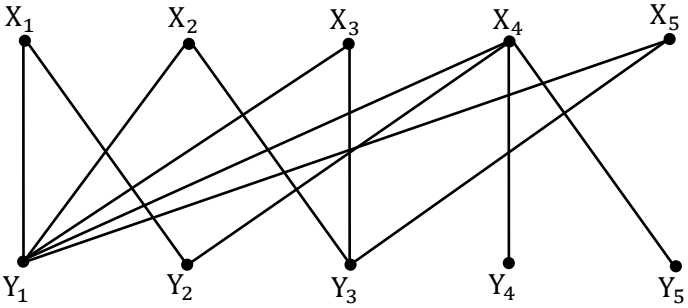
Q.26 - Q.55 Carry Two Mark each.

26. Consider two systems A and B belong to different networks with IP address 192.168.1.140 and 192.168.1.226 are connected using a 2-Port Router with Port:1 IP address as 192.168.1.246 and Port:2 IP address as 192.168.1.156. To which Port of a Router, system "A" should be connected to if subnet mask of the network is 255.255.255.224.

(A) Port:1
(B) Port:2
(C) Either Port:1 (or) Port:2
(D) Neither Port:1 (nor) Port:2

27. Consider a disk with a mean seek time of 8 msec, a rotational rate of 15000 rpm and 2, 62, 144 bytes per track. The data rate for block size of 2 KB is _____ [in KB/sec]

28. Consider the following graph:

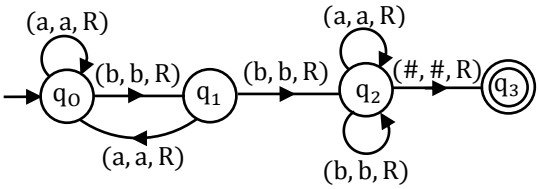


The size of minimum vertex cover and maximum matching are respectively,

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

29. Consider the following grammar
S → ABCDE
A → a |∈
B → b |∈
C → c
D → d |∈
E → e |∈
Find first (S)
(A) {a, b, c}
(B) {a}
(C) {a, b, c, ∈}
(D) {a, b, c, d, e, ∈}

30. Given a state diagram of a TM as follow



Note: R means right side movement.
means blank symbol
The minimum number of b's in a string accepted by the above TM is _____

31. If costs of sorting a routing information is 32-bits in a 100–node network and this information is exchanged 6 times in a minute, with each router has 3–lines to other routers, then how much band width is consumed in the exchange on every link?
(Assume those links are bidirectional)
(A) 320 bps
(B) 640 bps
(C) 1920 bps
(D) 960 bps

32. Following arithmetic expression is given in Infix notation
$5 * (6 + 2) - 12/4$
For the given expression if postfix natation is evaluated using STACK; how many POP operations will be needed to obtain the final result into given variable?

33. Consider an instruction pipeline with 4 stages with combinational delays of 1ns, 2ns, 4ns and 3ns. The pipeline register is required after each stage, which has delay of 1 ns. Under the steady condition the speedup of pipelined implementation compared to the non-pipelined implementation is _____

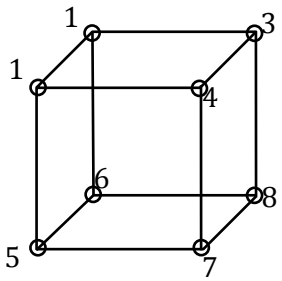
34. You have given a mathematical expression
$8 + 9 * 3 * 2/6 - 5$
In the evaluation of postfix notation of this expression using stack, what will be the top of the stack after 8 push and 6 pop operations

35. A 16 KB, 4-way set associative cache is organized with blocks of size 256B. The processor generates 32-bit address. The cache maintains valid and modified bit with every block. The total size of memory needed to store meta-data for the cache in bits is _____

36. Which of the following statement is NOT equivalent to the statement "There exists either a computer scientist or a mathematician who knows both discrete math and Java"
    (A) There exist a person who is a computer scientist and who knows both discrete math and Java or there exists a person who is a mathematician and who knows both discrete math and Java.
    (B) There exists a person who is a computer scientist or there exists a person who is a mathematician, who knows discrete math or who knows Java.
    (C) There exists a person who is a computer scientist and who knows both discrete math and Java or there exists a mathematician who knows both discrete math and Java.
    (D) There exists a computer scientist who knows both discrete math and Java or there exist a person who is a mathematician who knows both discrete math and Java.

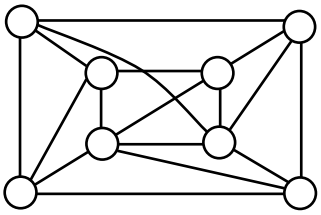
37. Consider the following Graph

G =

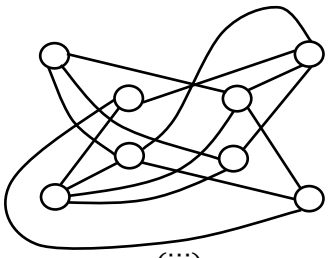


Which of the following statement is false?
    (A) Graph G is a bipartite graph.
    (B) Graph G is a planar graph
    (C) Independence no. of the graph is 5.
    (D) {1, 6, 7, 3} is a vertex covering of a graph G.

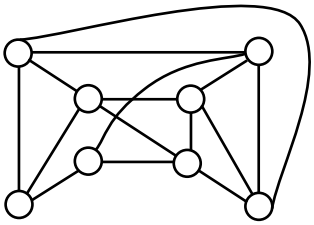
38. Determine which of the following Graph is/are isomorphic to $K_{4,4}$



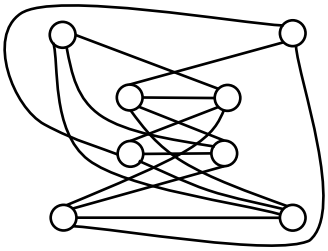
(i)



(iii)



(ii)



(iv)

(A) i and iv only
(B) iii and iv only
(C) iii and ii only
(D) i and ii only

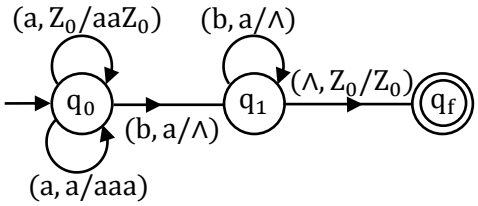
39. A CPU has 32-bit instructions. A program starts at address 400 (in decimal). Which one of the following is a legal program counter (all values in decimal)?
(A) 420
(B) 430
(C) 450
(D) 470

40. A file system with 600GB uses a file descriptor with 16 direct block address and 1 indirect address. The size of each disk block is 256 Bytes and the size of each disk block address is 8 Bytes. The maximum possible file size in this file system is _____ KB

41. Consider 2 instruction pipelines having same no. of stages. The pipeline A has single –port memory, while B is having two-port memory. Both pipelines allow overlapping of all instructions except memory related ones. There is one stall cycle penalty for two simultaneous memory operations. If there are 30% memory related instructions, the ratio of minimum performance gain possible with pipeline B to pipeline A is _____

42. Consider a statement given below
"A language accepted by a multi-tape Turing Machine is recursively enumerable"
If we try to design a Turing machine, then the time taken by the one tape TM to simulate n moves of K-tape TM is _____
(A) $O(n^2)$
(B) $O(n^3)$
(C) Both A and B
(D) None of these

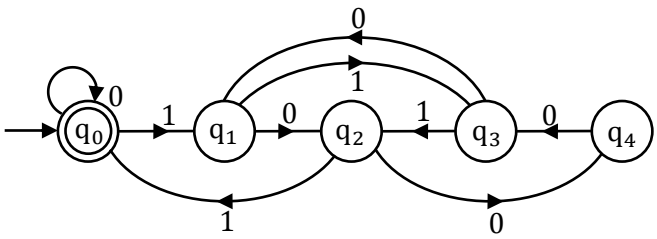
43. State diagram of a PDA is given below



Note: Z_0 is the initial symbol in the stack
∧ is the null symbol
Then what is the language corresponding to PDA?

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

44. Given a finite automata



The automata accepts a language which contains

(A) Set of binary numbers divisible by 5
(B) Set of binary numbers divisible by 4
(C) Set of binary numbers divisible by 3
(D) Set of binary numbers divisible by 7

45. Match the followings

Types of Index	Number of [first level] Index entries	Dense or Non dense
(i) Primary	a. Number of records in data file	p. Dense
(ii) Clustering	b. Number of records or number of distinct index field values	q. Non dense
(iii) Secondary [On key field]	c. Number of distinct index field values d. Number of blocks in data file	r. Any of the above

(A) (i)– b, q
(ii)– d, p
(iii)– c, q

(B) (i)– d, p
(ii)– c, p
(iii)– b, p

(C) (i)– c, q
(ii)– d, q
(iii)– b, p

(D) (i)– d, q
(ii)– c, q
(iii)– a, p

46. The employee information is stored in EMP(eno, ename, gender, salary,deptno).

```
SELECT      outer.deptno
FROM        emp outer
WHERE       outer.gender = 'M'
GROUP BY    outer.deptno
HAVING      avg(outer.salary) > (SELECT   avg(inner.salary)
                                 FROM     emp inner
                                 WHERE inner.gender = 'F'
                                 AND      inner.deptno = outer.deptno);
```

The above SQL query returns the deptno's in which

(A) Average salary of male employees is greater than average salary of the company.
(B) Average salary of male employees is greater than average salary of female employees in the company.
(C) Average salary of male employees is greater than average salary of female employees in that department.
(D) Average salary of employees is greater than average salary of female employees in that department.

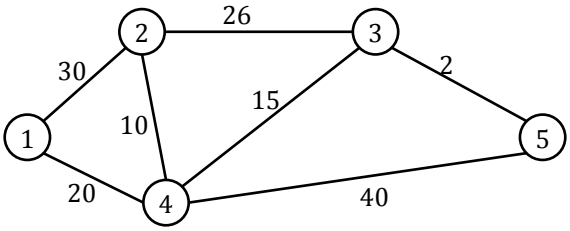
47. Consider the data transmission from station A to station B with the following information:-
Sliding Window Protocol = Selective Repeat
Bandwidth = 2 Mbps
Propagation Delay= 3 milliseconds
Size of Frame = 100 Bytes
Transmission Time for Acknowledgement = Negligible =0
What would be the minimum no of bits required to represent the sequence number to ensure a link utilization of 50%?

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

48. The value returned by following algorithm when called with n = 10 is _____

```
count = 0
for (i  = 1 to n)
    for (j =1 to i )
        for (k = 1 to j )
                count ++
return count
```

49. Consider the following network, which uses Distance-vector routing for routing data. On each of the link, the number represents a cost. Each router updates its table for every 10 sec. For a router 1, how much time (min) would it take to converge the routing information?



Assume that, all routers update their table simultaneously.

(A) 40 sec
(B) 60 sec
(C) 30 sec
(D) 10 sec

50. Consider a 3-level memory system, where the access times of level-1, level-2 and level-3 are 10ns, 20ns and 100ns respectively; and hit rate of level-1 is 80%. If a miss occurs in level-1 then referred block must be brought from level-2 to level-1(block size = 4 words). If there is also a miss in level-2 then a block of 8 words should be moved from level-3 to level-2 and associated block to level-1 from level-2. Now what should be the hit rate of level-2 to make average access time of the system 42ns, if level-3 contains all the data blocks?

51. Consider a cache that uses direct mapping, contains 64 blocks with block size of 16 bytes. The block number for the byte address 1600 is _____

52. Let F be a set of functional dependencies given as
$F = \{P \rightarrow QR, Q \rightarrow R, P \rightarrow Q, PQ \rightarrow R\}$
Minimum cover for F is _____

(A) $\{P \rightarrow Q, Q \rightarrow R\}$
(B) $\{P \rightarrow R, Q \rightarrow R\}$
(C) Both A and B
(D) None of these

53. Suppose you are given a relation R with four attributes ABCD and FDs are $AB \rightarrow C$, $AB \rightarrow D$, $C \rightarrow A$, $D \rightarrow B$. The candidate key & best normal form of R is _____

(A) {AB, BC, CD, AD}, 3NF
(B) {AB, CD}, BCNF
(C) Both A and B
(D) None of these

54.
```
int fun (int preorder [ ], int n)
{
    int a, b;
    for(int i = 0; i < n − 1; i + +)
    {
        a = preorder[i] − preorder[i + 1];
        b = preorder[i] − preorder[n − 1];
        if(a ∗ b < 0)
        return 0;
    }
    return 1;
}
```
Consider the following given function. If preorder traversal of BST is given then what does the function compute?

(A) Checking if BST has exactly one child node for each internal node
(B) Checking if BST has at-least one child for each internal node
(C) Checking if BST has at-most one child for some internal node
(D) None of these

55. Consider a paging system with 100 bytes page. Following byte addresses are referenced in sequence: 0100, 0423, 0201, 0612, 0109, 0611, 0188, 0627, 0110, 0203, 0498, 0526, 0643, 0104, 0102, 0321 and 0629.
Assume that these are 4 page frames available in memory. Number of page faults for these references, if LRU page replacement is being used; will be _____ [Assume that initially all frames are empty]

General Aptitude One Marks Question Q. 56 to Q. 60

56. Three bells chime at an interval of 18, 24 and 32 minutes respectively. At a certain time they begin to chime together. What length of time will elapse before they chime together again?

(A) 2 hours 24 minutes
(B) 1 hour 12 minutes
(C) 1 hour 36 minutes
(D) 4 hours 48 minutes

57. In a one day cricket match, the total runs made by a team were 200. Out of these 160 runs were made by spinners.
Conclusion I: 80% of the team consists of spinners.
Conclusion II: The opening batsmen were spinners.

(A) Only conclusion I follows
(B) Only conclusion II follows
(C) Either I or II follows
(D) Neither I nor II follows

58. In a car race of 12km, a participant covers a distance of the first 3 km in 6 minutes. He then increases his speed and covers twice the distance already covered in 6 minutes. He covers the rest of the distance in 12 minutes. Find his average speed.

(A) 9.23m/s
(B) 7.44m/s
(C) 6.20m/s
(D) 8.33m/s

Directions for Q. No. 59: Choose the option which is FARTHEST to the word mentioned in Question

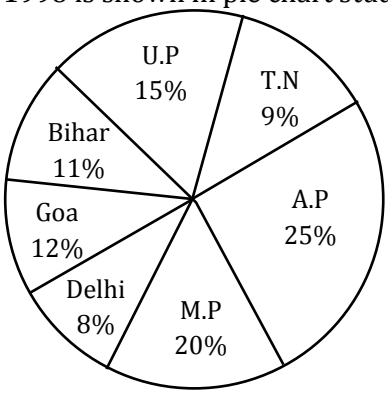
59. **MOROSE**

(A) Exuberant
(B) Moron
(C) Mortified
(D) Crestfallen

60. A team of five is to be selected from amongst five boys A, B, C, D and E and four girls P, Q, R and S. Some criteria for selection are as follows
C and P have to be together, Q cannot go with R. E cannot go with S. B and D have to be together. Q cannot go with A. Unless stated otherwise, these criteria apply to all the following questions.
If two of the members have to be boys, the team will consist of
(A) CEPQS
(B) AEPQS
(C) ACPRS
(D) BDPRS

General Aptitude Two Marks Question Q. 61 to Q. 65

Direction for Q. No 61: Data of different states regarding population of states in the year 1998 is shown in pie chart study the graph and answer the question that follows.



Total population of given states = 32,76,000
Following table shows that sex & literacy wise population ratio

States	Sex		Literacy	
	Male	Female	Literate	Illiterate
Andhra Pradesh	5	3	2	7
Madhya Pradesh	3	1	1	4
Delhi	2	3	2	1
Goa	3	5	3	2
Bihar	3	4	4	1
Uttar Pradesh	3	2	7	2
Tamil Nadu	3	4	9	4

61. What will be the total percentage of total number of males in U.P, M.P & Goa together to the total population of all given states ?

(A) 28.5%
(B) 18.5%
(C) 23%
(D) 32%

62. A cube is coloured red on one of the face, green on the opposite face, yellow on another face and blue on a face adjacent to the yellow face. The other two faces are left uncolored. It is then cut into 125 smaller cubes of equal size. How many cubes uncolored on the all the faces?
(A) 27
(B) 36
(C) 48
(D) 64

63. NOVICE: SEASONED
(A) Opulent: Grand
(B) Nefarious : Wicked
(C) Affluent: Impecunious
(D) Filthy: Disgusting

Direction for Q. No 61: Consider the information in the statements to be true. On the basis read the following questions and mark:

64. The Minister said that the teachers are still not familiarised with the need, importance and meaning of population education in the higher education system. They are not even clearly aware about their role and responsibilities in the population education programme.
I. Population education programme should be included in the college curriculum.
II. Orientation programme should be conducted for teachers on population education
(A) If only I follows
(B) If only II follows
(C) If neither I nor II follows
(D) If both I and II follow

65. The question is followed by two statements I and II. Mark the answer.
(A) If the question can be answered by using one of the statements alone, but cannot be answered using the other statement alone.
(B) If the question can be answered by using either statement alone.
(C) If the question can be answered by using both statements together, but cannot be answered using either statement alone.
(D) If the question cannot be answered even by using both statements together
What is the value of the ratio (a + c): c?
1. The ratio of a : b = 1 : 5.
2. The ratio of b : c = 3 : 2.