General Aptitude (GA)

Q.1-Q.5 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: -1/3)

Topic: General Aptitude
Concept: Numerical Ability
Sub-concept: Numerical Analysis
Concept-field: Ratio & Proportion
Level: Easy
Time: 60 sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

1. The ratio of boys to girls in a class is 7 to 3.
Among the options below, an acceptable value for the total number of students in the class is:
(1) 21
(2) 37
(3) 50
(4) 73

Ans. **(3)**

Sol. Ratio = boys : girls
= 7R : 3R
Total student in a class = 7R + 3R = 10R
Total number of students should be multiple of 10.
Hence from given option, only 50 is satisfies.
Option (3) is correct.

Topic: General Aptitude
Concept: Numerical Ability
Sub-concept: Quantitative Aptitude
Concept-field: Mensuration
Level: Easy
Time: 60 sec.
Q. Type: MCQ
Marks: 1 Marks

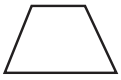
Negative: 0.33 Marks

2. A polygon is convex if, for every pair of points, P and Q belonging to the polygon, the line segment PQ lies completely inside or on the polygon.
Which one of the following is NOT a convex polygon?

(1) 

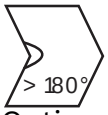
(2) 

(3) 

(4) 

Ans. **(1)**

Sol. According to convex polygon definition (interior angle should be less than 180°)



Option (1) is not polygon

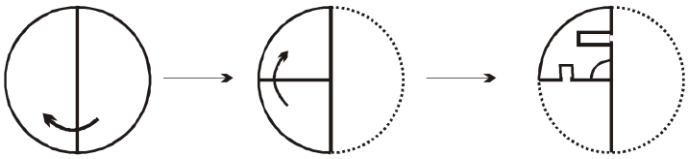
Topic: General Aptitude
Concept: Verbal Ability
Sub-concept: Sentence Correction
Concept-field: Common/Spotting Errors
Level: Easy
Time: 60 sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

3. Consider the following sentences:
(i) Everybody in the class is prepared for the exam.
(ii) Babu invited Danish to his home because he enjoys playing chess.
Which of the following is the CORRECT observation about the above two sentences?
(1) (i) is grammatically correct and (ii) is unambiguous
(2) (i) is grammatically incorrect and (ii) is unambiguous
(3) (i) is grammatically correct and (ii) is ambiguous
(4) (i) is grammatically incorrect and (ii) is ambiguous

Ans. **(3)**

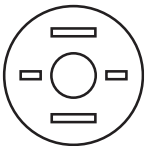
Sol. Statement (i) is correct.
For everybody or everyone we use singular form of the verb “is” is correct.
Statement (ii)is ambiguous
Ambiguous means more than one possibility, so here we not sure it can be Babu or Danish.
Hence, option (3) is correct.

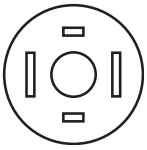
Topic: General Aptitude
Concept: Non-Verbal Ability
Sub-concept: Non-Verbal Reasoning
Concept-field: Paper Folding
Level: Easy
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 marks

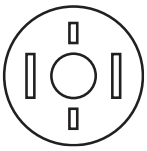
4. 

A circular sheet of paper is folded along the lines in the directions shown. The paper, after being punched in the final folded state as shown and unfolded in the reverse order of folding, will look like _____.

(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. If you unfolded in the reverse of folding option (1) image will satisfies.

Topic: General aptitude
Concept: Verbal Ability

Sub-concept: English Vocabulary
Concept-field: One Word Substitution
Level: Easy
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

5. _____ is to surgery as writer is to _____
Which one of the following options maintains a similar logical relation in the above sentence?
(1) Plan, outline
(2) Hospital, library
(3) Doctor, book
(4) Medicine, grammar

Ans. **(3)**

Sol. Doctor does surgery and writer write book so option (3) is correct.

Q.6-Q.10 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: -2/3)

Topic: General Aptitude
Concept: Non-Verbal Ability
Sub-concept: Non-Verbal Reasoning
Concept-field: Paper Folding
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

6. We have 2 rectangular sheets of paper, M and N, of dimensions 6 cm x 1 cm each. Sheet M is rolled to form an open cylinder by bringing the short edges of the sheet together. Sheet N is cut into equal square patches and assembled to form the largest possible closed cube. Assuming the ends of the cylinder are closed, the ratio of the volume of the cylinder to that of the cube is_____

(1) $\frac{\pi}{2}$

(2) $\frac{3}{\pi}$

(3) $\frac{9}{\pi}$

(4) 3π

Ans. **()**

Sol. Volume of cylinder (v) = $\pi r^2 h$

Circumference = $2\pi r = 6$

$r = \frac{6}{2\pi} = \frac{3}{\pi}$

and h = 1

side of cube = 1

$$\text{ratio} = \frac{\text{Volume of cylinder}}{\text{Volume of cube}}$$

$$= \frac{\pi \times \frac{9}{\pi^2} \times 1}{(1)^3}$$

$$\frac{9\pi}{1} = 9\pi$$

Topic: General Aptitude
Concept: Numerical Ability
Sub-concept: Quantitative Aptitude
Concept-field: Profit & Loss
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

7.

Items	**Cost (₹)**	**Profit %**	**Marked Price**
P	5,400	---	5,860
Q	---	25	10,000

Details of prices of two items P and Q are presented in the above table. The ratio of cost of item P to cost of item Q is 3:4. Discount is calculated as the difference between the marked price and the selling price. The profit percentage is calculated as the ratio of the difference between selling price and cost, to the cost

$\left(\text{Profit} = \frac{\text{Selling price} - \text{Cost}}{\text{Cost}} \times 100\right)$.

The discount on item Q, as a percentage of its marked price, is _____

(1) 25

(2) 12.5

(3) 10
(4) 5

Ans. **(3)**

Sol. Ratio = C.P P : C.P Q
= 3 : 4
cost price (C.P) of P = 5400

cost price (C.P) of Q = $\frac{5400}{3} \times 4$ = 7200

selling price of Q = C.P + profit

= 7200 + $\frac{7200}{100} \times 25$

= 9000

% discount = $\frac{10000 - 9000}{10000}$

= 10%

So, option (3) is correct.

Topic: General Aptitude
Concept: Numerical Ability
Sub-concept: Quantitative Aptitude
Concept-field: Probability
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

8. There are five bags each containing identical sets of ten distinct chocolates. One chocolate is picked from each bag.
The probability that at least two chocolates are identical is _____

(1) 0.3024
(2) 0.4235
(3) 0.6976
(4) 0.8125

Ans. **(3)**

Sol. P(at least two chocolates are identical) = 1 – P(all chocolates are different)

= 1 – $\frac{10 \times 9 \times 8 \times 7 \times 6}{10^5}$

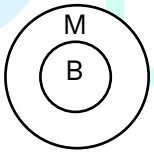
= 1 – 0.3024
= 0.6976
Hence, option (3) is correct.

Topic: General aptitude
Concept: Verbal Ability
Sub-concept: Statement & Conclusion
Concept-field: Syllogism
Level: Easy
Time: 90 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

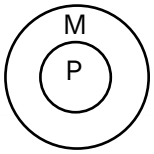
9. Given below are two statements 1 and 2, and two conclusions I and II.
Statement 1: All bacteria are microorganisms.
Statement 2: All pathogens are microorganisms.
Conclusion I: Some pathogens are bacteria.
Conclusion II: All pathogens are not bacteria.
Based on the above statements and conclusions, which one of the following options is logically CORRECT?
(1) Only conclusion I is correct
(2) Only conclusion II is correct
(3) Either conclusion I or II is correct.
(4) Neither conclusion I nor II is correct.

Ans. **(3)**

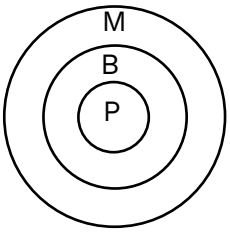
Sol. Statement 1 :



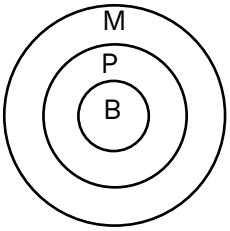
Statement 2 :



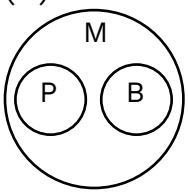
4 cases are possible
(i)



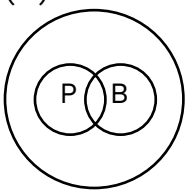
(ii)



(iii)



(iv)



According to ven-diagram either conclusion I or II is correct.
Hence, option (3) is correct.

Topic: General Aptitude
Concept: Verbal Ability
Sub-concept: Verbal Comprehension
Concept-field: Paragraph Formation
Level: Moderate
Time: 90 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

10. Some people suggest anti-obesity measures (AOM) such as displaying calorie information in restaurant menus. Such measures sidestep addressing the core problems that cause obesity: poverty and income inequality.
Which one of the following statements summarizes the passage?
(1) The proposed AOM addresses the core problems that cause obesity.
(2) If obesity reduces, poverty will naturally reduce, since obesity causes poverty.
(3) AOM are addressing the core problems and are likely to succeed.
(4) AOM are addressing the problem superficially.

Ans. **(4)**

Sol. AOM are only addressing the obesity problem superficially but not addressing the real problems, because the problem mentioned are poverty and inequality. But AOM are not addressing the main problem directly.

Hence option (4) is correct.

Computer Science and Information Technology (CS, Set-1)

Q.1-Q.10 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer : -1/3)

Topic: Theory of Computation
Concept: Introduction to Theory of Computation
Sub-concept: Language and types of language
Concept-field: Context Free Language
Level: Easy
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

1. Suppose that L_1 is a regular language and L_2 is a context-free language. Which one of the following languages is NOT necessarily context-free?

(1) $L_1 \cap L_2$

(2) $L_1 \cdot L_2$

(3) $L_1 - L_2$

(4) $L_1 \cup L_2$

Ans. **(3)**

Sol. CFL is not closed under complement

$L_1 - L_2 = L_1 \cap \overline{L_2}$

Hence option (3) is correct.

Topic: Programming & Data structure
Concept: Array
Sub-concept: Basics of Array
Concept-field: Introduction
Level: Easy
Time: 90 Sec.
Q. Type: MCQ

Marks: 1 Marks
Negative: 0.33 Marks

2. Let P be an array containing n integers. Let t be the lowest upper bound on the number of comparisons of the array elements. required to find the minimum and maximum values in an arbitrary array of n elements. Which one of the following choices is correct?

(1) $t > 2n - 2$

(2) $t > 3\left\lceil \frac{n}{2} \right\rceil$ and $t \le 2n - 2$

(3) $t > n$ and $t \le 3\left\lceil \frac{n}{2} \right\rceil$

(4) $t > \left\lceil \log_2 (n) \right\rceil$ and $t \le n$

Ans. **(3)**

Sol. For normal min/max loop
it will take = 2n – 2 comparisons
= 2(n - 1) comparisons in worst case
= (n – 1) Best case

According to OAC = $\frac{3n}{2} - 2$ comparisons in average case

= $\left\lceil \frac{3n}{2} \right\rceil$

$t > \left\lceil \frac{3n}{2} \right\rceil$ and $t \le (n-1)$

Hence option (3) is correct.

Topic: Algorithms
Concept: Asymptotic Analysis
Sub-concept: Asymptotic Notation
Concept-field: Comparisons of Functions
Level: Easy
Time: 90 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

3. Consider the following three functions.

$f_1 = 10^n$ $f_2 = n^{\log n}$ $f_3 = n^{\sqrt{n}}$

Which one of the following options arranges the functions in the increasing order of asymptotic growth rate?

(1) f_3, f_2, f_1

(2) f_2, f_1, f_3
(3) f_1, f_2, f_3
(4) f_2, f_3, f_1

Ans. **(4)**

Sol. Exponential power is greater than polynomial so f_1 is bigger

$n^{\sqrt{n}} = n^{\log n}$

$\sqrt{n} \times \log n = \log n \times \log n$

$\sqrt{n} > \log n$ Hence increasing

Order is f_2, f_3, f_1

Option (4) is correct.

Topic:
Concept: Programming & Data structure
Sub-concept: Trees
Concept-field: Tree Traversal
Level: Pre-Order/Post-Order Traversal
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

4. Consider the following statements.

S_1: The sequence of procedure calls corresponds to a preorder traversal of the activation tree.

S_2: The sequence of procedure returns corresponds to a post order traversal of the activation tree.

Which one of the following options is correct?

(1) S_1 is true and S_2 is false
(2) S_1 is false and S_2 is true
(3) S_1 is true and S_2 is true
(4) S_1 is false and S_2 is false

Ans. **(3)**

Sol. Both statements are true by definition.

Hence, option (3) is correct.

Topic: Complier Design
Concept: Parsing
Sub-concept: Basics of parsing
Concept-field: Introduction

Level: Easy
Time: 60 sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

5. Consider the following statements.
S_1 : Every SLR(1) grammar is unambiguous but there are certain unambiguous grammars that are not SLR(1).
S_2 : For any context-free grammar, there is a parser that takes at most $O(n^3)$ time to parse a string of length n. Which one of the following options is correct?
(1) S_1 is true and S_2 is false
(2) S_1 is false and S_2 is true
(3) S_1 is true and S_2 is true
(4) S_1 is false and S_2 is false

Ans. **(3)**

Sol. S_1 is true : Every SLR (1) grammar is unambiguous but vice-versa not true.
S_2 is true : Any CFG can be parsed by CYK algorithm which will take $O(n^3)$
Hence option (3) is correct.

Topic: Digital Logic Design
Concept: Number System
Sub-concept: Basics of Number System
Concept-field: Hexadecimal Number System
Level: Easy
Time: 90 sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

6. Let the representation of a number in base 3 be 210. What is the hexadecimal representation of the number?
(1) 15
(2) 21
(3) D2
(4) 528

Ans. **(1)**

Sol. $(210)_3 = 3^2 \times 2 + 3^1 \times 1 + 3^0 \times 0$
$= (21)_{10}$
$(21)_{10} = (10101)_2$
$(10101)_2 = (15)_{16}$
Hence Option (1) is correct.

Topic: Discrete Mathematics
Concept: Propositional Logic and Predicates
Sub-concept: Propositional Equivalences
Concept-field: Tautology
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

7. Let p and q be two propositions. Consider the following two formulae in propositional logic.

$$S_1 : \left(\neg p \wedge (p \vee q)\right) \rightarrow q$$

$$S_2 : q \rightarrow \left(\neg p \wedge (p \vee q)\right)$$

Which one of the following choices is correct?
(1) Both S_1 and S_2 are tautologies.
(2) S_1 is a tautology but S_2 is not a tautology.
(3) S_1 is not a tautology but S_2 is a tautology.
(4) Neither S_1 nor S_2 is a tautology.

Ans. **(2)**

Sol. $S_1 : \left(\neg p \wedge (p \vee q)\right) \rightarrow q$

$(p' \wedge (p \vee q)) \rightarrow q$

$\left(pp' + p'q\right) \rightarrow q$

$p'q \rightarrow q$ $\quad\quad$ $p \rightarrow q$

$p + q' + q$ $\quad\quad$ $p' + q$

P + 1 = 1 $\quad\quad$ (Tautology)

$S_2 : q \rightarrow \left(\neg p \wedge (p \vee q)\right)$

$q' + p'p + p'q$

$q' + p'q$

not a Tautology

Hence option (2) is correct.

Topic: Computer Network
Concept: Network Layer
Sub-concept: Address Resolution Protocol (ARP)
Concept-field: Basics of ARP
Level: Easy
Time: 60 Sec.

Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

8. Consider the following two statements.
S_1 : Destination MAC address of an ARP reply is a broadcast address.
S_2 : Destination MAC address of an ARP request is a broadcast address.
Which one of the following choices is correct?
(1) Both S_1 and S_2 are true.
(2) S_1 is true and S_2 is false.
(3) S_1 is false and S_2 is true.
(4) Both S_1 and S_2 are false.

Ans. **(3)**

Sol. ARP reply is unicasting.
ARP request is broadcasting.
Option (3) is true.

Topic: Algorithms
Concept: Divide & Conquer
Sub-concept: Sorting
Concept-field: Insertion Sort
Level: Easy
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

9. Consider the following array.

23	32	45	69	72	73	89	97

Which algorithm out of the following options uses the least number of comparisons (among the array elements) to sort the above array in ascending order?
(1) Selection sort
(2) Merge sort
(3) Insertion sort
(4) Quicksort using the last element as pivot

Ans. **(3)**

Sol. When the array is already sorted or almost sorted Insertion sort will perform best case time complexity, the number of comparisons will be O('n')
Hence, option (3) is correct.

Topic: Programming & Data Structure

Concept: Trees
Sub-concept: Binary Search Tree
Concept-field: Find Minimum & Maximum Element
Level: Easy
Time: 60 Sec.
Q. Type: MCQ
Marks: 1 Marks
Negative: 0.33 Marks

10. A binary search tree T contains n distinct elements. What is the time complexity of picking an element in T that is smaller than the maximum element in T?

(1) $\Theta(n\log n)$

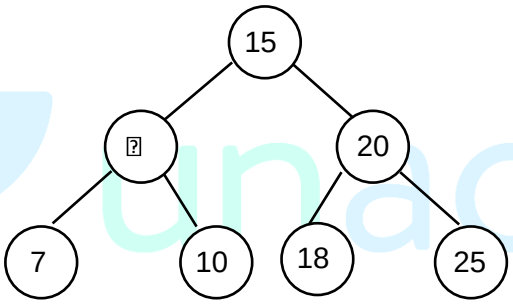
(2) $\Theta(n)$

(3) $\Theta(\log n)$

(4) $\Theta(1)$

Ans. **(4)**

Sol.



Compare any two element which will take constant $\Theta(1)$ time

$\Theta < 15$

Hence option (4) is correct.

Q.11-Q.15 Multiple Select Question (MSQ), carry ONE mark each (no negative marks)

Topic: Operating System
Concept: Memory management
Sub-concept: Non-Contiguous Memory Allocation
Concept-field: Paging
Level: Easy
Time: 60 Sec.
Q. Type: MSQ
Marks: 1 Marks
Negative: 0 Marks

11. In the context of operating systems, which of the following statements is/are correct with respect to paging?
(1) Paging helps solve the issue of external fragmentation.
(2) Page size has no impact on internal fragmentation.
(3) Paging incurs memory overheads.
(4) Multi-level paging is necessary to support pages of different sizes.

Ans. **(3, 4)**

Sol. [1] false: If the page size is large it may suffer from internal fragmentation only in the last page.
[2] False: Multilevel paging is not necessary to support different sizes of page.
[3] True: maintaining the page table is considered as overhead for system.
[4] True: There is no external fragmentation in the paging

Topic: Theory of Computation
Concept: Introduction of Theory of computation
Sub-concept: Automaton
Concept-field: Types of automata
Level: Moderate
Time: 90 Sec.
Q. Type: MSQ
Marks: 1 Marks
Negative: 0 Marks

12. Let $\langle M \rangle$ denote an encoding of an automaton M. Suppose that $\sum = \{0, 1\}$. Which of the following languages is/are NOT recursive?

(1) $L = \{\langle M \rangle \mid M \text{ is a DFA such that } L(M) = \phi\}$
(2) $L = \{\langle M \rangle \mid M \text{ is a DFA such that } L(M) = \sum^*\}$
(3) $L = \{\langle M \rangle \mid M \text{ is a PDA such that } L(M) = \phi\}$
(4) $L = \{\langle M \rangle \mid M \text{ is a PDA such that } L(M) = \sum^*\}$

Ans. **(4)**

Sol. [1] Decidable : DFA (Regular language) For DFA emptiness problem is Decidable (Recursive)
[2] Decidable : completeness problem is decidable in DFA.
[3] Decidable : PDD (CFL) For PDA emptiness problem is decidable.
[4] Undecidable : Completeness problem for CFL is undecidable.
Option 4 is true.

Topic: Database Management system

Concept: Transaction & Concurrency Control Technique
Sub-concept: Transaction
Concept-field: Introduction
Level: Easy
Time: 60 sec.
Q. Type: MSQ
Marks: 1 Marks
Negative: 0 Marks

13. Suppose a database system crashes again while recovering from a previous crash. Assume check pointing is not done by the database either during the transactions or during recovery.
Which of the following statements is/are correct?
(1) The same undo and redo list will be used while recovering again.
(2) The system cannot recover any further.
(3) All the transactions that are already undone and redone will not be recovered again.
(4) The database will become inconsistent.

Ans. **(1)**

Sol. Statement (1) : is correct
The same undo and redo list will be used
All committed transaction until previous checkpoint will perform redo. All transaction which are roll back state will perform undo until previous checkpoint.
(2) : is False
System crash recovery can be done by perform undo and redo operation.
(3) : false
Will be recovered by undo and redo operation.
(4) : False
Because do to base operation requested by user is logically correct.
Option (1) is correct.

Topic: Operating System
Concept: Introduction of Operating system
Sub-concept: Basics of Operating system
Concept-field: System Calls
Level: Moderate
Time: 90 Sec.
Q. Type: MSQ
Marks: 1 Marks
Negative: 0 Marks

14. Which of the following standard C library functions will always invoke a system call when executed from a single-threaded process in a UNIX/Linux operating system?
(1) exit
(2) malloc
(3) sleep

(4) strlen

Ans. **(1, 3)**

Sol. (1) exit ( ) : is a system call when a process terminates it executes an exit ( ) system call we sue.
(2) malloc ( ) : is used to allocate memory dynamic way but it is not a system call.
(3) sleep ( ) : is a system call specifying minimum amount of time that the process is to sleep resuming execution.
(4) strlen ( ) : is not a system call this is a function defined in standard c library.
Option (1, 3) is correct.

Topic: Operating System
Concept: File System & Disk Storage
Sub-concept: Directories
Concept-field: Operations on Directories
Level: Easy
Time: 60 sec.
Q. Type: MSQ
Marks: 1 Marks
Negative: 0 Marks

15. Consider a linear list-based directory implementation in a file system. Each directory is a list of nodes, where each node contains the file name along with the file metadata, such as the list of pointers to the data blocks. Consider a given directory foo.
Which of the following operations will necessarily require a full scan of foo for successful completion?
(1) Creation of a new file in foo
(2) Deletion of an existing file from foo
(3) Renaming of an existing file in foo
(4) Opening of an existing file in foo

Ans. **(1, 3)**

Sol. (1) While creating a now file we need to check whether the file name is exist or not. So full scan is required for successful completion.
(2) A deletion of a file does not require a full scan we can delete it.
(3) Renaming a new file requires to search the complete node for duplicate names. So full scan is required for successful completion.
(4) A opening of a file does a full scan.
Option (1, 3) is correct.

Q.16-Q.25 Numerical Answer Type (NAT), carry ONE mark each (no negative marks)

Topic: Desecrate Mathematics
Concept: Graph Theory
Sub-concept: Graph & Graph Models
Concept-field: Undirected Planar Graph
Level: Easy
Time: 60 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

16. In an undirected connected planar graph C, there are eight vertices and five faces. The number of edges in G is _____

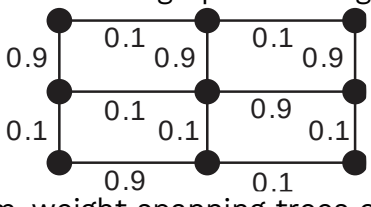
Ans. **(11)**

Sol. We know the formula
v – e + f = 2
v = number of vertices
e = number of edges
f = number of faces

8 – e + 5 = 2
e = 13 – 2 = 11
(11) is correct answer.

Topic: Discrete Mathematics
Concept: Graph Theory
Sub-concept: Simple Undirected Graph
Concept-field: Spanning Trees
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

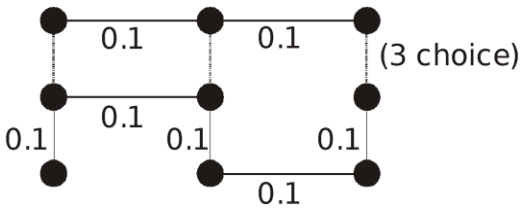
17. Consider the following undirected graph with edge weights as shown:



The number of minimum-weight spanning trees of the graph is _____.

Ans. **(3)**

Sol.



Take minimum edge first, now we have three choices to become connected.
So, 3 MST possible.
(3) is correct.

Topic: Engineering Mathematics
Concept: Probability & Distribution
Sub-concept: Random Variables
Concept-field: Continuous and Discrete Random Variables
Level: Moderate
Time: 120 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

18. The lifetime of a component of a certain type is a random variable whose probability density function is exponentially distributed with parameter 2. For a randomly picked component of this type, the probability that its lifetime exceeds the expected lifetime (rounded to 2 decimal places) is _____.

Ans. **(0.37)**

Sol. Probability density function = $\lambda e^{-\lambda x}$
Where λ = parameter = 2

$$\text{Mean} = \frac{1}{\lambda} = \frac{1}{2}$$

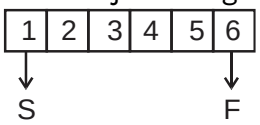
$P(X > x) = e^{-\lambda x}$
$P(X > \mu) = e^{-\lambda\mu} = e^{-1}$
$= 0.37$

Topic: Discrete Mathematics
Concept: Counting
Sub-concept: Permutations and Combinations
Concept-field: Permutations and Combinations
Level: Moderate
Time: 120 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

19. There are 6 jobs with distinct difficulty levels, and 3 computers with distinct processing speeds. Each job is assigned to a computer such that:
- The fastest computer gets the toughest job and the slowest computer gets the easiest job.
- Every computer gets at least one job.
The number of ways in which this can be done is _____.

Ans. **(65)**

Sol. Let computers be F, M, S
toughest job assign to F is 1 way
easiest job assign to S is 1 way



4 jobs assign to three computers so that computer M gets at least one job, since S and F already assigned a job.
Number of ways 4 jobs assign to three computers = 3^4
Number of ways 4 jobs assign to three computers, so that computer C does not get any job = 2^4
Total number of ways = $3^4 - 2^4$
= 65

Topic: Engineering Mathematics
Concept: Calculus
Sub-concept: Limits
Concept-field: One Variable Limits
Level: Moderate
Time: 120 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

20. Consider the following expression.

$$\lim_{x\to -3} \frac{\sqrt{2x+22}-4}{x+3}$$

The value of the above expression (rounded to 2 decimal places) is _____.

Ans. **(0.25)**

Sol. $\lim\limits_{x\to -3} \dfrac{\sqrt{2x+22}-4}{x+3}$

It is in $\left(\dfrac{0}{0}\right)$ form, so apply L-hospital rule (differentiate numerator, denominator)

$$\lim_{x\to -3} \frac{\frac{1}{2}(2x+2.2)^{-1/2}\times 2}{1}$$

Apply limit

$$= \frac{\frac{1}{2}(-6+22)^{-1/2} \times 2}{1}$$

$$= \frac{1}{2} \times \frac{1}{\sqrt{16}} \times 2$$

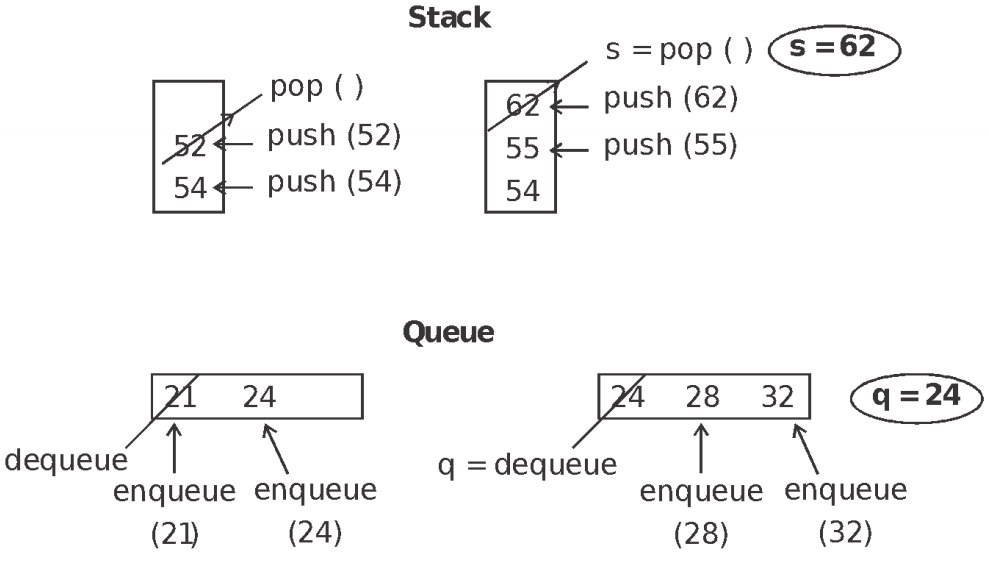
$$\frac{1}{4} = 0.25$$

Topic: Programming & Data Structure
Concept: Stacks & Queues
Sub-concept: Operations on Stacks & Queues
Concept-field: Push, Pop, Enqueue, Dequeue
Level: Easy
Time: 90 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

21. Consider the following sequence of operations on an empty stack.
push(54); push(52); pop(); push(55); push(62); s = pop();
Consider the following sequence of operations on an empty queue.
enqueue(21);enqueue(24); dequeue(); enqueue(28);enqueue(32); q = dequeue();
The value of s + q is _____.

Ans. **(86)**

Sol.



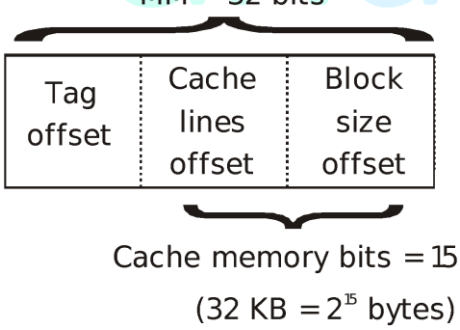
s + q = 62 + 24 = 86

Topic: Computer Organization & Architecture
Concept: Memory Hierarchy Design & Cache Memory
Sub-concept: Types of Cache Memory
Concept-field: Direct-Mapped Cache
Level: Moderate
Time: 2 min.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

22. Consider a computer system with a byte-addressable primary memory of size 2^{32} bytes. Assume the computer system has a direct-mapped cache of size 32 KB (1 KB = 2^{10} bytes), and each cache block is of size 64 bytes.
The size of the tag field is _____ bits.

Ans. **17**

Sol. Given direct mapped cache
Main memory = 2^{32} bytes
Cache memory = 32 KB
Block size = 64 bytes
Tag bits = ?



Tag bits = 32 – 15 = 17 bits

Topic: Database Management System
Concept: Structured Query Language (SQL)
Sub-concept: Relational Algebra
Concept-field: Tuple Relational Calculus
Level: Easy
Time: 90 Sec.
Q. Type: NAT
Marks: 1 Marks

Negative: 0 Marks

23. A relation r(A, B) in a relational database has 1200 tuples. The attribute A has integer values ranging from 6 to 20, and the attribute B has integer values ranging from 1 to 20. Assume that the attributes A and B are independently distributed.

The estimated number of tuples in the output of $\sigma_{(A>10)\vee(B=18)}(r)$ is _____.

Sol. 820

Probability of (A > 10) in a relation r (A.B) = $\frac{10}{15}$

Probability of (B = 18) in a relation r (A, B) = $\frac{1}{20}$

Probability of (A > 10 and B = 18) = $\frac{10}{15} \times \frac{1}{20} = \frac{1}{30}$

But, Both events are independent 30,

Probability (A > 10 or B = 18)

= P (A > 10) + P (B = 18) – P (A & B)

= $\frac{10}{15} + \frac{1}{20} - \frac{1}{30}$

= $\frac{40 + 3 - 2}{60} = \frac{41}{60}$

Then, The Number of tuples = $1200 \times \frac{41}{60} = 820$

Topic: Digital Logic Design
Concept: Number System
Sub-concept: Number Representation
Concept-field: floating point Representation
Level: Moderate
Time: 120 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

24. Consider the following representation of a number in IEEE 754 single-precision floating point format with a bias of 127.

S : 1 E : 10000001 F : 11110000000000000000000

Here S, E and F denote the sign, exponent and fraction components of the floating point representation.

The decimal value corresponding to the above representation (rounded to 2 decimal places) is _____.

Ans. **(-7.75)**

Sol.

$(-1)^S \times 1\ M \times 2^{(E-127)}$ is used to convert in IEEE 754 single precision
Sign : 1 means number is negative
Exponent : 10000001 → value is 129
Mantissa : 11110000000000000000000
After putting these values we have
$(-1)^1 \times 1 \times 11110000000000000000000 \times 2^{(129-127)}$
$= -1 \times 111.1100.....0$
$= -7.75$

Topic: Operating System
Concept: Process Management
Sub-concept: CPU scheduling Algorithms
Concept-field: Shortest Job First (SJF)
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 1 Marks
Negative: 0 Marks

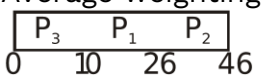
25. Three processes arrive at time zero with CPU bursts of 16, 20 and 10 milliseconds. If the scheduler has prior knowledge about the length of the CPU bursts, the minimum achievable average waiting time for these three processes in a non-preemptive scheduler (rounded to nearest. integer) is _____ milliseconds.

Ans. **(12)**

Sol. According to question we have to find minimum average waiting time
For minimum average waiting time we can use SJF

	BT	CT	WT
P_1	16	26	10
P_2	20	46	26
P_3	10	10	0

Average weighting time = $\frac{10+26+0}{3} = 12$



Point to remember
In this case TAT = CT because AT is 0

Since TAT = CT – AT ⇒ TAT = CT
WT = TAT – BT

Q.26-Q.39 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: -2/3)

Topic: Compiler Design
Concept: Syntax Directed Definition
Sub-concept: Basics of Syntax Direct Definition
Concept-field: Construction of Syntax Tree
Level: Hard
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

26. Consider the following grammar (that admits a series of declarations, followed by expressions) and the associated syntax directed translation (SDT) actions, given as pseudo-code :
P → D*E
D → int ID {record that ID.lexeme is of type int}
D → bool ID {record that ID.lexeme is of type bool}
E → E_1 + E_2 {check that E_1.type = E_2.type = int; set E.type := int}
E → !E_1 {check that E_1.type = bool; set E.type := bool}
E → ID {set E.type := int}
With respect to the above grammar, which one of the following choices is correct?
(1) The actions can be used to correctly type-check any syntactically correct program.
(2) The actions can be used to type-check syntactically correct integer variable declarations and integer expressions.
(3) The actions can be used to type-check syntactically correct boolean variable declarations and boolean expressions.
(4) The actions will lead to an infinite loop.

Sol. (2)
The grammar deriving only integer variables but not boolean variables. So, options 1, 3 and 4 are ruled out.

Topic: Database Management System
Concept: Structured Query Language (SQL)
Sub-concept: Basic Structure of SQL Query
Concept-field: Basic Structure of SQL Query

Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

27. The following relation records the age of 500 employees of a company, where empNo (indicating the employee number) is the key:

empAge(empNo, age)

Consider the following relational algebra expression:

$\Pi_{empNo}(empAge \underset{(age>age1)}{} \rho_{empNo1.age1}\ (empAge))$

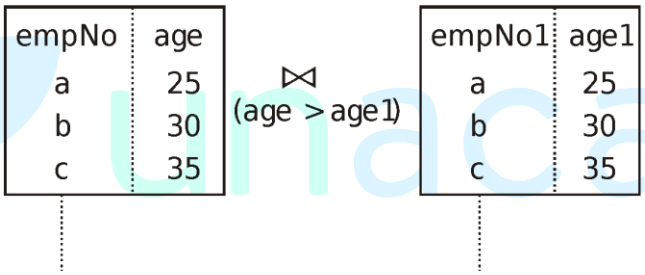
What does the above expression generate?

(1) Employee numbers of only those employees whose age is the maximum.
(2) Employee numbers of only those employees whose age is more than the age of exactly one other employee.
(3) Employee numbers of all employees whose age is not the minimum.
(4) Employee numbers of all employees whose age is the minimum.

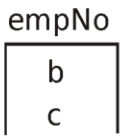
Ans. **(3)**

Sol. Expression: $\Pi_{empNo}\ (empAge \bowtie (age > age1)\ P_{emNo1,\ age1}\ (empAge))$

P: is used for renaming, in this case it is renaming empNo → empNo1 and age → age1 of the second table



Result :

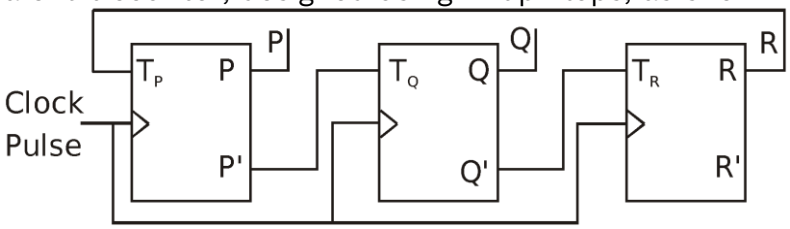


Employee number of all employees whose age is not the minimum.

Topic: Digital Logic Design
Concept: Sequential Circuit
Sub-concept: Flip-Flop Types & Analysis
Concept-field: T Flip-Flop
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ

Marks: 2 Marks
Negative: 0.66 Marks

28. Consider a 3-bit counter, designed using T flip-flops, as shown below:

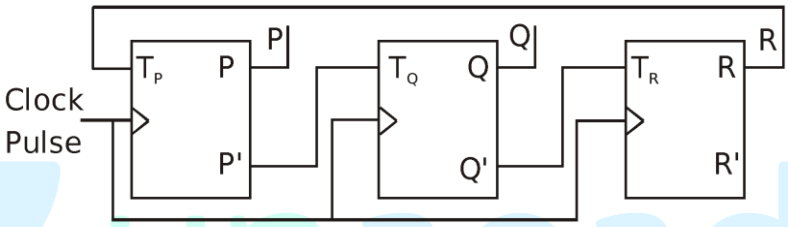


Assuming the initial state of the counter given by PQR as 000, what are the next three states?

(1) 011, 101, 000
(2) 001, 010, 111
(C) 011, 101, 111
(D) 001, 010, 000

Ans. **(1)**

Sol.



Initial state is given as PQR = 000

$T_P = R$, $T_Q = \bar{P}$, $T_R = \bar{Q}$

Initial state			Next state		
P_n	Q_n	R_n	P_{n+1}	Q_{n+1}	R_{n+1}
0	0	0	0	1	1
0	1	1	1	0	1
1	0	1	0	0	0

000 → 011 → 101

Topic: Computer Network
Concept: Data Link Layer
Sub-concept: Block Code
Concept-field: Hamming Code
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

29. Assume is the Which that a 12-bit Hamming codeword consisting of 8-bit data and 4 check bits is $d_8d_7d_6d_5c_8d_4d_4d_3d_2c_4d_1c_2c_1$, where the following tables:

Data bits							
d_8	d_7	d_6	d_5	d_4	d_3	d_2	d_1
1	1	0	X	0	1	0	1

Data bits			
c_8	c_4	c_2	c_1
1	1	0	X

Which one of the following choices gives of x and y?
(1) x is 0 and y is 0.
(2) x is 0 and y is 1.
(3) x is 1 and y is 0.
(4) x is 1 and y is 1.

Ans. **(1)**

Sol.

12	11	10	9	8	7	6	5	4	3	2	1
d_8	d_7	d_6	d_5	c_8	d_4	d_3	d_2	c_4	d_1	c_2	c_1
1	1	0	x	y	0	1	0	0	1	1	0

Checking for c_1 : 1,3,5,7,9,11 ⇒ 0 + 1 + 0 + 0 + x + 1 ⇒ x + 2,
x should be 0 for even parity

Checking for c_2 : 2,3,6,7,10,11 ⇒ 1 + 1 + 0 + 1 + 0 + 1 ⇒ 4

Checking for c_3 : 4,5,6,7,12 ⇒ 0 + 0 + 1 + 0 + 1 ⇒ 2

Checking for c_4 : 8,9,10,11,12 ⇒ x + y + 1 + 1 ⇒ x + y + 2,
if we put x = 0, then y = 0

Topic: Algorithms
Concept: Recurrence Methods
Sub-concept: Recurrence Relations Methods
Concept-field: Recurrence Tree
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

30. Consider the following recurrence relation.

$$T(n)\begin{cases} T(n/2)+T(2n/5) & \text{if } n>0 \\ 1 & \text{if } n=0 \end{cases}$$

Which one of the following options is correct?

(1) $T(n)=\theta(n^{5/2})$

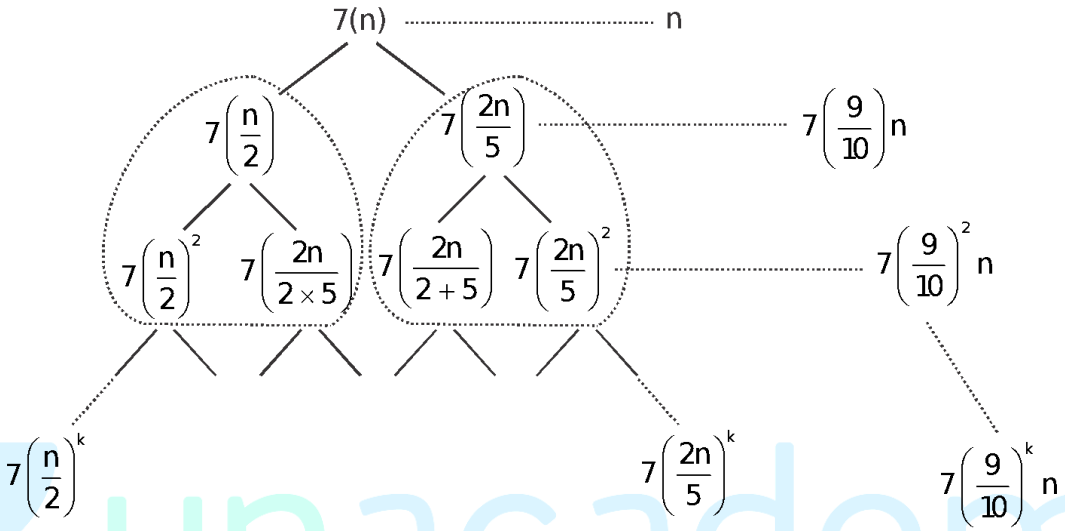
(2) $T(n)=\theta(n\log n)$

(3) $T(n) = \theta(n)$

(4) $T(n) = \theta\left((\log n)^{5/2}\right)$

Ans. **(3)**

Sol. $$T(n)\begin{cases} T(n/2) + T(2n/5) & \text{if } n > 0 \\ 1 & \text{if } n = 0 \end{cases}$$



If we look closely then left sub tree is having height more than right sub tree because of (n/2) > (2n/5), now height in the worst case will be decided by left sub tree i.e

$\left(\frac{n}{2}\right)^k = 1 \Rightarrow k = \log_2 n$

$$T(n) \le 7(n) + 7\left(\frac{9}{10}\right)n + 7\left(\frac{9}{10}\right)^2 n + \ldots\ldots 7\left(\frac{9}{10}\right)^k n$$

$$\le 7n\left[\left(\frac{9}{10}\right)^0 + \left(\frac{9}{10}\right)^1 + \ldots\ldots\left(\frac{9}{10}\right)^k\right]$$

NOTE : This is G.P series common factor r = 9/10

Since r < 1

$$S_n = a\left(\frac{1-r^{k+1}}{1-r}\right)$$

$$\le 7n\left[\frac{1-\left(\frac{9}{10}\right)^{k+1}}{1-\frac{9}{10}}\right]$$

$$\leq 7n\left[\frac{1-\left(\frac{9}{10}\right)^{\log_2 n+1}}{\frac{1}{10}}\right]$$ **NOTE :** putting the value of $k = \log_2 n$

$$\leq \underbrace{70(n)}_{n} - \underbrace{70n\left(\frac{9}{10}\right)^{\log_2 n+1}}_{n}$$

$T(n) \leq O(n)$

$T(n) \approx \theta(n)$

Topic: Compiler Design
Concept: Parsing
Sub-concept: Top-Down Parser
Concept-field: Non-Recursive Decent Parsing (LL1)
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

31. Consider the following context-free grammar where the set of terminals is {a, b, c, d, f}

$$S \rightarrow daT \mid Rf$$
$$T \rightarrow aS \mid baT \mid \in$$
$$R \rightarrow caTR \mid \in$$

The following is a partially-filled LL(1) parsing table.

	a	b	c	d	f	$
S			①	$S \rightarrow daT$	②	
T	$T \rightarrow aS$	$T \rightarrow baT$	③		$T \rightarrow \in$	④
R			$R \rightarrow caTR$		$T \rightarrow \in$	

Which one of the following choices represents the correct combination for the numbered cells in the parsing table ("blank" denotes that the corresponding cell is empty) ?

(1) ① $S \rightarrow Rf$ ② $S \rightarrow Rf$ ③ $T \rightarrow \in$ ④ $T \rightarrow \epsilon$

(2) ① Blank ② $S \rightarrow Rf$ ③ $T \rightarrow \in$ ④ $T \rightarrow \epsilon$

(3) ① $S \rightarrow Rf$ ② Blank ③ Blank ④ $T \rightarrow \epsilon$

(4) ① Blank ② $S \rightarrow Rf$ ③ blank ④ Blank

Ans. **(1)**

Sol.

$$S \rightarrow daT \mid Rf$$
$$T \rightarrow aS \mid baT \mid \in$$
$$R \rightarrow caTR \mid \in$$

The following is a partially-filled LL(1) parsing table.

	a	b	c	d	f	$
S			$S \rightarrow Rf$	$S \rightarrow daT$	$S \rightarrow Rf$	
T	$T \rightarrow aS$	$T \rightarrow baT$	$T \rightarrow \in$		$T \rightarrow \in$	$T \rightarrow \in$
R			$R \rightarrow caTR$		$T \rightarrow \in$	

First we build the table of FIRST and FOLLOW

	First	Follow
S → daT|Rf	{dcf}	{$cf}
T → aS|baT|∈	{ab∈}	{$cf}
R → caTR|∈	{c∈}	{f}

Topic: Database Management System
Concept: Transaction & Concurrency Control Technique
Sub-concept: Serializability
Concept-field: Conflict Serializability
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

32. Let $r_i(z)$ and $w_1(z)$ denote read and write operations respectively on a data item z by a transaction T_i. Consider the following two schedules.

S_1 : $r_1(x)$ $r_1(y)$ $r_2(x)$ $r_2(y)$ $w_2(y)$ $w_1(x)$

S_2 : $r_1(x)$ $r_2(x)$ $r_2(y)$ $w_2(y)$ $r_1(y)$ $w_1(x)$

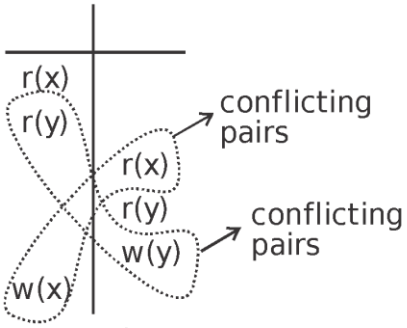
Which one of the following options is correct? u

(1) S_1 is conflict serializable, and S_2 is not conflict serializable.
(2) S_1 is not conflict serializable, and S_2 is conflict serializable.
(3) Both S_1 and S_2 are conflict serializable.
(4) Neither Si nor $9 is conflict serializable.

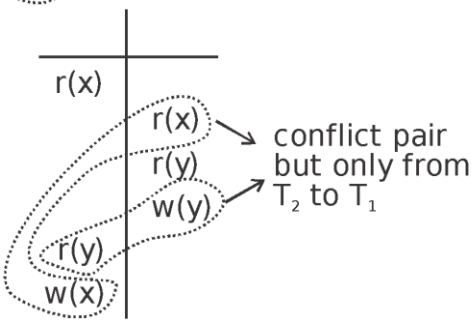
Ans. **(2)**

Sol. S_1 : $r_1(x)$ $r_1(y)$ $r_2(x)$ $r_2(y)$ $w_2(y)$ $w_1(x)$

S_2 : $r_1(x)$ $r_2(x)$ $r_2(y)$ $w_2(y)$ $r_1(y)$ $w_1(x)$



precedence graph has cycle
hence not conflict serializable



precedence graph has no cycle
therefore conflict serializable

Topic: Database Management System
Concept: Normalization
Sub-concept: Properties of Decomposition
Concept-field: Lossless Join Decomposition
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

33. Consider the relation R(P, Q, S, T, X, Y, Z, W) with the following functional dependencies.

PQ → X; P → YX; Q → Y; Y → ZW

Consider the decomposition of the relation R into the constituent relations according to the following two decomposition schemes.

D_1 : R = [(P, Q, S, T); (P, T, X); (Q, Y); (Y, Z, W)]

D_2 : R = [(P, Q, S); (T, X); (Q, Y); (Y, Z, W)

Which one of the following options is correct?

(1) D_1 is a lossless decomposition, but D_2 is a lossy decomposition.

(2) D_1 is a lossy decomposition, but D_2 is a lossless decomposition.

(3) Both D_1 and D_2 are lossless decompositions.

(4) Both D_1 and D_2 are lossy decompositions.

Ans. **(1)**

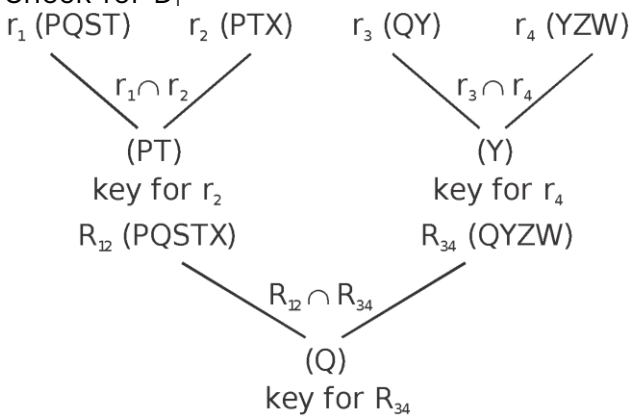
Sol. PQ → X; P → YX; Q → Y; Y → ZW

Given a decomposition we have to find lossless or lossy decomposition

D_1 : R = [(P, Q, S, T); (P, T, X); (Q, Y); (Y, Z, W)]

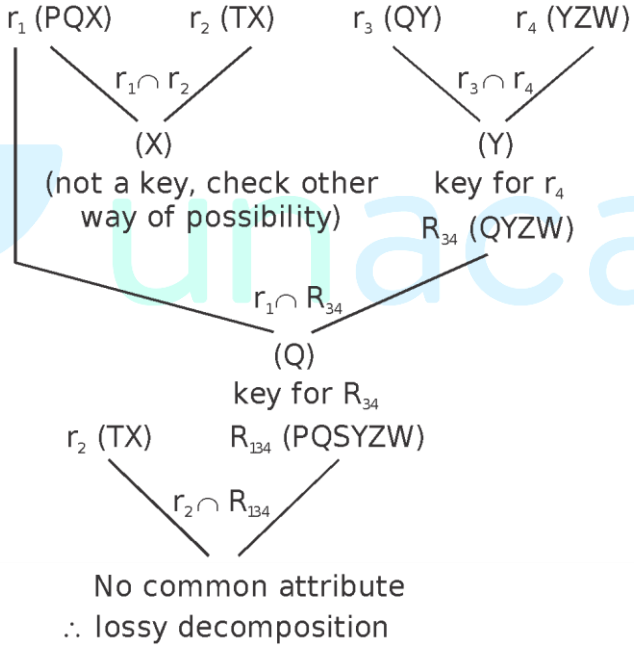
D_2 : R = [(P, Q, S); (T, X); (Q, Y); (Y, Z, W)

Check for D_1



Hence the D_1 is lossless decomposition.

Check for D_2



Topic: Discrete Mathematics
Concept: Group Theory
Sub-concept: Group Theory
Concept-field: Cyclic Group
Level: Moderate
Time: 120 Sec.

Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

34. Let G be a group of order 6, and H be a subgroup of G such that $1 < |H| < 6$. Which one of the following options is correct?
(1) Both G and H are always cyclic.
(2) G may not be cyclic, but H is always cyclic.
(3) G is always cyclic, but H may not be cyclic.
(4) Both G and H may not be cyclic.

Ans. **(2)**

Sol. Given G is a group of order 6.
H is subgroup of G such that $1 < H < 6$

According to Lagrange theorem:
A order of subgroup always divide the order of G

Order of G is 6, it may be cyclic or not
Order of H will be 2,3 (since the order is prime)
It will be cyclic always.

Topic: Engineering Mathematics
Concept: Probability & Distribution
Sub-concept: Random variables
Concept-field: Continuous & Discrete Random Variables
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

35. Consider the two statements.
S_1 : There exist random variables X and Y such that

$$\left(E\left[\left(X-E(X)\right)\left(Y-E(Y)\right)\right]\right)^2 > \text{Var}\left[X\right]\text{Var}\left[Y\right]$$

S_2 : For all random variables X and Y,

$$\text{Cov}\left[X,Y\right] = E\left[\left|X-E\left[X\right]\right|\left|Y-E\left[Y\right]\right|\right]$$

Which one of the following choices is correct?
(1) Both S_1 and S_2 are true.
(2) S_1 is true, but S_2 is false.
(3) S_1 is false, but S_2 is true.
(4) Both S_1 and S_2 are false.

Sol.
Statement-I:
$(\text{cov}\ (x, y))^2 = (E\ ((x - E\ (x))\ (y-E\ (y)))^2$
As per covariance formula

Now $E((x-e(x))(y-E(y)))^2 \leq E((x-E(x)))^2$
$E((y-E(y)))^2$

As $(E(xy))^2 \leq E(x^2)\,E(y^2)$

So, $(\text{cov}(x, y))^2 \leq E((x-E(x))^2)\,E((y-E(y))^2)$
$= \text{var}(x)\,\text{var}(y)$
So, First is False.
Statement-II:
$\text{Cov}[x, y] = E[|x - E[x]|\,|y - E[y]|]$
Covariance can be negative, positive or zero. Mean while, as there is mod function in expected value, it cannot be negative. So both cannot be equal in case of negative value of covariance.
Ans. Option (4)

Topic: Discrete Mathematics
Concept: Graph Theory
Sub-concept: Representing Graphs
Concept-field: Adjacency Matrix
Level: Moderate
Time: 120 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

36. Let G = (V, E) be an undirected unweighted connected graph. The diameter of G is defined as:

diam(G) = $\max_{u,v \in V}$ {length of shortest path, between u and v}
Let M be the adjacency matrix of G.
Define graph G_2 on the same set of vertices with adjacency matrix N, where

$$N_{ij} = \begin{cases} 1 & \text{if } M_{ij} > 0 \text{ or } P_{ij} > 0, \text{ where } P = M^2 \\ 0 & \text{otherwise} \end{cases}$$

Which one of the following statements is true?

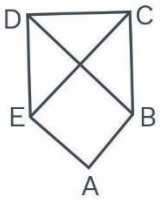
(1) $\text{diam}(G_2) \leq \lceil \text{diam}(G)/2 \rceil$

(2) $\lceil \text{diam}(G)/2 \rceil < \text{diam}(G_2) < \text{diam}(G)$

(3) $\text{diam}(G_2) = \text{diam}(G)$

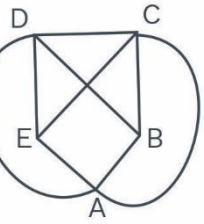
(4) $\text{diam}(G) < \text{diam}(G_2) \leq 2\,\text{diam}(G)$

Sol. Option I. Not Correct
Consider following graph

G = 

diam (G) = 2

$$M = \begin{bmatrix} 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \end{bmatrix} \quad M^2 = \begin{bmatrix} 0 & 1 & 2 & 2 & 1 \\ 1 & 0 & 1 & 1 & 3 \\ 2 & 1 & 0 & 1 & 1 \\ 2 & 1 & 1 & 0 & 1 \\ 1 & 3 & 1 & 1 & 0 \end{bmatrix}$$

G_2 = 

Diam (G_2) = 2

As we can see, diam (G_1) can never be less then diam (G_2).

Option 2: It can be seem from above example diam (G_1) = diam (G_2).

Option 3: Let G = = diam (G) = 4

$$M = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \quad M^2 = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \end{bmatrix}$$

G_2  = diam (G_2) = 2

This is course option

Option 1: diam (G_2) = diam (G_1)

This is wrong.

Topic: Programming & Data Structure

Concept: C Programming

Sub-concept: Basics of C Programming
Concept-field: Introduction
Level: Easy
Time: 90 Sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

37. Consider the following ANSI C program.

```
#include <stdio.h>
int main()
{
    int i, j, count;
    count = 0;
    i = 0;
    for (j = -3; j <= 3; j++)
    {
        if ((j >= 0) && (i++))
            count = count + j ;
    }
    count = count + i ;
    printf ("%d", count);
    return 0;
}
```

Which one of the following options is correct?

(1) The program will not compile successfully.
(2) The program will compile successfully and output 10 when executed.
(3) The program will compile successfully and output 8 when executed.
(4) The program will compile successfully and output 13 when executed.

Ans. **(2)**

Sol.

```
#include <stdio.h>
int main()
{
    int i, j, count;
    count = 0;
    i = 0;
    for (j = -3; j <= 3; j++)
    {
        if ((j >= 0) && (i++))
            count = count + j ;
    }
    count = count + i ;
    printf ("%d", count);
    return 0;
}
```

For j = –3
    if ((j >= 0) && (i++))
    False,
For j = –2
    if ((j >= 0) && (i++))

False,

Similarly for j = –1

When j = 0,
if ((j >= 0) && (i++)) count = count + j
True, (because i returns 0 and increment to 1)

When j = 1,
if ((j >= 0) && (i++)) count = count + j
True, (because i returns 1 and increment to 2)

When j = 2,
if ((j >= 0) && (i++)) count = count + j
True, (because i returns 2 and increment to 3)

When j = 3,
if ((j >= 0) && (i++)) count = count + j
True, (because i returns 3 and increment to 4) (i = 4) (count = 6)

count = count + i
= 6 + 4
= 10

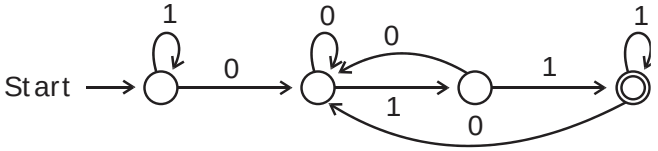
Topic: Theory of Computation
Concept: Finite Automata
Sub-concept: Finite Acceptor
Concept-field: Deterministic Finite Automata
Level: Moderate
Time: 120 sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

38. Consider the following language.

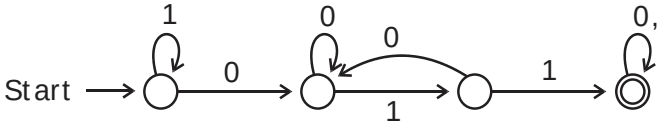
$L = \{w \in \{0,1\}^* \mid w \text{ ends with the substring } 011\}$

Which one of the following deterministic finite automata accepts L?

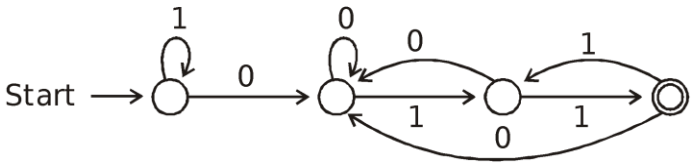
(1)



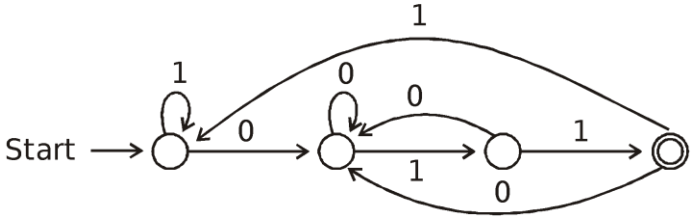
(2)



(3)



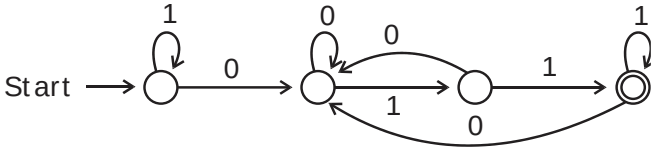
(4)



Ans. **(4)**

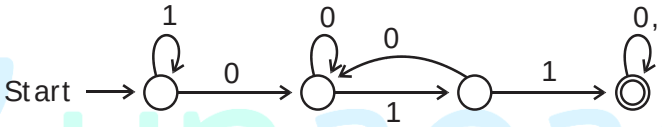
Sol. $L = \{w \in \{0,1\}^* \mid w \text{ ends with the substring } 011\}$

(1)



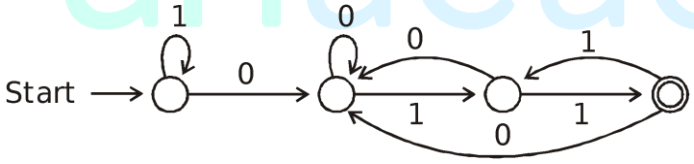
May ending with 0111*

(2)



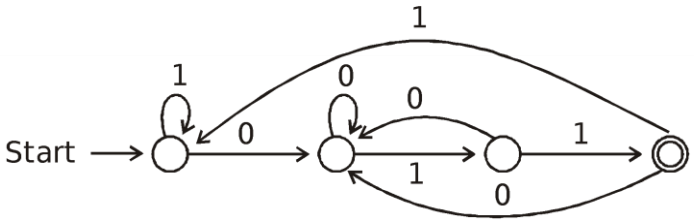
May ending with 011(0+1)*

(3)



May ending with 011(11)*

(4)



Always end with 011

Topic: Theory of Computation
Concept: Decidability
Sub-concept: Basics of Decidability

Concept-field: Decidability for Recursive Enumerable Language
Level: Hard
Time: 120 sec.
Q. Type: MCQ
Marks: 2 Marks
Negative: 0.66 Marks

39. For a Turing machine M, $\langle M \rangle$ denotes an encoding of M. Consider the following two languages.

$L_1 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on all inputs}\}$

$L_2 = \{\langle M \rangle \mid M \text{ takes more than 2021 steps on spine input}\}$

Which one of the following options is correct?

(1) Both L_1 and L_2 are decidable.
(2) L_1 is decidable and L_2 is undecidable.
(3) L_1 is undecidable and L_2 is decidable.
(4) Both L_1 and L_2 are undecidable.

Sol. Both turing machine L_1 and L_2 are decidable.

L_1: Counting any number of bits/steps always decidable (Recursive). M takes more than 2021 steps on all inputs will always decidable because whether turing machine will accept or reject.

L_2: For some inputs (at least one) we can design TM it takes more than 2021 inputs it may half on accepting state or rejecting state, so L_2 is also decidable.

Hence, Both L_1 and L_2 are decidable

Q.40-Q.47 Multiple Select Question (MSQ), carry TWO mark each (no negative marks)

Topic: Algorithm
Concept: Dynamic Programming
Sub-concept: Basics of Dynamic Programming
Concept-field:
Level: **Medium**
Time: **120 sec**
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

40. Define R_n, to be the maximum amount earned by cutting a rod of length n meters into one or more pieces of integer length and selling them. For i > 0, let p[i] denote the selling price of a rod whose length is i meters. Consider the array of prices:

p[1] = 1, p[2] = 5, p[3] = 8, p[4] = 9, p[5] = 10, p[6] = 17, p[7] = 18

Which of the following statements is/are correct about R_7?

(1) $R_7 = 18$

(2) $R_7 = 19$

(3) R_7 is achieved by three different solutions.

(4) R_7 cannot be achieved by a solution consisting of three pieces.

Ans. **(1,3)**

Sol. One single piece off length 7 meter will give 18

i.e. P[7] = 18

P[2] + P[3] + P[2] = 5 + 8 + 5 ⇒ 18

and there is one more way

P[1] + P[6] = 1 + 17 ⇒ 18

Topic: Discrete mathematics
Concept: Graph Theory
Sub-concept: Connectivity
Concept-field: Connected Components
Level: Moderate
Time: 120 Sec.
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

41. An articulation point in a connected graph is a vertex such that removing the vertex and its incident edges disconnects the graph into two or more connected components.

Let T be a DFS tree obtained by doing DFS in a connected undirected graph H. Which of the following options is/are correct?

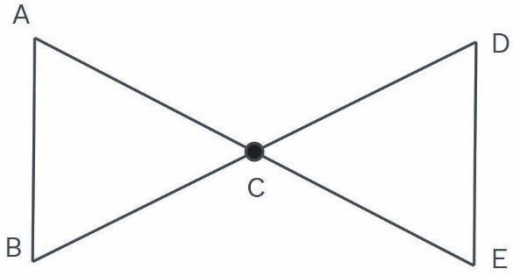
(1) Root of T can never be an articulation point in G.

(2) Root of T is an articulation point in G if and only if it has 2 or more children.

(3) A leaf of T can be an articulation point in G.

(4) If u is an articulation point in G such that x is an ancestor of u in T and y is a descendent of u in T, then all paths from x to y in G must pass through u.

Sol. (2)



We can do these type of questions by negating the statements.

(a) DFS

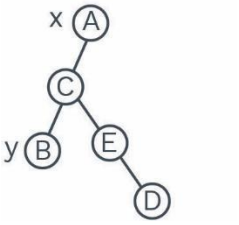
False:

(b) True: Because articulation point is connecting two or more components

\ If it is a root it must have two or more children

(c) False: We can new make 'C'as leaf as it will lead to some verticals Audis covered.

(d) False:



But direct path between A and B possible.

Topic: Digital Logic Design
Concept: Boolean Algebra
Sub-concept: Boolean Function
Concept-field: Complement of Boolean function
Level: Moderate
Time: 120 Sec.
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

42. Consider the following Boolean expression.

$$F = (X + Y + Z)(\bar{X} + Y)(\bar{Y} + Z)$$

Which of the following Boolean expressions is/are equivalent to T (complement of F)?

(1) $(\bar{X} + \bar{Y} + \bar{Z})(X + \bar{Y})(Y + \bar{Z})$

(2) $X\bar{Y} + \bar{Z}$

(3) $(X + \bar{Z})(\bar{Y} + \bar{Z})$

(4) $X\bar{Y} + Y\bar{Z} + \bar{X}\bar{Y}\bar{Z}$

Sol. (2), (3) & (4)

$$F = (X + Y + Z)(\bar{X} + Y)(\bar{Y} + Z)$$

(XX' + XY + X'Y + Y + X'Z + YZ) (Y' + Z) (XX' = 0)

(XY + X'Y + Y + X'Z + YZ) (Y' + Z)

{Y(X + X' + 1 + z) + X'Z} (Y' + Z) (1 + any value = 1)
(Y + X'Z) (Y' + Z)
YY' + YZ + X'Y'Z + X'Z
YZ + X'Y'Z + X'Z
YZ + X'Z(1 + Y')
YZ + X'Z
Taking complement
(YZ + X'Z)'
{(YZ)'(X'Z)'} (Demorgan's Law)
(Y' + Z') (X + Z')
XY' + Y'Z' + XZ' + ZZ'
XY' + Y'Z' + XZ'
XY' + (X + X')Y'Z' + X(Y + Y')Z'
XY' + XY'Z' + X'Y'Z' + XYZ' + XY'Z'
XY' (1 + Z' + Z') + Z' (X'Y' + XY) (X'Y' + XY = 1)
XY' + Z'

(2) XY' + Z'

(3) (X + Z') (Y' + Z')
XY' + XZ' + Y'Z' + Z'
XY' + Z'(X + Y' + 1)
XY' + Z'

(4) XY' + YZ' + X'Y'Z'
XY' + (X + X')YZ' + X'Y'Z'
XY' + XYZ' + X'YZ' + X'Y'Z'
XY' + XYZ' + X'Z'(Y + Y') (Y + Y' = 1)
XY' + XYZ' + X'Z'
X(Y' + YZ') + X'Z'
X(Y' + Z') + X'Z' {(Y' + YZ') = (Y' + Z')}
XY' + XZ' + X'Z'
XY' + Z'(X + X')
XY' + Z'

So, option 2,3 and 4 are equivalent.

Topic: Discrete Mathematics
Concept: Set Theory
Sub-concept: Relations
Concept-field: Properties of Relations
Level: Moderate
Time: 120 sec.
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

43. A relation R is said to be circular if aRb and bRc together imply cRa. Which of the following options is/are correct?

(1) If a relation S is reflexive and symmetric, then S is an equivalence relation.
(2) If a relation S is circular and symmetric, then S is an equivalence relation.
(3) If a relation S is reflexive and circular, then S is an equivalence relation.
(4) If a relation S is transitive and circular, then S is an equivalence relation.

Sol. (3)

If R is reflexive and circular, then it is symmetric because assume aRb. Then since R is reflexive, we have bRb. Since R is circular. So, aRb, bRb will mean that we have bRa. So, R is symmetric.

If R is reflexive and circular then it is transitive because assume aRb, bRc. Since R is circular as cRa then R is symmetric as aRc so R is transitive. So, option 3 is correct.

Topic: Computer Network
Concept: Transport Layer
Sub-concept: Transmission Control Protocol (TCP)
Concept-field: TCP Services
Level: Moderate
Time: 90 Sec.
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

44. A TCP server application is programmed to listen on port number P on host S. A TCP client is connected to the TCP server over the network.

Consider that while the TCP connection was active, the server machine S crashed and rebooted. Assume that the client does not use the TCP keepalive timer.

Which of the following behaviors is/are possible?

(1) If the client was waiting to receive a packet, it may wait indefinitely.
(2) The TCP server application on S can listen on P after reboot.
(3) If the client sends a packet after the server reboot, it will receive a RST segment.
(4) If the client sends a packet after the server reboot, it will receive a FIN segment.

Sol. (1), (2) & (3)

(a) If the client was waiting to receive a packet, it may wait indefinitely, i.e, there is possibility of waiting indefinitely waiting because client is not using keep alive timer.
(a is true)

(b) The TCP server application on Scan listen on P after reboot, since there is a possibility that after restart server goes into listen state.
(b is true)

(c) If the client sends a packet after the server reboot, it will receive a RST segment, because it will try to terminate all the previous connection established.
(c is true)

(d) If the client sends a packet after the server reboot, it will receive a FIN segment, false, since server already terminated and there is no connection FIN will not be send.
(d is false)

Topic: Computer Network
Concept: Network Layer & Transport Layer
Sub-concept:
Concept-field:
Level: **medium**
Time: **120sec**
Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

45. Consider two hosts P and Q connected through a router R. The maximum transfer unit (MTU) value of the link between P and R is 1500 bytes, and between R and Q is 820 bytes.
A TCP segment of size 1400 bytes was transferred from P to Q through R, with IP identification value as Ox1234. Assume that the IP header size is 20 bytes. Further, the packet is allowed to be fragmented, i.e., Don't Fragment (DF) flag in the IP header is not set by P.
Which of the following statements is/are correct?
(1) Two fragments are created at R and the IP datagram size carrying the second fragment is 620 bytes.
(2) If the second fragment is lost, R will resend the fragment with the IP identification. value 0x1234.
(3) If the second fragment is lost, P is required to resend the whole TCP segment.
(4) TCP destination part can be determined by analyzing only the second fragment.

Sol. (1) & (3)

Two fragments are created at R,
First fragment is 800+20(Ip header size) = 820 bytes
Second fragment is 600+20(Ip header size) = 620 bytes.

If the second fragment is lost, P is required to resend the whole TCP segment.

Topic: Operating System
Concept: Synchronization
Sub-concept: Semaphore
Concept-field:
Level: Moderate
Time: 90 Sec.
Q. Type: MSQ

Marks: 2 Marks
Negative: 0 Marks

46. Consider the following pseudocode, where S is a semaphore initialized to 5 in line number 2 and counter is a shared variable initialized to 0 in line number 1. Assume that the increment operation in line number 7 is not atomic.

```
1.  int counter = 0;
2.  Semaphore S = init(5);
3.  void parop (void)
4.  {
5.      wait (S);
6.      wait (S);
7.      counter++;
8.      signal(S);
9.      signal(S);
10. }
```

If five threads execute the function parop concurrently, which of the following program behavior(s) is/are possible?

(1) The value of counter is 5 after all the threads successfully complete the execution of parop.

(2) The value of counter is 1 after all the threads successfully complete the execution of parop.

(3) The value of counter is 0 after all the threads successfully complete the execution of parop.

(4) There is a deadlock involving all the threads.

Sol.

Counter value 5 is possible if threads run in any sequence, i.e., one by one.
So, option (A) is true.

Counter value 1 is also possible if a thread which is entered in first and read the counter = 0 and writing counter value 5 at the end of after executing all other threads.
So, option (B) is true.

if there are two wait() and two signal() for each thread. So, if when these threads will be completed, final counter value can never be 0.
So, option (C) is false.

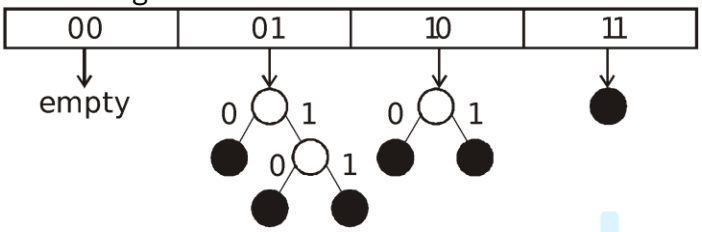
Five threads getting pre-empted after executing only first wait(S); line-5.
Now, second wait(S); line-6, will cause deadlock.
So, option (D) is true.

Topic: **Programming and data structures**
Concept: **Hashing**
Sub-concept: **Hashing Techniques**
Concept-field:
Level: **medium**
Time: **120sec**

Q. Type: MSQ
Marks: 2 Marks
Negative: 0 Marks

47. Consider a dynamic hashing approach for 4-bit integer keys:
1. There is a main hash table of size 4.
2. The 2 least significant bits of a key is used to index into the main hash table.
3. Initially, the main hash table entries are empty.
4. Thereafter, when more keys are hashed into it, to resolve collisions, the set of all keys corresponding to a main hash table entry is organized as a binary tree that grows on demand.
5. First, the 3rd least significant bit is used to divide the keys into left and right subtrees.
6. To resolve more collisions, each node of the binary tree is further sub-divided into left and right subtrees based on the 4th least significant bit.
7. A split is done only if it is needed, i.e., only when there is a collision.

Consider the following state of the hash table.



Which of the following sequences of key insertions can cause the above state of the hash table (assume the keys are in decimal notation)?
(1) 5, 9, 4, 13, 10, 7
(2) 9, 5, 10, 6, 7, 1
(3) 10, 9, 6, 7, 5, 13
(4) 9, 5, 13, 6, 10, 14

Sol. Given keys for insertion: 10, 9, 6, 7, 5, 13

Number	10	9	6	7	5	13
Binary	1010	1001	0110	0111	0101	1101

Since the given dynamic hashing approach is for 4-bit integer keys and the keys are inserted into the main hash table based on their 2-least significant bits

Table entry	Keys
01	9, 5, 13
10	10, 6
11	7

Hence:

Now for collision resolution 3rd least significant bit is used to divide the keys into left and right sub-trees

Since collision at table entry 01 therefore the third least significant bit is checked and 9 is placed as the left child of 01.
Similarly for 5 and 13 the fourth least significant bit is checked. They key 5 is placed as left child and 13 as right child.
Note: Left child: least significant bit 0

Right child: least significant bit 1
Similarly for entries 10 and 6. Checking the 3rd least significant bit 10 is placed as left child and 6 is placed as right child of 10.
Ans. Option (1)

Q.48-Q.55 Numerical Answer Type (NAT), carry TWO mark each (no negative marks)

Topic: Programming & Data Structure
Concept: C Programming
Sub-concept: Functions
Concept-field: Basics of Functions
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

48. Consider the following ANSI C function:

```
int SimpleFunction (int Y[] , int n, int x)
{
    int total = Y[0], loopindex;
    for (loopindex = 1; loopindex <= n – 1; loopindex++)
            total = x * total + Y[loopIndex];
    return total;
}
```

Let. Z be an array of 10 elements with Z [i] = 1. for all i such that $0 \le i \le 9$. The value returned by SimpleFunction(Z, 10, 2) is _____.

Sol. 1023
Initially, total = 1
for (loopIndex =1; loopIndex< = n−1; loopIndex++)
total = x* total + Y[loopIndex];
total = 2 * 1 + 1 = 3
again total = 2 * 3 + 1 = 7
again total = 2 * 7 +1 = 15
again total = 2 * 15 +1 = 31 and so on
which form a series like: $2^{(i+1)} - 1$ and the value of i should be $0 \le i \le 9$.
So, $2^{(9+1)} - 1 = 2^{10} - 1 = 1024\text{-}1 = 1023$

Topic: Computer Network

Concept: Data Link Layer
Sub-concept: Flow Control
Concept-field: Flow Control Protocol
Level: Moderate
Time: 90 sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

49. Consider the sliding window flow-control protocol operating between a sender and a receiver over a full-duplex error-free link. Assume the following:
- The time taken for processing the data frame by the receiver is negligible.
- The time taken for processing the acknowledgement frame by the sender is negligible.
- The sender has infinite number of frames available for transmission.
- The size of the data frame is 2,000 bits and the size of the acknowledgement frame is 10 bits.
- The link data rate in each direction is 1 Mbps (= 10^6 bits per second).
- One way propagation delay of the link is 100 milliseconds.

The minimum value of the sender's window size in terms of the number of frames, (rounded to the nearest integer) needed to achieve a link utilization of 50% is _____.

Sol.

Given-

Size of data (D) = 2000 bits and acknowledgement frame size is 10 bits.

So, total data size = 2010 bits
Bandwidth (B) = 2 * 10^6 bps (2Mbps)
Propagation delay (T_p) = 100 milliseconds
So, transmission time (T_t) = L/B = 2010/2 * 10^6 = 2.01 milliseconds
Window size (N) = ?
For 50% utilization, efficiency will be,

$$\frac{1}{2} = \frac{N}{1+2a}$$

$$\frac{1}{2} = \frac{N}{1+2\frac{Tp}{Tt}} \qquad (a = T_p / T_t)$$

$$\frac{1}{2} = \frac{N}{1+2*\frac{100}{2.01}}$$

N = 100.50 / 2
N = 50.25
N = 51 (nearest integer)

Topic: Compiler Design
Concept: Intermediate Code Generation (ICG)
Sub-concept: Basics of ICG
Concept-field: Direct Acyclic Graphs (DAGs)

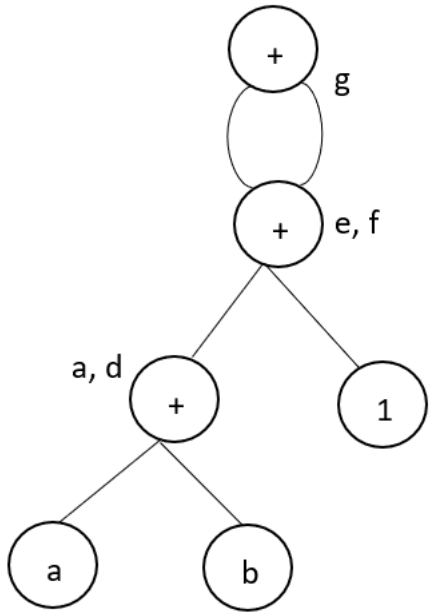
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

50. Consider the following C code segment:

```
a = b + c;
e = a + 1;
d = b + c;
f = d + 1;
g= e + f;
```

In a compiler, this Code segment is represented internally as a directed acyclic graph (DAG). The number of nodes in the DAG is _____.

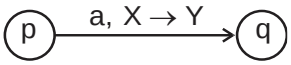
Sol. 6



Total number of nodes in DAG will be 6.

Topic: Theory of Computation
Concept: Context Free language
Sub-concept: Pushdown Automata
Concept-field:
Level: Moderate
Time: 150 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

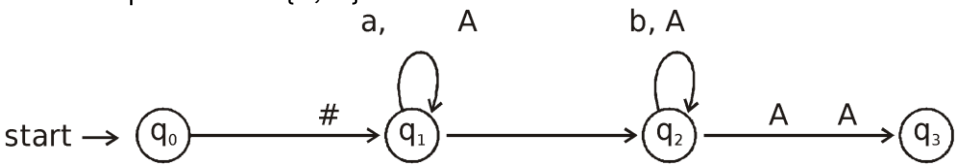
51. In a pushdown automaton $P = (Q, \Sigma, \Gamma, \delta, q_0, F)$ a transition of the form,



where p, q ∈ Q, a ∈ Σ ∪ {ε}, and X, Y ∈ Γ ∪ {ε}, represents

$$(q, Y) \in \delta(p, a, X).$$

Consider the following pushdown automaton over the input alphabet Σ = {a, b} and stack alphabet Γ = {#, A}.



The number of strings of length 100 accepted by the above pushdown automaton is _____.

Sol. 50

Given PDA can accept the language (L1) = $\{a^x, x>=1\}$ upto 100 length

And another language (L2) is accepted by PDA = $\{a^y b^z, y>z\}$

Therefore, the language L = $\{a^x, x>=1\}$ U $\{a^y b^z, y>z\}$

$$L = \{a^x b^y, x > y \;\&\&\; x + y = 100\}$$

Examples: $a^{51}b^{49}$, $a^{52}b^{48}$, $a^{51}b^{49}$, $a^{51}b^{49}$,...., $A^{99}b^{1}$

So, number of strings are 50.

Topic: Engineering Mathematics
Concept: Linear Algebra
Sub-concept: Eigen Value & Eigen vector
Concept-field: Eigen Value
Level: Easy
Time: 120 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

52. Consider the following matrix.

$$\begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

The largest eigenvalue of the above matrix is _____.

Sol. 3

We can directly calculate maximum eigen value by adding each row and take maximum of each row addition. Each row addition will be 3 and maximum also 3. So, answer will be 3.

Topic: Computer Organization & Architecture
Concept: Pipelining
Sub-concept: Basics of Pipelining
Concept-field: Efficiency of Pipeline
Level: Moderate
Time: 120 sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

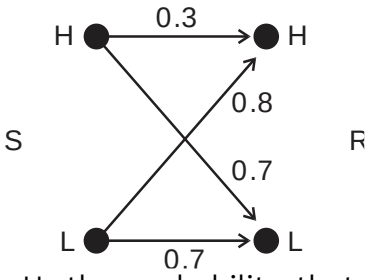
53. A five-stage pipeline has stage delays of 150, 120, 150, 160 and 140 nanoseconds. The registers that are used between the pipeline stages have a delay of 5 nanoseconds each. The total time to execute 100 independent instructions on this pipeline, assuming there are no pipeline stalls, is _____ nanoseconds.

Sol. 17,160

Number of instructions (n) = 100
Total stage (k) = 5
Pipeline cycle time (t) = maximum of stage delay + Register delay
t = maximum (150, 120, 150, 160, 140) + 5
t = 160 + 5
t = 165 nanoseconds
Total time = (k + n - 1) * t
Total time = (5 + 100 - 1) * 165
Total time = 104 * 165
Total time = 17,160 nanoseconds

Topic: Engineering Mathematics
Concept: Probability
Sub-concept: Basics of Probability
Concept-field:
Level: Moderate
Time: 90 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

54. A sender (S) transmits a signal, which can be one of the two kinds: H and L with probabilities 0.1 and 0.9 respectively, to a receiver (R).
In the graph below, the weight of edge (u, v) is the probability of receiving v when u is transmitted, where u, v ∈ {H, L}. For example, the probability that the received signal is L given the transmitted signal was H, is 0.7.



If the received signal is H, the probability that the transmitted signal was H (rounded to 2 decimal places) is _____.

Sol. 0.04

Sender (S) transmit the signal H and L with probability 0.1 and 0.9 respectively to a receiver. And Receive Signal is H, the probability that the transmitted signal was H. So,

$$= \frac{(0.1*0.3)}{[(0.1*0.3)+(0.9*0.8)]}$$

$$= \frac{0.03}{(0.03+0.72)}$$

$$= \frac{0.03}{0.75}$$

$$= 0.04$$

Topic: Computer Organization & Architecture
Concept: Machine Instructions
Sub-concept: Instructions Classification
Concept-field: Program Control Instructions
Level: Moderate
Time: 120 Sec.
Q. Type: NAT
Marks: 2 Marks
Negative: 0 Marks

55. Consider the following instruction sequence where registers R1, R2 and R3 are general purpose and MEMORY[X] denotes the content at the memory location X.

Instruction	Semantics	Instruction Size (bytes)
MOV R1, (5000)	R1 ← MEMORY [5000]	4
MOV R2, (R3)	R2 ← MEMORY [R3]	4
ADD R2, R1	R2 ← R1 + R2	2
MOV (R3), R2	MEMORY[R3] ← R2	4
INC R3	R3 ← R3 + 1	2

DEC R1	R1 ← R1 – 1	2
BNZ 1004	Branch if not zero to the given absolute address	2
HALT	Stop	1

Assume that the content of the memory location 5000 is 10. and the content of the register R3 is 3000. The content of each of the memory locations from 3000 to 3010 is 50. The instruction sequence starts from the memory location 1000. All the numbers are in decimal format. Assume that the memory is byte addressable.
After the execution of the program, the content of memory location 3010 is _____.

Sol. 50

1. MOV R1, (5000)
   Content at memory location 5000 is 10. So, 10 is assign to the R1 (R1 = 10)
2. MOV R2, (R3)
   Content of R3 is 3000 and the value at 3000 is 50 (50 at each location from 3000 to 3010). So, 50 is assign to the R2 (R2 = 50)
3. ADD R2, R1
   Adding the values of R1 & R2. So, the value is 60 and assign to R2 (R2 = 60)
4. MOV (R3), R2
   MOVE (3000), 60. So, 60 will be present at address 3000.
5. INC R3
   Increment in R3, so pointing at address 3001
6. DEC R1
   Now decrement in R1. So, value of R1 is 9 (R1 = 9)
7. BNZ 1004
   Jump on second statement because the instruction sequence starts from the memory location 1000 and first instruction size is 4 bytes. So, control points to the second statement.
   Similarly, values at 3000 is 60, 3001 is 59, 3002 is 58 ..... 3009 is 51. After in R1 = 0 Condition false. Then the content at 3010 will be as it is means 50.
9. HALT
   So, answer will be 50 at address 3010.
