

OVERALL ANALYSIS

Solution Report

[All](#) [Correct Answers](#) [Wrong Answers](#) [Not Attempted Questions](#)

Q.1)

The tightest lower bound on the number of comparisons, in the worst case, for any comparison based sorting algorithm is of the order of?

Subject: Algorithms

Max Marks: 1

 A) $O(n)$ B) $O(n \log n)$

Correct Option

Solution: (B)

The number of comparisons that a comparison based sort algorithm requires is given by $O(n \log n)$, where n is the number of elements to sort.

 C) $O(1)$ D) $O(n^2)$

Q.2)

What is the efficient asymptotic running time to find the median of a sorted array of size n ?

Subject: Algorithms

Max Marks: 1

 A) $O(n)$ B) $O(\log n)$

Correct Option

 C) $O(1)$

Solution: (C)

If array is odd sized pick the middlemost. If even, pick the two middlemost and average. Either way, this can be done in constant number of steps, so $O(1)$.

 D) $O(n \log n)$

Q.3)

Suppose $T(n) = n \sqrt{n}$. Consider the following statements.

Subject: Algorithms

Max Marks: 1

(A) $T(n)$ is $O(n^3)$ (B) $T(n)$ is $O(n \log n)$ A) Both (A) and (B) are correct B) (A) is correct, but (B) is not

Correct Option

Solution: (B)

\sqrt{n} is not $O(\log n)$, so $n \sqrt{n}$ is not $O(n \log n)$. $O(n^2)$ is a tighter bound than $O(n^3)$, but the weaker bound is also correct.

 C) (B) is correct, but (A) is not D) Neither (A) nor (B) is correct

Q.4)

Consider the following 4 matrices with dimensions A : (5 x 4)

Subject: Algorithms

Max Marks: 1



B : (4 x 6) C : (6 x 2) D : (2 x 7). Using the recursive definition for matrix chain multiplication, compute the values for X and Y in the table below.

(For example table entry [BC] represents the minimum number of scalar multiplication required to multiply matrices B and C : $4 * 6 * 2 = 48$)

D	C	B	A	
A	Y	X	120	0

B	104	48	0
C	84	0	
D	0		

A X = 88 and Y = 120

B X = 116 and Y = 156

C X = 88 and Y = 158

Correct Option

Solution: (C)

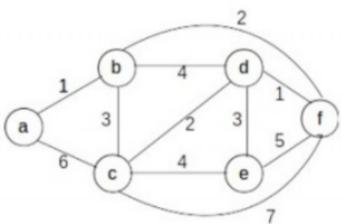
D X = 88 and Y = 244

Q.5)

Which of the following can be the sequence of edges added to the MST using Prim's algorithm?

Subject: Algorithms

Max Marks: 1



A (c,d) (d,f) (a,b) (d,e) (b,f)

B (d,e) (d,f) (b,f) (a,b) (d,c)

C (d,e) (d,f) (d,c) (b,f) (a,b)

D (d,f) (c,d) (b,f) (a,b) (d,e)

Correct Option

Solution: (D)

Q.6)

Consider the following pseudocode. Assume that IntStack is integer stack. What does the DoSomething function do?

```
void DoSomething(int n)
{
    IntStack s = new IntStack();
    s.push(0);
    s.push(1);
    for (int i = 0; i < n; i++)
    {
        int a = s.pop();
        int b = s.pop();
        s.push(a);
        s.push(a + b);
        printf("%d", b);
    }
}
```

A Prints numbers from 0 to n-1

B Prints numbers from n-1 to 0

C Prints first n Fibonacci numbers

Correct Option

Solution: (C)

Everytime top of the stack is pushed with next fibonacci number which is being printed.

D Prints first n Fibonacci numbers in reverse order.

Q.7)

Subject: Algorithms

Max Marks: 1



Which one of the following rates of growth is correct for the number of leaves $L(N)$ in a binary tree with N nodes?

A $L(N) = \Theta(N)$

Correct Option

Solution: (A)

The number of leaves in a binary tree with N nodes is $\lceil N/2 \rceil = \Theta(N)$.

B $L(N) = \Theta(\log N)$

C $L(N) = \Theta(N^2)$

D $L(N) = \Theta(N \log N)$

Q.8)

Subject: Algorithms

Max Marks: 1



Consider the following algorithm to build a balanced search tree from a sorted sequence.

i. Make the midpoint of the sequence the root of the tree

ii. Recursively construct balanced search trees from elements to the left and right of the midpoint and make these the left and right subtrees of the root.

What is the complexity of this procedure where the sorted sequence is a sorted array?

A $O(n^2)$

B $O(n \log n)$

C $O(n)$

Correct Option

Solution: (C)

The recursive construction has the recurrence $T(n) = 2T(n/2) + O(1)$ since we can find the midpoint of an array in constant time

D Depends on the contents of the original sequence

Q.9)

Subject: Algorithms

Max Marks: 1



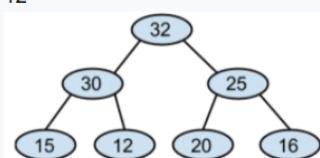
The elements 32,15,20,30,12,25,16 are inserted one by one in the given order into a MAX heap that is initially empty. Which of the following node does not lie in the right subtree of the root ?

A 12

Correct Option

Solution: (A)

12



B 25

C 16

D 20

Q.10)

Subject: Algorithms

Max Marks: 1



A list of n strings, each of length at most n , is sorted in lexicographic order using the merge sort algorithm. Which of the following gives the worst case complexity of this?

Hint: Account for the cost of comparing two strings also.

A $O(n^2)$

B $O(n \log n)$

C $O(n^2 + \log n)$

D $O(n^2 \cdot \log n)$

Correct Option

O($n^2 \log n$)

Correct Option

Solution: (D)

Merge sort requires $O(n \log n)$ comparisons. So for string of length k , a string comparison at ?most requires $O(k)$. Therefore sorting k length string will take $O(k^2 \log k)$.

Q.11)

Subject: Algorithms

Max Marks: 1

An airline charges a different price for each direct flight, depending on the sector. For each sequence of hopping flights, the ticket price is the sum of the fares of the individual sectors. Make My Trip has precalculated the cheapest routes between all pairs of cities so that it can offer an optimum choice instantly to customers visiting its website. Overnight, the government has added a 17% luxury service charge to the cost of each individual flight. Which of the following most accurately describes the impact of this surcharge on Make My Trip's computation?

A

There is no impact. Cheapest routes between all pairs of cities remains unchanged.

Correct Option

Solution: (A)

The surcharge increases the cost of every path uniformly by 17%, so there is no change in the relative order of paths in terms of cost.

B

The precomputed cheapest route may not longer be optimal where there is a shorter route in terms of number of flights.

C

The precomputed cheapest route may not longer be optimal where there is a longer route in terms of number of flights.

D

The impact is unpredictable

Q.12)

Subject: Algorithms

Max Marks: 1

Suppose a circular queue is implemented with an array of n elements. What is the condition for a queue being full?

A

REAR == FRONT

B

(REAR+1) mod n == FRONT

Correct Option

Solution: (B)

C

(FRONT+1) mod n == REAR

D

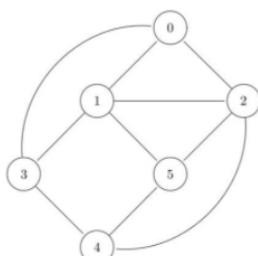
None of Above

Q.13)

Subject: Algorithms

Max Marks: 1

Which sequence corresponds to that of depth first search for the graph given below. The search starts at vertex 0 and lexicographic ordering is assumed for the edges emanating from each vertex.



A

0 1 2 4 3 5

Correct Option

Solution: (A)

0 1 2 4 3 5

A correct sequence of DFS traversal is 0 1 2 4 3 5

There is no edge between 2 and 3 and also 5 which is connected to 2 is unvisited.

B

0 1 2 5 4 3

C

0 1 2 3 4 5

D

0 1 3 4 2 5

Q.14)

Subject: Algorithms

Max Marks: 1

For an undirected graph G. If number of vertices is 100 and number of edges is 300. The minimum cost spanning tree has a weight of 500. If the weight of each edge in graph G is increased by five, the weight of the minimum spanning tree becomes?

- A 500
- B 1000
- C 1005
- D 995

Correct Option

Solution: (D)

As there will be 99 edges in Minimum Spanning Tree (MST). When weight of every edge is increased by 5, the increment in weight of MST is = $99 * 5 = 495$ So new weight of MST is $500 + 495$ which is 995.

Q.15)

Subject: Algorithms

Max Marks: 1

Which traversal is the most suitable for deleting all the nodes in a binary tree ?(You can assume the tree to be binary)

- A Inorder
- B Preorder
- C Postorder
- D Any traversal

Correct Option

Solution: (C)

Before deleting the parent node we should delete its children first

Q.16)

Subject: Algorithms

Max Marks: 2

Match the sorting algorithm to the appropriate set of data.(2 Mark)
 S1. Sorting 24,000,000 evenly distributed real numbers between 1 and 6,006
 S2. Sorting an array of 32,000,000 integers between 0 and 32,000,00
 S3. Independently sorting each of 1,000,000 arrays, each with 5 elements
 S4. Sorting a set of 4,000,000 numbers in worst case $O(n \lg n)$ time.

- i. Insertion Sort
- ii. Quick Sort
- iii. Radix Sort
- iv. Bucket Sort
- v. Merge Sort

- A S1-II, S2- IV, S3-I, S4-II
- B S1-IV, S2- III, S3-I, S4-V
- C S1-III, S2- IV, S3-II, S4-V
- D S1-IV, S2- II, S3-III, S4-V

Correct Option

Solution: (B)

S1: Bucket sort, the input is uniformly distributed, so Bucket Sort runs in linear time.
 S2: Radix Sort, both run in linear time on the bounded input
 S3: Insertion sort, due to the very low constant factors involved in running it on small inputs
 S4: Merge Sort, as it has the required running time

- C S1-III, S2- IV, S3-II, S4-V
- D S1-IV, S2- II, S3-III, S4-V

Q.17)

Subject: Algorithms

Max Marks: 2

Consider a hash table of size $m = 1000$ and a corresponding hash function $h(k) = \text{floor}(m(kA \bmod 1))$ for $A = (\sqrt{5} - 1)/2$. Assume that the keys are 61, 62, 63, 64, and 65. Then the location to which the key 64 mapped _____ ?

- A 552

553

554

Correct Option

Solution: (c)

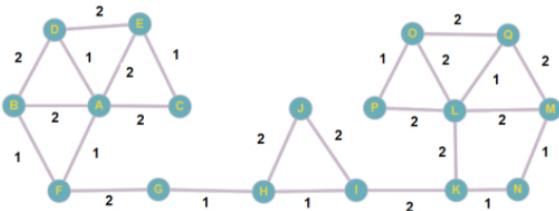
554

$$h(64) = \lfloor 1000(64 \cdot \frac{\sqrt{5}-1}{2} \bmod 1) \rfloor = 554.$$

555

Q.18)

The number of distinct minimum spanning trees possible for the undirected weighted connected graph given below.



Subject: Algorithms

Max Marks: 2

Correct Answer

Solution: (54)

54

For left half all the 1's are compulsory to add to cover the vertices so we are left with 3 choices for the 2's

In the middle we have 2 choice we can take any one out of this 2's

In the right hand side all 1's are compulsory and we are left with 3 choices for 2's (QM,LM,LK) and 3 choices for 2's (PL,OL,OQ)
 $3*2*3*3 = 54$

Q.19)

Subject: Algorithms

Max Marks: 2

Suppose you are given k sorted arrays, each with n elements, and you want to combine them into a single array of kn elements.

Consider the following approach. Using the merge subroutine, you merge the first 2 arrays, then merge the given array with this merged version of the first two arrays, then merge the given array with the merged version of the first three arrays, and so on until you merge in the final input array.

What is the running time taken by this successive merging algorithm, as a function of k and n ?

θ(nk^2)

Correct Option

Solution: (A)

For simplicity, we say the time required for a merge is simply equal to the sum of the list lengths.

So for the first merge, we have $T(1) = n+n$

For the second merge, we have $T(2) = n+2n$.

For the third merge , we have $T(3) = n+3n$

So on for last merge we have kn

$$2n+3n+4n+ \dots + kn = (k-1)(kn+2n) / 2 \quad \text{Sum of AP : } N/2[\text{First term} + \text{Last}] \\ = \theta(nk^2)$$

θ($n \log(k)$)θ(nk)θ(n^2k)

Q.20)

Consider the following binary search tree.

Subject: Algorithms

Max Marks: 2





What is the postorder traversal of the BST after deleting the node 8 ? (Assume that we replace the deleted node with its inorder successor)

A

2,10,9,11,4,19,21,18,22,14

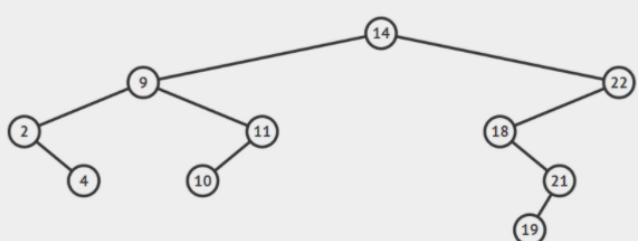
B

4,2,10,11,9,19,21,18,22,14

Correct Option

Solution: (B)

Since we are asked to replace the deleted node with its inorder successor, we replace 8 with 9. Node 9 has a right child , so in order to maintain the binary search tree property , the right child of 9 made as left child of 11 after replacement. So the final BST after deleting node 8 is



The post order traversal is 4 2 10 11 9 19 21 18 22 14

C

2,4,9,10,11,14,18,19,21,22

D

4,2,9,10,11,19,18,21,22,14

Q.21)

Consider the following the statements:

Subject: Algorithms

Max Marks: 2

S1. There exists a comparison sort of 5 numbers that uses at most 6 comparisons in the worst case.

S2. Heapsort can be used as the auxiliary sorting routine in radix sort, because it operates in place

S3. If the DFS finishing time $f[u] > f[v]$ for two vertices u and v in a directed graph G, and u and v are in the same DFS tree in the DFS forest, then u is an ancestor of v in the depth first tree.

S4. The sequence 20,15,18,7,9,5,12,3,6,2 is a max-heap

Which of the following are NOT TRUE?

A

S1 and S2

B

S1, S2 and S3

Correct Option

Solution: (B)

Statement 1: False.The number of leaves of a decision tree which sorts 5 numbers is $5!$ and the height of the tree is at least $\lg(5!)$. Since $5! = 120$, $2^6 = 64$, and $2^7 = 128$, we have 6

Statement 2: False.The auxiliary sorting routine in radix sort needs to be stable, meaning that numbers with the same value appear in the output array in the same order as they do appear in the input array. Heapsort is not stable. It does operate in place, meaning that only a constant number of elements of the input array are ever stored outside the array.

Statement 3: False. In a graph with three nodes r, u and v, with edges (r,u) and (r,v), and r is the starting point for the DFS, u and v are siblings in the DFS tree, neither as the ancestor of the other

Statement 4: True. For every node with 1-based index $i > 1$, the node with index $\text{ceil}(i/2)$ is larger.

C

S2 and S4

D

S1 and S3

Q.22)

Consider inserting the keys 10, 22, 31, 4, 15, 28, 17, 88, 59 into a hash table of length $m = 11$ using open addressing with the auxiliary hash function $h'(k) = k \bmod 11$. If we are using linear probing for collision resolution then the location of the key 59 is (index starts with 0)

Subject: Algorithms

Max Marks: 2

A

4

B

6

C

8

Correct Option

Solution: (C)

After inserting all the elements in hash table by using linear probing is

Index	Key
0	22
1	88
2	
3	
4	4
5	15
6	28
7	17
8	59
9	31
10	10

D

10

Q.23)

A binary min heap has its level order traversal as 140,64,70,46,20,16,42,10,24,9. If the element 90 is inserted into the min heap, then the postorder traversal will be ?

Subject: Algorithms

Max Marks: 2



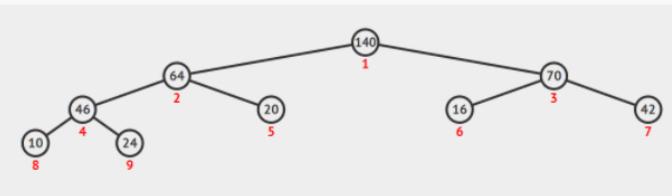
A

10,24,46,9,20,64,90,16,42,70,140

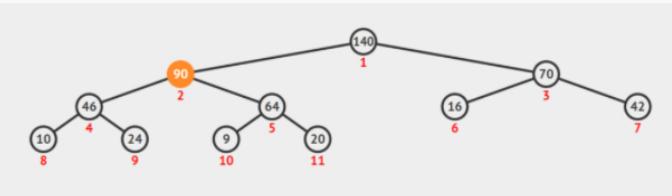
Correct Option

Solution: (A)

Constructing tree from level order traversal



After inserting key 90



Postorder traversal is 10,24,46,9,20,64,90,16,42,70,140

B

10,24,46,9,20,90,64,16,42,70,140

C

10,46,24,9,90,20,64,16,42,70,140

D

10,24,46,20,9,64,90,42,16,70,140

Q.24)

A burglar breaks into a museum with a knapsack that can carry a maximal weight of 20 Kg. There are 3 items in the museum and weight of i^{th} item is w_i and its profit is p_i . The items can be broken into smaller pieces, hence the burglar can select fractions of items. The items should be selected in such a way that the burglar will carry those items for which he will gain

Subject: Algorithms

Max Marks: 2



maximum profit. What is the maximum profit the burglar can gain ?

Item	1	2	3
Value	25	24	15
Weight	18	15	10



Correct Answer

Solution: (31.5)

31.5

$p_1/w_1=1.3$

$p_2/w_2=1.6$

$p_3/w_3=1.5$

15kg(item 2) + 5 kg(fraction of item 3)

Profit= 24(item 2)+7.5 (=15/10 * 5 of item 3)=31.5

Q.25)

Consider the following insertions into an AVL tree in the given sequence 16,15,12,14,13,18,17

Subject: Algorithms

Max Marks: 2

The postorder traversal of resultant AVL tree will be ?



A 12,13,14,15,16,17,18



B 15,13,12,14,17,16,18



C 12,14,13,16,18,17,15

Correct Option

Solution: (c)

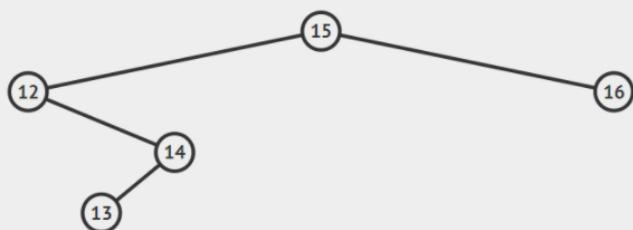
INSERT 16,15,12



ROTATE LEFT



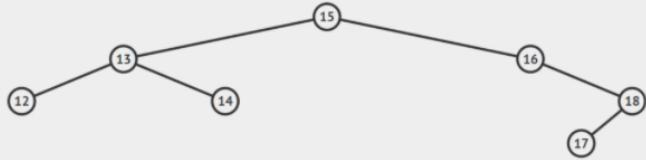
INSERT 14,13



RL IMBALANCE - ROTATE RIGHT , ROTATE LEFT



INSERT 18,17



RL IMBALANCE - ROTATE RIGHT , ROTATE LEFT



POST ORDER TRAVERSAL OF RESULTING TREE IS 12,14,13,16,18,17,15

D 12,14,13,18,17,16,15

Q.26)

What is the minimum number of interchanges needed to convert the array
21,14,13,17,15,16,10,12,18,20,19 into Max heap __?

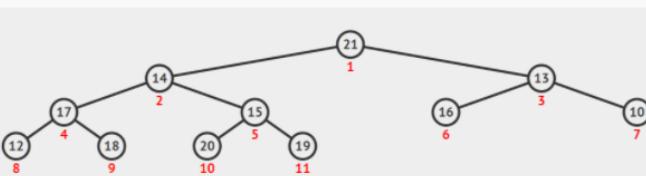
Subject: Algorithms

Max Marks: 2

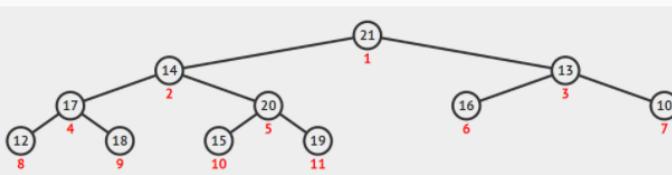
Correct Answer

Solution: (5)

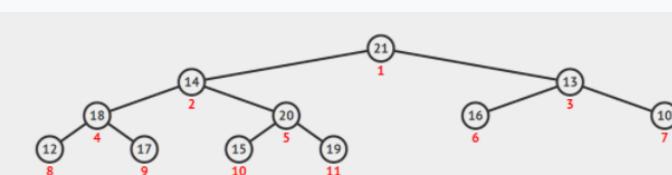
5



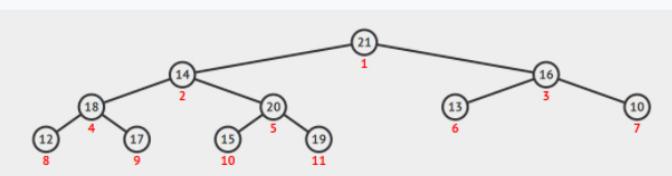
Step 1:



Step 2:

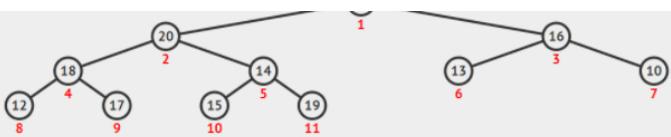


Step 3:

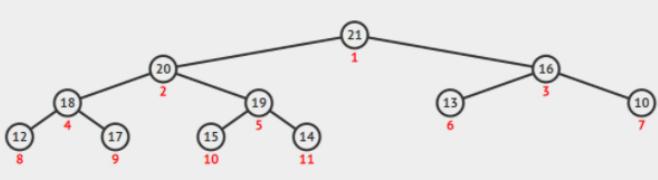


Step 4:





Step 5:



Minimum number of interchanges needed is 5

Q.27)

Consider the recurrence relation given below

$$\text{fun}(n) = \begin{cases} 0, & \text{if } n = 0 \\ 1, & \text{if } n = 1 \\ \text{fun}(n-1) + \text{fun}(n-2), & \text{if } n > 1 \end{cases}$$

The number of function invocations for evaluating $\text{fun}(10)$ is called ___?

Subject: Algorithms

Max Marks: 2

Correct Answer

Solution: (177)

$\text{fib}(0)=1$ (because $\text{fib}(0)$ is also a function call)

$\text{fib}(1)=1$ (because $\text{fib}(1)$ is also a function call)

$\text{fib}(2)=\text{fib}(0) + \text{fib}(1) + 1 = 3$ (1 is added because $\text{fib}(2)$ is also included in function call)

$\text{fib}(3)=\text{fib}(2)+\text{fib}(1)+1= 5$

$\text{fib}(4)=\text{fib}(3)+\text{fib}(2)+1 = 9$

$\text{fib}(5)=\text{fib}(4)+\text{fib}(3)+1 = 15$

$\text{fib}(6)=\text{fib}(5)+\text{fib}(4)+1 = 25$

$\text{fib}(7)=\text{fib}(6)+\text{fib}(5)+1 = 41$

$\text{fib}(8)=\text{fib}(7)+\text{fib}(6)+1 = 67$

$\text{fib}(9)=\text{fib}(8)+\text{fib}(7)+1 = 109$

$\text{fib}(10)=\text{fib}(9)+\text{fib}(8)+1 = 177$

Q.28)

What is the length of the longest common subsequence in the two DNA sequences, S1= GTTGTG and S2=TGCGTGT?

Subject: Algorithms

Max Marks: 2

Correct Answer

Solution: (4)

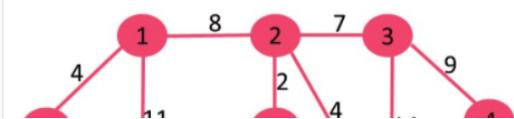
j	0	1	2	3	4	5	6	7
i	y	T	G	C	G	T	G	T
0	x	0	0	0	0	0	0	0
1	G	0	1	0	1	1	1	1
2	T	0	1	1	1	1	1	2
3	T	0	1	1	1	1	2	2
4	G	0	1	1	2	2	1	2
5	T	0	1	2	1	2	1	3
6	G	0	1	1	2	1	2	1

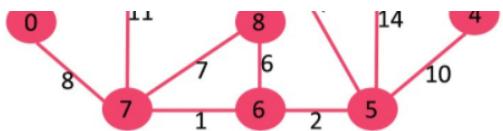
Q.29)

Which of the following sequence is the order in which vertices are deleted from the priority queue using Dijkstra?

Subject: Algorithms

Max Marks: 2





A 0,1,7,6,5,2,8,3,4

Correct Option

Solution: (A)

Vertex Distance from Source

0	0
1	4
2	12
3	19
4	21
5	11
6	9
7	8
8	14

B 0,1,7,6,5,8,2,3,4

C 0,1,7,6,5,8,3,2,4

D 0,1,7,8,2,6,5,3,4

Q.30)

Consider the following letter frequency table.

Subject: Algorithms

Max Marks: 2

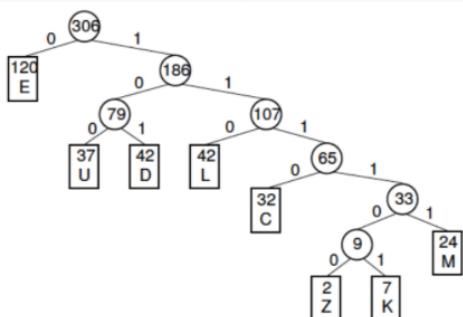
Letter frequency table

Letter	Z	K	M	C	U	D	L	E
Frequency	2	7	24	32	37	42	42	120

What is the maximum number of bits required for encoding any letter using Huffman coding scheme ?

Correct Answer

Solution: (B)



Huffman code

Letter	Freq	Code	Bits
E	120	0	1
D	42	101	3
L	42	110	3
U	37	100	3
C	32	1110	4
M	24	11111	5
K	7	111101	6
Z	2	111100	6

close

