Q.1) Max Marks: 1

Given below the following items with their profits and weights and capacity of the standard container is 10 units, what is the maximum profit possible given that the least unit of an item which can be taken is 1 unit. What maximum value of x could yield a profit of ____

Item	Profit	Weight
1	10	2
2	40	5
3	30	4
4	50	6

Correct Answer

Solution: (82)

Solution 82

Item	Profit	Weight	Density=profit/weight
1	10	2	5
2	40	5	8
3	30	4	7.5
4	50	6	8.33

Items are sorted in order of profit/weight Initially Item 4 is added completely
Profit=50
Wt=6
Now Item 2 is added and only 4 units can be added therefore
Profit=50+32=82

Q.2) Max Marks: 1

Given below the following items with their profits and weights and capacity of the standard container is 10 units, what is the maximum profit possible given that either an item can be included completely or is excluded. What is the maximum profit possible for this given knapsack_____.

Item	Profit	Weight
1	10	2
2	40	5
3	30	4
4	50	6

Correct Answer

Solution: (80)

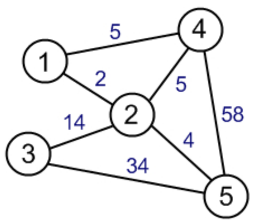
Since this is a small instance with small no of items we can check by burte force approach.
S1 Items {1} Profit=10
S2 Items {2} Profit=40
S3 Items {3} Profit=30
S4 Items {4} Profit=50
S5 Items {1, 2} Profit=50 Weight 7
S6 Items {1, 3} Profit=40 Weight 6
S7 Items {1, 4} Profit=60 Weight 8
S8 Items {2, 3} Profit=70 Weight 9
S9 Items {2, 4} Profit=90 Weight 11>10
S10 Items {3, 4} Profit=80 Weight 10
S11 Items {1, 2, 3} Profit=80 Weight 11>10
S12 Items {2, 3, 4} Profit=___Weight >10
S13 Items {1, 3, 4} Profit=___Weight >10
S14 Items {1,2,4}Profit=___Weight>10
S15 Weight>10

Optimal profit is of S10 =80

Q.3) Max Marks: 1

Q.3)

Consider the following graph which represents 5 locations across a city and a person has to travel all of them starting from vertex 1 and returning back, what is the cost of the optimal tour.



A 1-2-3-4-5-1

B 1-5-3-2-4-1

C 1-4-3-5-2-1

D 1-4-5-3-2-1 Correct Option

Solution: (D)
For the above graph, only one of the options is the Hamiltonian path exists which is the only route for the optimal Hamiltonian path which is 1-4-5-3-2-1 or 1-2-3-5-4-1.

Q.4) Max Marks: 1

Which of the following cannot be solved optimally and completely using the Greedy Design Technique?

A **Single-Source Shortest Path.** Correct Option

Solution: (A)
This is because in SSSP cannot be solved in all the cases by a greedy algorithm i.e. Dijkstra's Algorithm in case of negative weight edge and negative weight cycle it may fail.

B **Minimal Spanning Tree.**

C **Optimal Merge Pattern.**

D **Job Sequencing with in deadlines.**

Q.5) Max Marks: 1

The length of the longest common subsequences for the given following strings is _____
"hippopotamus"
"spontaneous"

Correct Answer

Solution: (6)
The length of the longest common subsequence is 6 and it is p, o, t, a, u, s.

Q.6) Max Marks: 1

In the Floyd Warshall Algorithm for all pairs shortest path. The matrix D^i represents

A **The shortest paths of length i in between all the vertices.**

B **The shortest path of the first i vertices among themselves.**

C **Intermediate paths of length i in the shortest path between all pairs of vertices.**

D **None of the above.** Correct Option

Solution: (D)

D^i in the Floyd Warshal algorithm represents the shortest paths between all the vertices including the vertices labelled <=i.

Q.7) Max Marks: 1

Which of the following statements is true with respect to the Bellman-Ford algorithm for the single-source shortest paths.
Statement 1. It can find the shortest paths in a graph which contains a negative weight cycle.
Statement 2. It can find the shortest paths in the graph which does not contain a negative weight cycle but contains negative weight edges.

Only I is true

A Only I is true.

B **Only II is true.** Correct Option

Solution: (B)
In case of a graph with a negative weight cycle the Bellman-Ford algorithm fails to determine the shortest paths in that graph in fact it is not possible to determine the shortest paths in such a graph as they do not exist. In case of a graph with a negative weight edge but not a negative weight cycle it can be determined using the Bellman-Ford Algorithm.

C **Both I and II are true.**

D **Neither I nor II is true.**

Q.8) Max Marks: 1

Consider a simple undirected weighted graph G(V, E) with 20 vertices and 190 edges, assume (u, v) are two vertices weight of each edge is given by the formula =lu- vl then the number of minimal spanning trees of G____

Correct Answer

Solution: (1)
The MST, in this case, would consist of exactly (n-1) edges and each of cost 1, there is only one such unique MST for this graph as all the remaining edges are having cost>1.

Q.9) Max Marks: 1

Given a graph G(V, E) where V represents the set of vertices and E represents the set of edges and its minimal spanning tree S is calculated. If all the edges within the spanning tree are decremented by a constant factor c (c>0) and all the edges of the graph which are not a part of the spanning tree are decremented by the same factor c then the new spanning tree of this modified graph can be calculated by using the Kruskal's algorithm in how much time

A Θ(ElogV)

B Θ(E)

C Θ(log V)

D **None of the above.** Correct Option

Solution: (D)
For such a graph the spanning tree remains unchanged and there is no need to do any computation. This is because if we decrease the edge weight the relative ordering of the edges in the MST remain the same and the MST would be formed in the same way if Prims or Kruskal's algorithm is used.

Q.10) Max Marks: 1

Given files f_1,f_2,f_3,f_4,f_5 with 20, 43, 12, 9, 16, records and they have to be merged
What is the optimal sequence of merging so that the movement of records is minimal

A **((f4,f5), (f3,f2)), f1**

B **((f3,f4), (f5,f1)), f2** Correct Option

Solution: (B)
For the optimal merge pattern, we initially sort the files in order of the no of records
f4 (9), f3 (12), f5 (16), f1(20), f2(43).
We merge f4 and f3 =9+12=21

Now we have
f4+f3 (21), f5 (16), f1(20), f2(43).

Merging f1 and f5 we get

f4+f3 (21), f5+ f1(36), f2(43).

Merging f4+f3 and f5+ f1 we get

f5+ f1+ f4+ f3 (57) and f2(43)

Finally, they are merged the optimal merge pattern is given by ((f3,f4), (f5,f1)), f2.

C (((f_3,f_4), f_5),f_1), f_2

D **None of the above.**

Q.11)

Max Marks: 2

Given the following set of jobs with their respective deadline and profit which need to be processed using a single processor. What is the number of jobs which cannot be scheduled in the optimum profit yielding schedule_____

Job	Deadline	Profit
1	3	72
2	4	2
3	5	3
4	5	45
5	2	4
6	9	9
7	6	8
8	4	5

Correct Answer

Solution: (1)

For job sequencing with in deadlines, we need to sort the jobs in order of the profit and then allocate them as late as possible also respecting the deadline.

Following is the schedule which we get for optimum profit.

Time	1	2	3	4	5	6	7	8
Job	3	5	1	8	4	7		6

The Job 2 cannot be scheduled as already all the slots <=4 time are occupied. There fore 1 job cannot be scheduled.

Q.12)

Max Marks: 2

Given 4 matrices M1, M2, M3, M4. which are having the orders of the following form 2*3, 3*4, 4*7, 7*2, this matrix multiplication was done by using the optimal parenthesization then the number of multiplication operations done are _______.

Correct Answer

Solution: (92)

The Recurrence relation for getting the minimum no of matrix multiplication is

$$M[i,j] = \begin{cases} 0 & \text{if } i=j \\ \min_{i \le k < j} \{M[i,j] = M[i,k] + M[k+1,j] + p_{i-1}p_k p_j\} \end{cases}$$

M[1,1]=0
M[2,2]=0
M[3,3]=0
M[4,4]=0

M[1,2]=2*3*4=24
M[2,3]=3*4*7=84
M[3,4]=4*7*2=56

M[1,3]= Min((M[1,1]+M[2,3]+ (2*3*7)), (M[1,2]+M[2,2]+(2*4*7)))=Min(84+42,80)=80
M[2,4]= Min((M[2,2]+M[3,4]+ (3*4*2)), (M[2,3]+M[4,4]+(3*7*2)))=Min(80, 84+42)=80

M[1,4]=Min((M[1,1]+M[2,4]+ (2*3*2)),
(M[1,2]+M[3,4]+(2*4*2)),(M[1,3]+M[4,4]+(2*7*2)))=Min(80+12, 24+56+16, 80+28)=92

Q.13)

Max Marks: 2

Given the following message has to be encoded using Huffman encoding
“All the best!”
Ignore double quotations ignore space and special characters and ignore the case, what is the number of bits required to encode this message._______.

Correct Answer

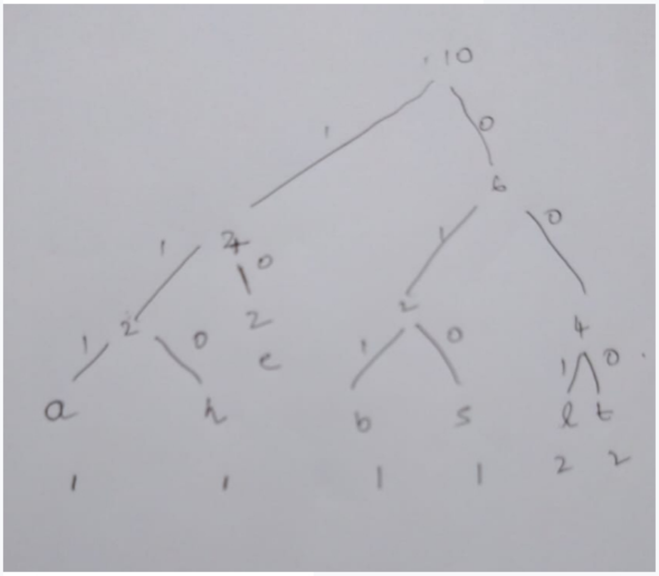
Solution: (28)

Solution 28

Character	Frequency
a	1
l	2

t	2
h	1
e	2
b	1
s	1

On drawing the Huffman tree we get a figure similar to this



For a-3 bits, h-3, e-2, b-3, s-3, t-3, l-3

No of bits required is 8*3+2*2=28.

Q.14)

Max Marks: 2

If the tightest upper bound for the time complexity required to solve the Travelling Salesman Problem by using dynamic programming is represented by O(f(n)) and that of 0/1 Knapsack problem is by using dynamic programming O(g(n)) (for small capacity of knapsack when compared to the no of items) and that of Floyd Warshals algorithm is O(h(n)) then which of the following captures the relation in between them.

A f(n)=O(g(n)), and g(n)=O(h(n))

B f(n)=Ω(g(n)) and g(n)=O(h(n)) Correct Option

Solution: (B)

Since time complexity for solving TSP using DP is approximately $O(n^2 2^n)$ and 0/1 Knapsack using DP is O(nW) and Floyd Warshal is $O(n^3)$, therefore f grows faster than g and g grows faster than h, the last option is the most appropriate.

C f(n)=O(g(n)) and g(n)=Ω(h(n))

D f(n)=Ω(g(n)) and g(n)=Ω(h(n))

Q.15)

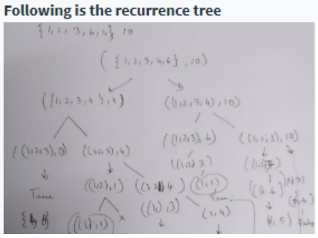
Max Marks: 2

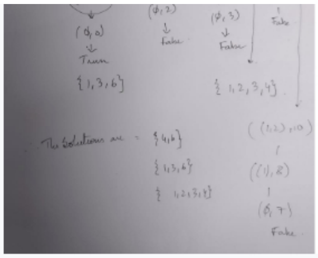
Given the following set of integers
A={1,2,3,6,4}
Number of subsets of A which have the sum of elements =10

Correct Answer

Solution: (3)

There are 6 solutions for the subset sum problem when we solve using dynamic programming we get the following solutions.
The isSubsetSum problem can be divided into two subproblems
a) Include the last element, recur for n = n-1, sum = sum – set[n-1]
b) Exclude the last element, recur for n = n-1.
Following is the recurrence tree





$(\phi, 2)$
$(\phi, 3)$
False
$(\phi, 0)$
False
False
True
$\{1, 3, 6\}$
$\{1, 2, 3, 4\}$
$((1,2), 10)$
The Solutions are = $\{4, 6\}$
$\{1, 3, 6\}$
$((1), 8)$
$\{1, 2, 3, 4\}$
$(\phi, 7)$
False

close