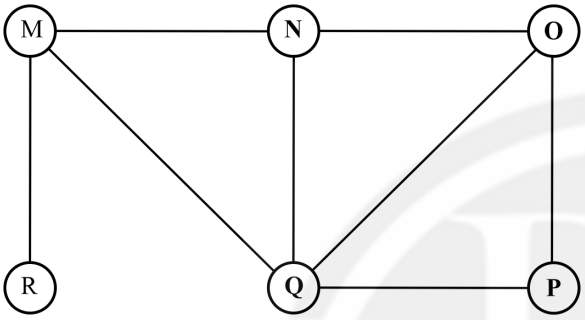
DS & AI

Artificial Intelligence

DPP 01

Un- Informed Search

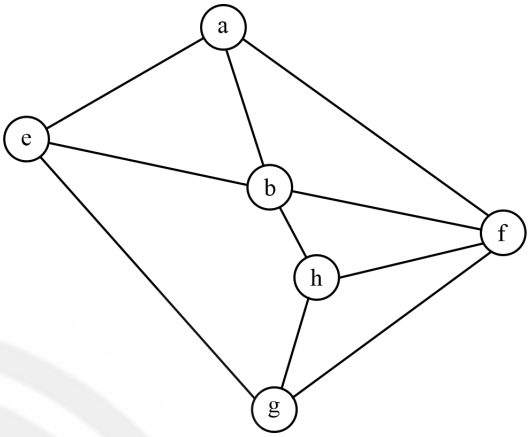
Q1 The Breadth First Search (BFS) algorithm has been implemented using the queue data structure. Which one of the following is a possible order of visiting the nodes in the graph below ?



(A) MNOPQR
(B) NQMPOR
(C) QMNROP
(D) POQNMR

Q2 The time and space complexity of BFS is (For time and space complexity problems consider b as branching factor and d as depth of the search tree.)
(A) O(bd) and O(bd)
(B) O(b2) and O(d2)
(C) O(d2) and 0(b2)
(D) O(d2) and O(d2)

Q3 Consider the following graph:
Among the following sequences:
I. abeghf
II. abfehg
iiI. abfhge
IV. afghbe
Which are the depth-first traversals of the above graph?

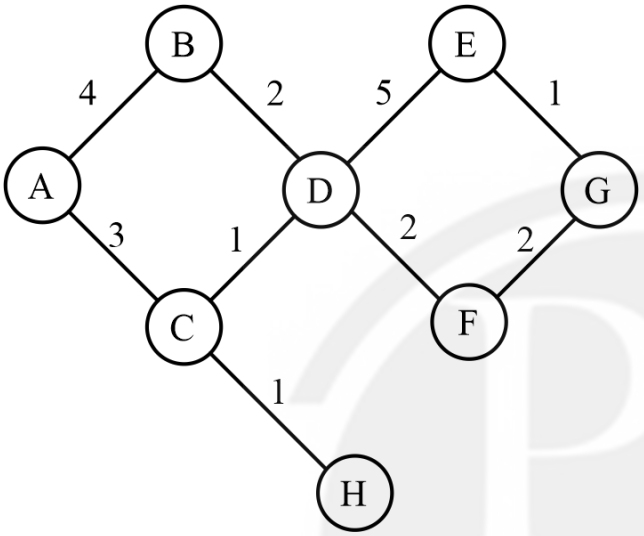


(A) I, II and IV only
(B) I and IV only
(C) II, III and IV only
(D) I, III and IV only

Q4 Suppose we do Iterative Deepening Search (IDS) but instead of increasing depths as 1,2,3,4... we increase it as 1,2,4,8,16... i.e. double the depth instead of increasing it by
• This modified version of IDS is
(A) Optimal but not complete
(B) Complete but not optimal
(C) More efficient than standard IDS in the worst case
(D) Less efficient than standard IDS in the worst case

Q5 Suppose there is only one goal state and each step cost is k (k>0). Which of the following search algorithm(s) will return the optimal path?
(A) Breadth-First Search
(B) Depth First Search
(C) Uniform Cost Search
(D) Iterative Deepening Search

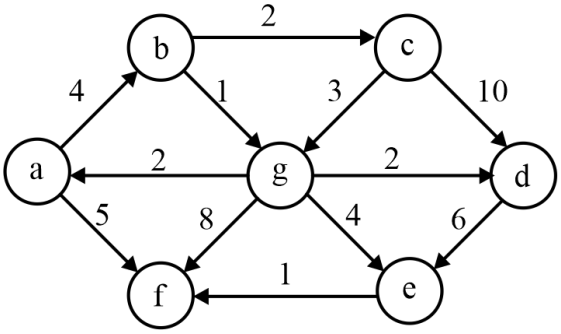
Q6 Consider the following graph in which we are searching from start state A to goal state G. The number over each edge is the transition cost. Find the path to the goal found by Depth First Search with full duplicate detection, which explores children in lexicographical order. (Write answer as a string with no spaces. For example, if the order of exploration is A followed by B followed by C followed by D then write ABCD)



(A) ABDCHEGI (B) ABCCHEGI
(C) ABDCHEGG (D) ABDJHEGI

Q7 Consider the depth-limited search algorithm with depth limit f. If the only goal state exists at depth d then which of the following statement(s) is/are correct?
(A) if f > d then it is complete but not optimal
(B) If f > d then it is not complete and not optimal
(C) If < f d then it is complete but not optimal.
(D) if f < d then it is not complete and not optimal.

Q8 Consider the following graph:



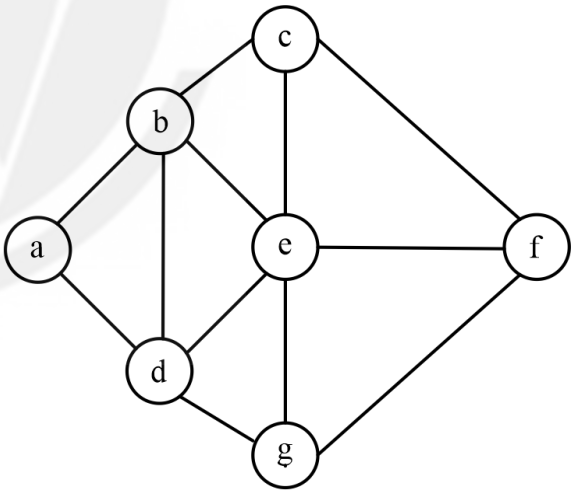
What is the minimum cost to reach vertex f starting from vertex c ?

Q9 Consider a 2-D grid where each coordinate represents a location. A robot is standing at (0, 0) and the goal exists at (2. 2). In each move, the robot can either move up, down, left, or right with equal probability. What is the probability that the robot will reach the goal in 4 moves?

Give the answer rounded to three decimal places.

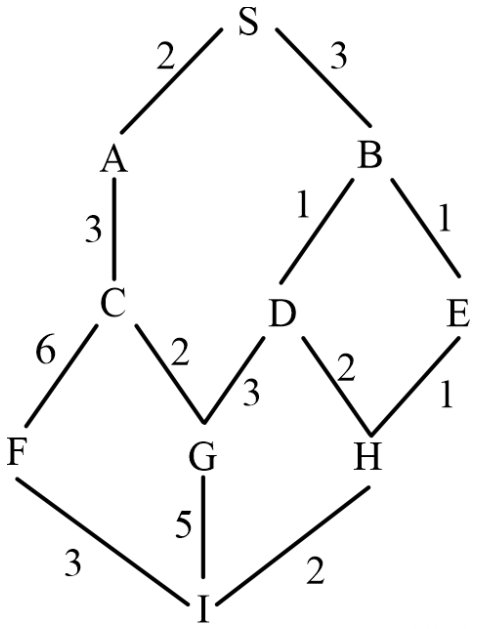
Q10 Consider the following sequence of nodes for the undirected graph given below
1. abefdgc
2. abefcgd
3. adgebcf
4. adbcgef

A Depth First Search (DFS) is started at node 'a'. The nodes are listed in the order they are first visited. Which of the above is/are possible output(s)? 1 and 3 only



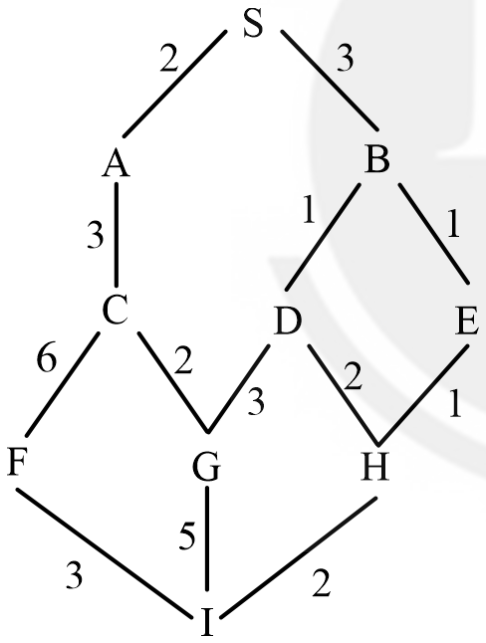
(A) 1 and 3 only
(B) 2 and 3 only
(C) 2, 3 and 4 only
(D) 1, 2 and 3 only

Q11 Consider the graph below with F,G,H as the goal nodesBy applying BFS, the algorithm will end at which Goal Node



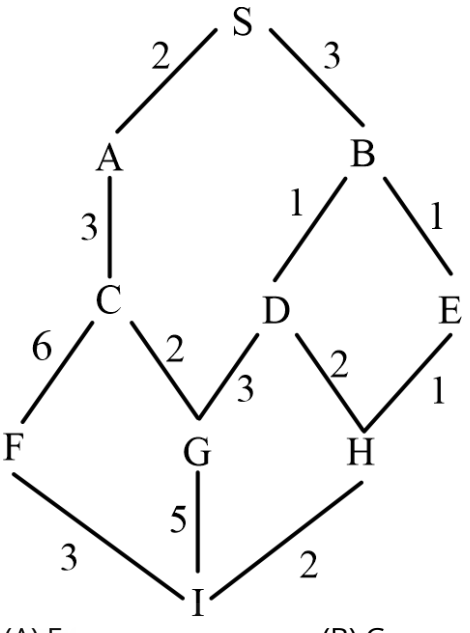
(A) F (B) G
(C) H (D) I

Q12 Consider the graph below with F,G,H by applying DFS, the algorithm will end at which Goal Node



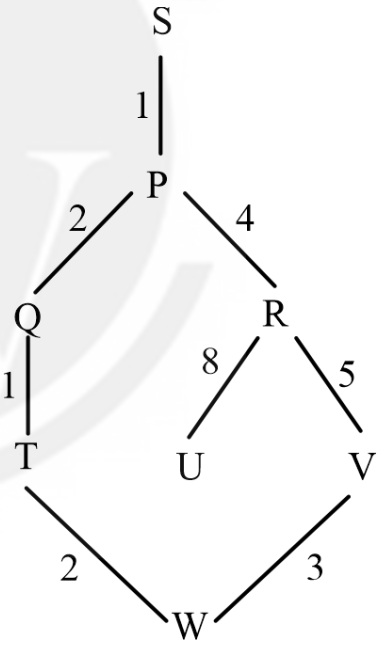
(A) F (B) G
(C) H (D) I

Q13 Consider the graph below with F,G,H by applying UCS, the algorithm will end at which Goal Node



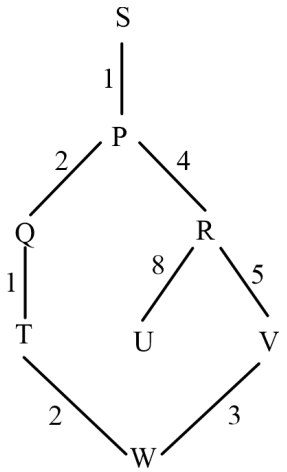
(A) F (B) G
(C) H (D) I

Q14 Consider the graph below with goal nodes R and T, by applying BFS, the algorithm will end at which Goal Node



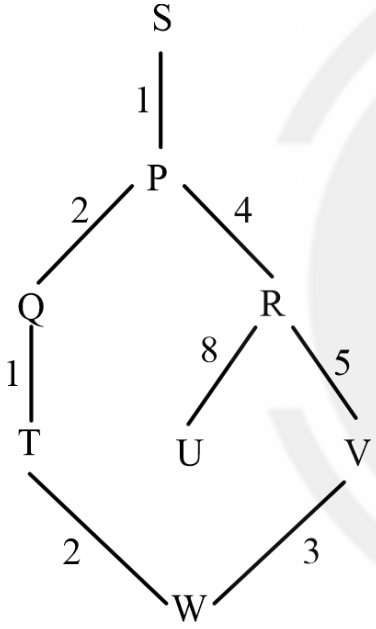
(A) P (B) Q
(C) R (D) T

Q15 Consider the graph below with goal nodes R and T by applying DFS, the algorithm will end at which Goal Node



(A) P (B) Q
(C) R (D) T

Q16 Consider the graph below with goal nodes R and T by applying UCS, the algorithm will end at which Goal Node



(A) P (B) Q
(C) R (D) T

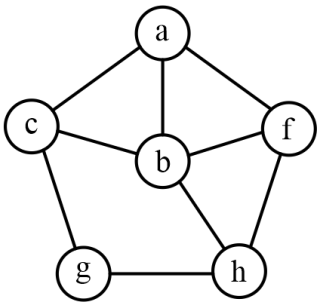
Q17 In a graph where the goal is to reach from node S to node G, the following edges and costs are given:

- S to A. cost 1
- S to B: cost 2
- a to C: cost 3
- B to C: cost 1
- C to G. cost 2

Using Uniform Cost Search, what is the total cost of the path found by UCS if it finds the shortest path to G?

(A) 4 (B) 5
(C) 6 (D) 7

Q18 Consider the following graph:



For the graph; the following sequences of depth first search (DFS) are given

A. abcghf
B. abfchg
C. abfhgc
D. afghbc

Which of the following is correct?

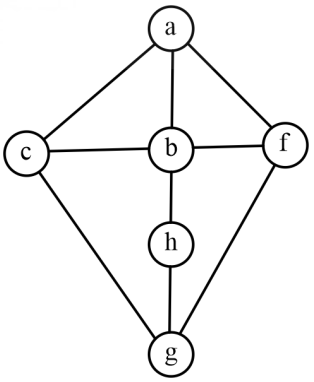
(A) (A), (B) and (D) only
(B) (A), (B), (C) and (D)
(C) (B), (C) and (D) only
(D) (A), (C)

Q19 Consider the following graph

Among the following sequences

I. abeghf
II. abfehg
III. abfhge
IV. afghbe

Which are depth first traversals of the above graph?



(A) I, II, and IV only
(B) I and IV only
(C) II, III, and IV only
(D) I, III, and IV only

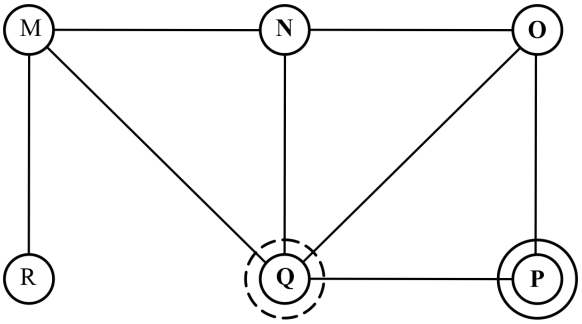
Answer Key

Q1	D
Q2	A
Q3	D
Q4	C
Q5	A, C, D
Q6	A
Q7	A, D
Q8	8~8
Q9	0.023~0.023
Q10	B
Q11	A
Q12	A
Q13	C
Q14	C
Q15	D
Q16	D
Q17	B
Q18	D
Q19	D

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:



Q2 Text Solution:

The time and space complexity of BFS are both **O(b)**, where **b** is the branching factor and **d** is the depth.

Thus, the correct answer is **Option A: O(b) and O(b)**.

Q3 Text Solution:

Sequence I: a b e g h f

Step-by-step:

- From a, go to b.
- From b, go to e.
- From e, go to g.
- g has no new adjacent unvisited nodes; backtrack.
- Back to e, then back to b.
- From b, go to h.
- From h, no unvisited nodes (except already visited ones); backtrack.
- Back to b, then to a.
- From a, go to f.

This follows the depth-first strategy.

Thus, Sequence I is a **valid DFS traversal**.

Sequence II: a b f e h g

Step-by-step:

- From a, go to b.
- From b, go to f.
- From f, go to e.
- From e, go to h.
- From h, go to g.

This also follows DFS properly without violating the depth-first rule.

Thus, Sequence II is a **valid DFS traversal**.

Sequence III: a b f h g e

Step-by-step:

- From a, go to b.
- From b, go to f.
- From f, go to h.
- From h, go to g.
- After g, the sequence says go to e.

But from g, there is no direct edge to e. To visit e, you would need to backtrack through several nodes, but DFS would not jump to e like that.

Thus, Sequence III is **not a valid DFS traversal**.

Sequence IV: a f g h b e

Step-by-step:

- From a, go to f.
- From f, go to g.
- g has no unvisited adjacent nodes; backtrack.
- Back to f.
- From f, go to h.
- From h, go to b.
- From b, go to e.

This matches the DFS process.

Thus, Sequence IV is a **valid DFS traversal**.

Option A: I, II, and IV only

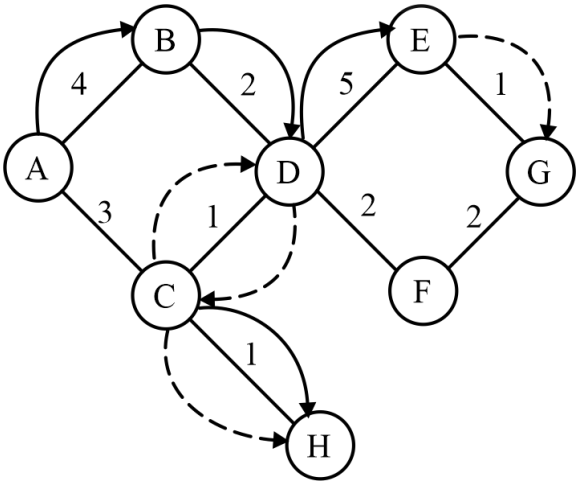
Q4 Text Solution:

- More efficient than standard IDS in the worst case

Q5 Text Solution:

- **Breadth-First Search (BFS)**:
  BFS expands nodes level by level.
  If step cost is constant ($k > 0$), **BFS always finds the shallowest (and thus optimal) path**.
- **Depth-First Search (DFS)**:
  DFS may go deep unnecessarily and does **not guarantee the shortest or optimal path**.
- **Uniform Cost Search (UCS)**:
  UCS expands the node with the least total path cost first, so **it always finds the optimal path**, even if step costs vary.
- **Iterative Deepening Search (IDS)**:
  IDS performs DFS repeatedly with increasing depth limits;
  since it explores level by level like BFS when costs are equal, **it also finds the optimal path** when each step cost is equal.
- **A: Breadth-First Search**
- **C: Uniform Cost Search**
- **D: Iterative Deepening Search**

Q6 Text Solution:



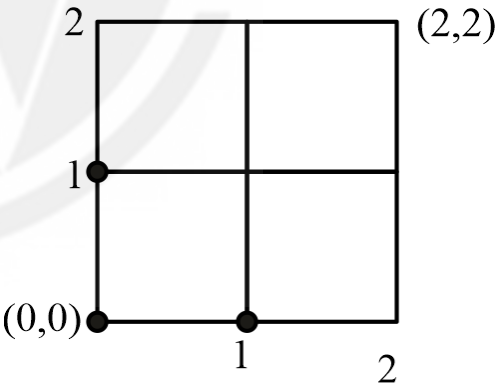
Q7 Text Solution:

If **f > d**, depth-limited search will find the goal and be **complete but not optimal** if multiple paths exist.
If **f < d**, it won't reach the goal, so it is **not complete and not optimal**.
, correct options are **A and D**.

Q8 Text Solution:

	c	g	a	d	e
a	∞	5	5	5	5
b	∞	∞	9	9	9
c	0	0	0	0	0
d	10	5	5	5	5
e	∞	7	7	7	7
f	∞	11	11	11	(8)
g	3	3	3	3	3

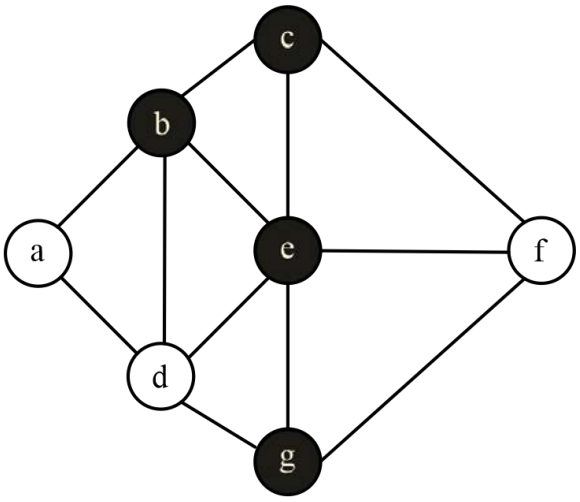
Q9 Text Solution:



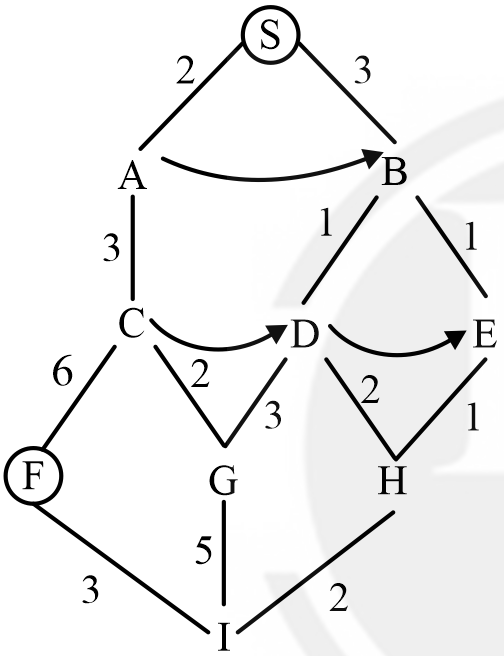
To reach (2,2) from (0,0) in exactly 4 moves, robot needs **2 right** and **2 up** moves.

- Number of favorable paths = $\frac{4!}{2!2!} = 6$, total possible paths = $4^4 = 256$.
- Thus, probability = $\frac{6}{256} = \frac{3}{128} \approx 0.023$.

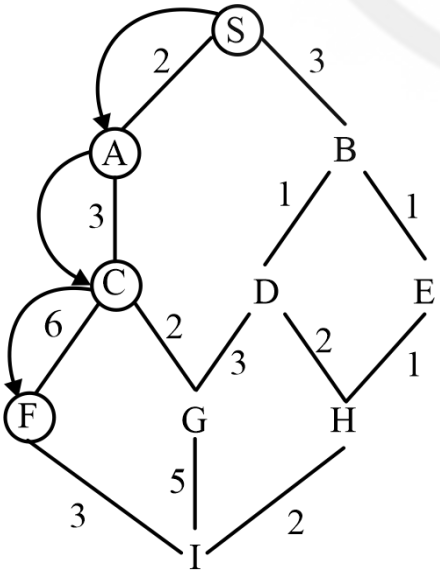
Q10 Text Solution:



Q11 Text Solution:



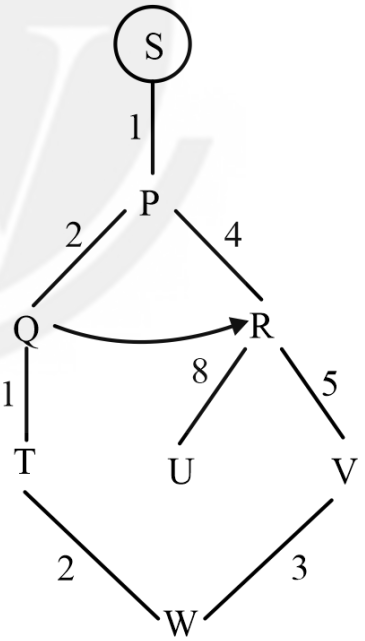
Q12 Text Solution:



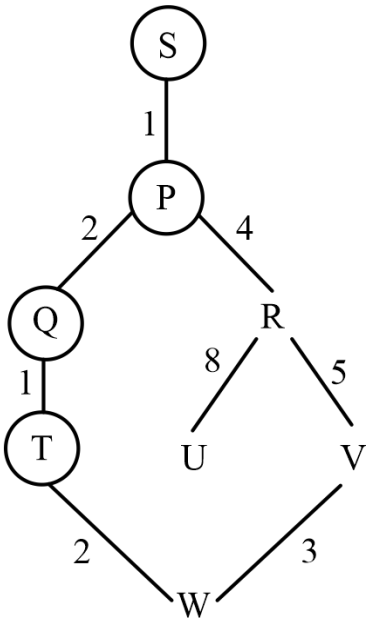
Q13 Text Solution:

S	0	0	0	0	0
A	2	2	2	2	2
B	3	3	3	3	3
C	∞	5	5	5	5
D	∞	∞	4	4	4
E	∞	∞	4	4	4
F	∞	∞	∞	∞	∞
G	∞	∞	∞	7	7
H	∞	∞	∞	6	5
I	∞	∞	∞	∞	∞

Q14 Text Solution:



Q15 Text Solution:



Q16 Text Solution:

S	0	0	0
P	1	1	1
Q	∞	3	3
R	∞	5	5
T	∞	∞	4
U	∞	∞	∞
V	∞	∞	∞
W	∞	∞	∞

Q17 Text Solution:

S	0	0	0	0
A	1	1	1	1
B	2	2	2	2
C	∞	4	3	3
G	∞	∞	∞	5

Q18 Text Solution:

Graph connections:

- a b, c, f
- b a, c, f, h
- c a, b, g
- f a, b, h
- g c, h
- h b, f, g

Option A: abcghf

Traversal: a b c g h f

All edges exist in sequence.

This is a valid DFS order.

Option B: abfchg

Traversal: a b f c h g

Edge between f and c does not exist.

This is not valid.

Option C: abfhgc

Traversal: a b f h g c

All edges in sequence are valid.

This is a valid DFS order.

Option D: afghbc

Traversal: a f g

Edge between f and g does not exist.

This is not valid.

Correct answer: D (A), (C)

Q19 Text Solution: