Question 1: (10 points)

a. **(1 point)** Answer: 120/5! (binary marking 1 point for the correct answer, no explanation needed)
b. **(3 points)** Answer: Draw all 4 successor states (3 points if all are 4 states are correct)
    i. 1 point is deducted if 1 state is wrong or extra
    ii. 2 points are deducted if 2 states are wrong or if extra
    iii. 3 points are deducted if more than 2 states are wrong or if extra
c. **(6 points)** Part c is divided into multiple components as follows:
    i. 2.5 points for evaluating the cost/score of all the states (4 successor states + 1 start state), 0.5 mark for each state
    ii. 2.5 points for mentioning the following:
        a. the initial state has a better evaluation than the successors (local minima if cost is compared, or local maxima if the score is compared)
        b. According to the steepest ascent hill climb search from the initial state, the initial state will be the final state.
        c. 1 mark is deducted if either of the above is not mentioned
    iii. 1 point for mentioning that the final state is not a solution to the problem with justification.

Note that answer to part c is contingent on the correctness of the answer to part b. The correct answer to part c can not be justified with incorrect successor states.

Question 2: (10 points)

a) **(2 points)**

i) 2 marks if the entire tree is correct

ii) 1.5 marks if there is one mistake

iii) 1 mark if there are two mistakes

iv) 0 marks if more than two mistakes

Here, the number of mistakes denotes the number of nodes with incorrect values in the tree.

b) **(3 points)**

Answer: Edges 5 → 17 and 3 → 13 are pruned. So, the leaf nodes 17 and 13 are not explored.

The overall part is divided into 2 subtrees. The one with root 4 is called the left subtree, and the one with root 3 is called the right subtree.

i) 1 mark for the correct left subtree.

ii) 2 marks for the right subtree, provided the left subtree is correct. If the left subtree is wrong, this part gets 0 marks.

c) **(5 points)**

i) When the node is replaced with 3

1) **(2 points)** Pruning (Answer: 4 edges pruned)

(a) 2 marks for correct pruning in the tree

(b) 1 mark is deducted if the answer has a small mistake or the tree is not drawn. As per the problem statement, drawing a tree is expected.

(c) **(0.5 point)** 0.5 for comparison with pruning in the original tree. Justification is also needed. No marks if the answer is written without justification. Answer: Pruning increases.

ii) When the node is replaced with 15

1) **(2 points)** Pruning (Answer: 2 edges pruned)

(a) 2 marks for correct pruning in the tree

(b) 1 mark is deducted if the answer has a small mistake or if the tree is not drawn. As per the problem statement, drawing a tree is expected.

2) **(0.5 point)** 0.5 marks for comparison with pruning in the original tree. Justification is also needed. No marks if the answer is written without justification. Answer: Pruning remains the same

Question 3: (12 points)

a) **(2 points)** **Expectation**: Check the symmetric arc consistency between the nodes (variables). That is, check the arc consistency for A→B, B→A, B→D, D→B, etc.
   i) 2 points for checking the consistency of all the arcs.
   ii) 1 point for checking one-way arcs i.e A→B, B→D, A→C, and C→D.

b) **(3 points)** **Expectation**: Explore the variables and their values in the given order. Draw the search tree and show the goal. The total number of variable assignments while reaching the goal should be 10.
   i) 0.5 points for exploration of variables and values in the correct order.
   ii) 2 points for a fully correct search tree.
   iii) 0.5 points for calculating the number of variable assignments.

c) **(3 points)** **Expectation**: Perform forward-checking after every variable assignment. Draw the correct search tree and show how the solution has been obtained. The number of variable assignments in this case should be 5.
   i) 1.5 points for fully correct forward checking
   ii) 1 point for search tree
   iii) 0.5 points for calculating the number of variable assignments.

d) **(4 points)** **Expectation**: Perform forward checking after every variable assignment. Note that, the domain of D will reduce to a singleton once B is assigned the value 2. Hence ensure arc consistency (B→D, etc.,) which will reduce the domain of C to {2} and the search stops. The number of variable assignments in this case should be 4.
   i) 0.5 points for correct forward checking
   ii) 2 points for checking arc consistency when the domain of D becomes {3}.
   iii) 1 point for a fully correct search tree.
   iv) 0.5 points for calculating the number of variable assignments.

Question 4:(10 points)

a) (3 marks)

Introduction of variables [1.25 points]
Factorization of the join [1.25 points]
Denominator Normalization [0.25 points]
Calculation [0.25 points]

b) (4 marks)

Introduction of variables [1.5 points]
Factorization of the join [1.5 points]
Denominator Normalization [0.5 points]
Calculation [0.5 points]

c) (3 marks)

Correct set of nodes identified [1.5 points]
Justification [1.5 points]

Question 5: (6 points)

Marks will be awarded solely based on the correctness of the answer. 1 point is awarded for the correct answer and -0.5 for the wrong answer. (No discussions on the answer key please).

a)True b)False c)True d)True e)False f)False