

1. Being a very busy person, John has exactly 10 hours to do some interesting things and he want to do maximum number of things. These things and the time that John will take to complete each of them are given in the following table:

Thing	1	2	3	4	5	6
Time Required	5	4	3	2	1	6

Use greedy approach to calculate the maximum number of things that John can do in the limited time that he has.

(10 marks)

2. The following is an array of six numbers:

0	1	2	3	4	5
14	<u>71</u>	52	25	36	17

- a) Use Insertion Sort to sort the six numbers in the array in **ascending** order. Show the result of each step by showing the whole array in a new line with sorted numbers underlined.
(5 marks)
- b) Use Selection Sort to sort the six numbers in the array in **ascending** order. Show the result of each step by showing the whole array in a new line with sorted numbers underlined.
(5 marks)
3. Use mathematical induction to prove that $1 + 2 + 3 + \dots + n = n(n + 1)/2$ for all positive integers n .
(10 marks)
4. On Knights and Knave Island, all natives are either knights, who always tell the truth, or knaves, who always tell lies. You meet two islanders, John and Mary, who make the following statements:

John: "Both of us are knights."

Mary: "John is a knave."

Identify the type each belongs to.

(10 marks)

5. Use Induction to design a reduce-and-conquer algorithm for finding the sum of all the numbers in an array of n numbers.

(10 marks)

- i.) Calculate a lower bound on the cost for completing the three tasks. Is this a feasible solution?
- ii.) Calculate an upper bound on the cost for completing the three tasks. Is this an optimal solution in general?

(10 marks)

9. The following is an array of five numbers:

50	40	30	20	10
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Use Bubble Sort to sort the five numbers in the array in ascending order. Show the result of each pass.

(10 marks)

10. The provision of an effective national security policy that addresses needs for both security and freedom of the population is, by its very nature, a wicked problem. Information Technology infrastructure lies at the heart of this issue.

Discuss how IT contributes to the problem and how it may contribute to the 'solution'.

You may wish to address some of the following characteristics of a wicked problem in your discussion:

- i) There is no definitive formulation of a wicked problem.
- ii) Wicked problems have no stopping rule.
- iii) Solutions to wicked problems are not true-or-false, but good or bad.
- iv) There is no immediate and no ultimate test of a solution to a wicked problem.
- v) Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly.
- vi) Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan.
- vii) Every wicked problem is essentially unique.
- viii) Every wicked problem can be considered to be a symptom of another problem.
- ix) The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
- x) The social planner has no right to be wrong (i.e., planners are liable for the consequences of the actions they generate).

(10 marks)