ALGORITHMS AND INFORMATION SYSTEMS (CT102)

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Time allowed: *one* hour.
Attempt *three* questions.

1. Write down (step by step) the position of each letter in the word WEXFORD when sorted using **quicksort**. Exactly how many comparisons are required in this particular case? In the "best case" scenario, exactly how many comparisons are required in the quicksort of a 7-letter word?

2. Explain **one** divide and conquer approach to the multiplication of two large integers. In your explanation, derive and state the complexity (in "Big Oh" notation) of the approach.

3. (a) Draw an example of
   i. A cyclic graph with 5 nodes.
   ii. A disconnected graph with 6 edges.
   iii. A ternary (3-ary) tree with 10 leaves.
   iv. A binary tree with 6 edges and 2 leaves.

   (b) Explain how the linear/sequential search of a list can be viewed using a decision tree, and sketch the tree in question.

4. (a) Write (in pseudocode) an algorithm to calculate the sum of the first n natural numbers. The input is n and the output should be

$$1 + 2 + 3 + \ldots + (n-1) + n.$$

   (b) Suppose in a certain country, only two coins exist, in units of 5 and 9. We want to make up some amount M using the fewest number of coins. State what answer (if any) is given by the **Greedy Approach** if
   i. $M = 29$
   ii. $M = 32$
   iii. $M = 33$

   In which (if any) of these cases does the Greedy Strategy obtain the best possible answer?

Beannachtaí na Nollag oraibh go leir