

**Question 1**                    *Important features of Object Oriented programming are encapsulation, abstraction, inheritance and polymorphism. Describe an example where you have seen abstraction used in a program.*

**Question 2**                    *Given an  $n$ -element sequence  $S$ , you have an algorithm  $B$  that chooses (the next integer greater than  $n \log n$ )  $\lceil n \log n \rceil$  elements at random and executes an  $O(n^3)$ -time calculating for each. What is the worst case running time of  $B$ ?*

**Question 3**                    *A program to generate all the permutations of a set is run on a computer that writes the output to a file at a rate of 1300 permutations per second. How long will it take the computer to generate all the permutations of a set with 7 (distinct) elements?*

**Question 4**                    *Write in pseudo code a recursive algorithm for finding the maximum element in a sequence,  $R$ , of  $p^3$  elements. What is your running time and space usage?*

**Question 5**                    *Memoization and Dynamic programming are both methods used in recursive algorithms for what purpose? Explain in one to two sentences how this is achieved.*

**Question 6**                    *def Arithmetic (n)*  
*for i in range(1, n):*  
*for j in range(i, (i+5)/3):*  
*a = n<sup>i</sup> - 2.j*  
*return a*

*What is the big O complexity of Arithmetic. Show working.*

**Question 7**                    *What are the two manipulation functions required for a Queue ADT based on a Linked List. Give the pseudo code to implement these on the base structure.*

**Question 8**

- 1. Write a definition for a general Graph and write in words Euler's generalise theorem on the complete traversal of a graph, which is called an Eulerian cycle. If you remove the condition of the start and end point being the same, you have an Eulerian path*
- 2. Draw a graph with 5 vertices that has: an Euler cycle; an Euler path but not an Euler cycle; neither of these.*
- 3. Write in pseudo code an algorithm to traverse a graph and verify if the graph has an Eulerian cycle or path. First consider how you will represent the edges and vertices in your code and show this.*