End-of-Year Revision Exercise for Year 12 HL

** indicates question was taken from an IB past paper*

1) Write a **recursive** and an **iterative** pseudocode to evaluate the function:

$$F(n) = 1^2 + 2^2 + 3^2 + \ldots + n^2$$

2) * Consider the following recursive method

```
public int foo (int n)
{
  if (n <= 0) return –1; else
  {
    if (n == 1) return 1; else
    {
      int y = n % 2;
      if (y == 0) return foo(n/2);
          else return foo(3 * n + 1);
    }
  }
}
```

a) From the above code find:

i) A formal parameter; *[1 mark]*

ii) A local variable. *[1 mark]*

b) By copying and completing the following table, trace the algorithm for the call foo(3). *[2 marks]*

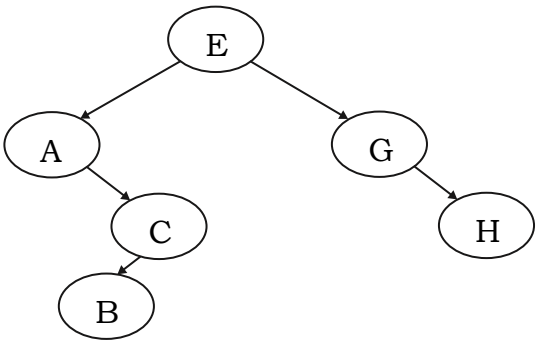
n	**y**	**return**
3		

c) Suggest a way to modify the method above in order to optimize the tests on n. *[2 marks]*

d) Suggest how the method bfoo, that returns Boolean values, can be obtained as a modification of the method foo. *[2 marks]*

e) State **one** advantage and **one** disadvantage of recursion versus iteration. *[2 marks]*

3) * Consider the following binary search tree.



Draw the resulting binary search tree after

a) deleting H from the initial tree; *[1 mark]*

b) deleting C from the initial tree; *[1 mark]*

c) deleting E from the initial tree. *[2 marks]*

4) * Consider the array and algorithm shown below.

	[0]	[1]	[2]	[3]	[4]
A	1.5	7.2	3.6	5.3	0.1

```
for (int index = 4; index > 0; index = index – 1)
{
    int j = index;
    for (int i = index – 1; i >= 0; i = i – 1)
    {
        if (A[i] < A[j]) { j = i; }
    }
    if (j != index)
    {
        double w = A[j]; A[j] = A[index];
        A[index] = w;
    }
}
```

a) Outline the operation of the outer **for** loop. [2 marks]

b) Analyse the efficiency of the algorithm in terms of *BigO notation.* *[3 marks]*

c) Identify, by tracing the algorithm or otherwise, the contents of the array A after each execution of the outer loop. *[4 marks]*

d) State the purpose of the algorithm. *[1 mark]*

5) Question about the CPU

a) What is the role of the CPU in a computer?

b) What do we mean by

i) instruction set

ii) bandwidth

iii) clock speed

c) What is the difference between a RISC and a CISC processor?

d) Explain the role of each of the following registers inside a CPU:

i) Accumulator

ii) CIR

iii) PC

iv) MAR

v) MDR

vi) Status register

e) What do we mean by cache?

f) What does the fetch-execute-cycle do?

6) The names of students attending a science fair were recorded in a stack data structure as each one arrived.

The first item stored in the stack was “Sophie”.

Note that “Troy” is currently in position 0 in the stack.

a) Construct the pseudocode that will search the stack for a specific name, and output its position in the stack. You may assume that all names in the stack are unique. [5]

b) Explain the benefits of using a binary search tree, compared to a stack, when searching for a specific item. [3]

If the tree is populated with the data from the stack, the first item popped off will become the root. For each subsequent item popped from the stack, a recursive procedure is followed until the item is correctly placed in the tree.

c) Without writing code, describe this recursive procedure. [4]

d) By considering only the data visible in the stack shown above, sketch the binary search tree that has been created from the items removed from the stack. [3]

7) A linked list holds names. An element E holds two parts (i) the name, which is indicated by name(E) reference to the next element, which is indicated by refnext(E). The following pseudocode shows an algorithm that displays all the elements of the linked list:

```
{
    p = refStart;
    while ( p != nil )
    {
        Display name (E);
        p = refnext(E);
    }
)
```

Write pseudocode that counts the number of 'Joe' in the linked list.

8) Describe the Queue data structure. State one application where it can be used.