The use of electronic calculators is NOT permitted
Section A is restricted and cannot be published
Question 1

This question is about "nuts and bolts" Java programming, involving arrays and loops.

1.1 Write a class called Calculator which has an int instance variable to represent the current stored value. The constructor should set that value to zero. It should have a method void add(int other) which adds another value to the one stored, and a method void display() which prints the current stored value. (5 marks)

1.2 Now we will change this into a slightly unusual calculator in that it will store several values at once. Replace the int instance variable with an array of ints. Have the constructor take the required size of the array as its parameter, and create the array. Hint: when you create an array of ints, the values in it are all zero by default, so you don't need to set them. Change the add() and display() methods so that each takes another int parameter which says which value in the array to add to or display. You don't need to check that the parameter is valid. (5 marks)

1.3 Write a method int maximum() which will return the maximum value stored in the array. You can assume that this value will not be negative. (5 marks)
Question 2

This question is about **inheritance**. It involves writing code, but you only need to write the code which exactly corresponds to the items mentioned in the question.

2.1 Explain how inheritance in programming languages is related to the way we manage complexity in the real world, and what its main advantages are.  

(4 marks)

2.2 Draw a UML class diagram which shows an abstract class `TimeDisplayDevice`, with subclasses `Clock` and `Watch`.  

(3 marks)

2.3 Show how the three classes would be declared in Java.  

(3 marks)

2.4 Write the `TimeDisplayDevice` class, assuming that:

- It represents the time with two `ints`, for the hours and minutes. Initial values for these are provided as parameters to the constructor

- There are public methods to get the hours and minutes

- There is a method to display the time as a `String`. This method will be implemented differently in each subclass.  

(5 marks)
Question 3

This question is about collections.

3.1 State TWO ways in which an ArrayList is similar to an array. (2 marks)

3.2 State FOUR ways in which an ArrayList is different from an array. (4 marks)

3.3 Assume you have a Train class, and each Train has a unique ID and a current position, accessed by the methods String getID() and Position getCurrentPosition().

Briefly explain what the following method does. (4 marks)

```java
public Position find(Train[] trains, String trainID) {
    Position result = null;
    int i = 0;
    while(i < trains.length) {
        if (trains[i].getID().equals(trainID)) {
            result = trains[i].getCurrentPosition();
        } else {
            // Not found yet, do nothing
        }
        i++;
    }
    return result;
}
```

3.4 If instead, the condition was written

```java
if (trains[i].getID() == trainID)
```

it would not work correctly. Explain why not. (1 mark)

3.5 Explain how, by using a suitable collection, we could avoid using a loop altogether. (It's not necessary to write the actual code so long as the explanation is clear). Hint: an ArrayList is not a suitable collection for this job. (4 marks)
Question 4

This question is about **storing external data**.

4.1 Give a brief outline of how, in a Java application, you would store data about trains, such as owner, capacity, position etc. using each of the following formats.

   a) Java serialised objects. (2 marks)

   b) Comma-separated value (CSV) files. (2 marks)

   c) XML files. (2 marks)

   d) A relational database. (2 marks)

4.2 Suppose the reason you are storing this information is that you are building an information system for Network Rail. Which TWO formats would you seriously consider using, and why? (4 marks)

4.3 Suppose the reason you are storing this information is that the trains are not real ones (phew!) but models owned by enthusiasts, each of whom will have at most a few tens of them, collected over a period of years. Which TWO formats would you seriously consider using, and why? (3 marks)