

# Computer Science

**Time Allowed – 1½ hours**

The questions in this paper are divided into two sections: A and B.  
Answer **TWO** questions in total, i.e. the only question in section A and your choice of question from section B. Each question answered will be worth 50 marks.

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## SECTION A

1. a) In a ‘typed’ programming language of your choice (not a database), what data structures or primitive data types would be most appropriate for storing each of the following? Please specify the programming language used. You should provide reasons for your answers:

- The number of people competing in a race
- The length of a road – in kilometres
- A UK car registration number
- The type of fuel a vehicle uses
- The value of an expression like  $x \leq z$
- The set of times for a group of entrants in a race
- A collection of information about an individual car – like make, manufacturer, engine size, colour etc.
- All the information about a number of vehicles taking part in a rally
- A pile of cards to be used in a game of solitaire
- The state of the board in a game of noughts and crosses (tic-tac-toe)

[15 marks]

b) An Ordnance Survey Grid Reference, such as SX624678 and SN5881, contains information about distance of a point to the East of an origin (the first 50% of the digits) and to the North of an origin (the second 50% of the digits). The two letters provide further information that specifies a region of the United Kingdom, which can be used ‘as is’ or used as further numerical data (using a conversion process that is not relevant to this question).

Describe the data structures and/or variable types that a software engineer might reasonably use to store Grid References within a program in the following cases. Your answer should give an explanation for the decision, among which you may wish to include performance issues.

- i. The data will only be used to display the Grid Reference within a printed list.
- ii. The data are to be used within the program to perform arithmetic calculations based on position, and also plotted on a map, but the Grid References themselves will not be displayed to the user.

- iii. The data are to be used within the program to perform arithmetic calculations based on position, and also plotted on a map, where the Grid References themselves will be displayed to the user.

[12 marks]

- c) Write an algorithm in clear pseudo code, i.e. write down the steps using ideas like:

```
if (something is true)    or    while (some condition is true)
then                      do some action
    do action 1                repeatedly
else
    do action 2
```

that describes how you might print the first 100 rows of Pascal's Triangle.

Pascal's Triangle starts with a single 1 in the first row and each entry of each subsequent row is constructed by adding the number above and to the left with the number above and to the right, treating blank entries as 0. The first 5 rows are shown here, for reference.

```

                1
            1      1
        1      2      1
    1      3      3      1
1      4      6      4      1
```

Your answer should specify the data structures that you use, list any optimisations that you have made, and may describe other optimisations that you could make, specifically addressing the trade off between memory use and execution speed. You may wish to add additional comments to explain your algorithm.

[23 marks]

## SECTION B

2. Giving examples from your own experience where necessary:

- a) Define what is meant by an **operating system**. [9 marks]
- b) Describe ways in which an Operating System attempts to optimise the use of the underlying computer hardware. Your answer should include, but not be limited to, Virtual Memory and multiple processors. [15 marks]
- c) Some computing devices do not have an Operating System. Discuss the constraints that this places upon the devices and upon software developers, as well as the consequences for portability of software. What benefits, if any, are gained by not having an Operating System? [16 marks]
- d) Why is it necessary that devices such as disk storage and communications products use well defined standards? [10 marks]

3. a) Explain what is meant by the terms **Internet** and **World Wide Web**. Your answer should give examples of uses for each concept. As a starting point you might wish to discuss the different ways in which a person might use and access their electronic mail. [20 marks]
- b) The term “Cloud Computing” has become well used in the mainstream media and in more technical situations. Provide a reasoned explanation of what **The Cloud** is, and describe the various different meanings of the term **Cloud Computing**. Your answer should consider the positive and negative consequences of using Cloud technologies for an individual. [20 marks]
- c) Why is it hard to control how the internet is used or abused? [10 marks]