

## **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 in 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 height of a person, in metres
- The number of people in a room
- The type of fuel a vehicle uses
- A UK Postcode (e.g. SY23 3DB)
- The result of a mathematical expression such as  $y > x$
- The marks for a set of students sitting an exam
- A collection of information about an individual person – name, age, height, NI number, etc.
- The same collection of information about each member of a group of people
- The sequence of cards in a shuffled pack of playing cards
- The state of the board in a game of draughts (also known as checkers)

[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 find all of the factors of each of the numbers from 1 to 100. For example, the factors of 16 are 2, 4 and 8 because:

$$2 \times 8 = 16$$

$$4 \times 4 = 16$$

$$8 \times 2 = 16$$

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) Many computing devices have an **Operating System**. Describe ways in which an Operating System attempts to optimise the use of the underlying computer hardware. Your answer should consider the differences in requirements between desktop computer and mobile phone Operating Systems. [20 marks]
- b) 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]
- c) Given the wide range of Operating Systems that are used, discuss the necessity or otherwise for agreed standards between the creators of operating systems, hardware and application software [14 marks]

3. a) Explain what is meant by the terms **Local Area Network** and **Wide Area Network**. Your answer should cover the relationship between the two, and the differences in speed and security between them. [12 marks]
- b) Many devices are now marketed as “Internet-enabled”, from cameras to smartphones to home automation devices to cars. Discuss the privacy and security issues that these devices can cause, and whether these are significant compared with the benefits that internet enabling provides. [13 marks]
- c) Governments in many countries wish to control how the Internet is used and regulated. Provide an extensive discussion of why such control is difficult to achieve; the steps that governments are able to take; and the ways that people can avoid them. Your answer should consider the role of corporations in policing the internet, and should also include any other topics that you consider to be relevant to the topic. [25 marks]