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.

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 number of swimmers in a race
   - The length of a street, in metres
   - A person's gender
   - A UK grid reference e.g. SN596881
   - The result of a mathematical comparison such as $((x+y) > 2z)$
   - The number of visitors to a tourist attraction each day in a month
   - The layout and content of a sudoku puzzle
   - A collection of information about an athlete in a race – name, age category, starting time, race number, etc.
   - The same collection of information about each member of a group of athletes
   - A pile of cards to be used in a game of solitaire

   [15 marks]

   b) 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 can 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:

   2x8=16

   4x4=16

   8x2=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.

[19 marks]

c) In clear, detailed steps (as in question1. b, above) indicate how you could determine if a phrase is a Palindrome (i.e. reads the same backwards as forwards). The phrases "MADAM I'M ADAM" "PEEP" and "ABLE WAS I ERE I SAW ELBA" are all palindromes (we ignore spaces and punctuation).

[16 marks]

SECTION B

2. With reference to a simple model of a desktop computer system:
   a) Explain each of the following terms, and describe the role that each item carries out within the computer:
   (i) Hard disk (HDD)

[3 marks]

   (ii) RAM

[3 marks]

   (iii) ALU

[3 marks]

   (iv) CPU cache

[3 marks]

   b) Describe what RAID is and discuss commonly used types of RAID. Your answer should consider the advantages and disadvantages of them for different user applications.

[16 marks]

   c) Why is it necessary that devices such as disk storage and communication products use well defined standards?

[10 marks]

   d) What benefits (or drawbacks) has increasing hardware parallelisation had on software developers and on end-users? Your answer should consider users of a range of different types of software.

[12 marks]

3. a) Many devices are now marketed as "Internet-enabled", from coffee machines to smartphones to home fitness equipment 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.

[18 marks]

b) IoT (Internet of Things) devices have the potential to generate large quantities of data. Memory and storage are generally measured in the same units, with the prefixes:

M   G   T   P   E

Give the names for these units, a precise definition of the multiplier that they represent, and the relationship between each. Your answer should consider the different number bases used by computers and by humans.

[15 marks]

c) 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, including ways to mitigate the security limitations.

[17 marks]