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|  | **Entrance Examination**  **May 2021** |
| **COMPUTER SCIENCE**  Time allowed: 1.5 hours (90 minutes)  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? You must specify the programming language used and provide reasons for your answers:

* The length of a mountain walk, in kilometres
* A person’s gender
* A UK grid reference e.g. SN596881
* The number of walkers taking part in a in a charity event
* The number of visitors to a tourist attraction each day in a month
* The layout and content of a sudoku puzzle
* The result of a mathematical comparison such as ((x+y) > 2z)
* A location on Earth, storing a name, the latitude and the longitude
* The same collection of information for multiple locations
* A pile of cards to be used in a game of solitaire

[15 marks]

b) A programmer is tasked with writing a program that will calculate whether a number received from a user is the sum of two squares.

For example, 5 would output TRUE as 5 = 12 + 22.

11 would output FALSE as it is not made of two squares.

136 would output TRUE as it is the sum of 62 + 102.

In clear, detailed pseudo code write an algorithm that the programmer could use i.e. write down the steps using ideas like:

while (some condition is true)

do some action

repeatedly

if (something is true) then

do action 1

else

do action 2

**or**

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 programatically sum the individual digits in an integer value (stored in the computer’s memory as a numeric value). You should try to make your answer efficient to compute.

For example: 9374 would output the answer 23, as 9+3+7+4 = 23.

[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) Hardware expansion bus  
 [3 marks]

(ii) RAM  
 [3 marks]

(iii) ALU  
 [3 marks]

b) Different computer tasks can place different demands on storage solutions. The provision of data storage on a computer can be seen as a trade-off between write and read speed, fault tolerance, and cost. Discuss how machines used for particular tasks (such as a video editing machine or a fileserver, or a computationally intensive task on small amounts of data) might have their disk storage configured in different ways to optimise that trade off. What disk technologies, involving either single or multiple disks, might be considered for the different tasks?

[16 marks]

c) Why is it necessary that devices such as hardware peripherals and communication products comply with well defined standards?

[10 marks]

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

[15 marks]

3. a) Extensively discuss the question “Is computing an environmental disaster or the saviour of our planet?”. Your answer should be supported by specific examples.

[30 marks]

b) Describe what an operating system is and explain why they are used. In your answer also discuss the possibility of a computer that did not have an operating system, and how that would affect programs that run on that computer.

[20 marks]