

**BCS THE CHARTERED INSTITUTE FOR IT**

BCS HIGHER EDUCATION QUALIFICATIONS  
BCS Level 4 Certificate in IT

**SOFTWARE DEVELOPMENT**

Thursday 6<sup>th</sup> May 2021 - Afternoon

Time: TWO hours

Section A and Section B each carry 50% of the marks.  
You are advised to spend about 1 hour on Section A (30 minutes per question)  
and 1 hour on Section B (12 minutes per question).

**Answer the Section A questions you attempt in Answer Book A  
Answer the Section B questions you attempt in Answer Book B**

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are <b>NOT</b> allowed in this examination.
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**SECTION A**

**Answer 2 questions (out of 4). Each question carries 30 marks.**

**A1.**

- a) A prime number is a positive integer greater than 1 that cannot be formed by multiplying two smaller positive integers.

Write pseudocode for a function `isPrime(n)` which accepts a positive integer `n` (where  $n > 1$ ) as an argument and returns true if `n` is a prime number and false if `n` is not a prime number.

**(10 marks)**

- b) Draw a flowchart of the algorithm which is used in your answer to part a).

**(10 marks)**

- c) Twin primes are pairs of prime numbers of the form  $(p, p+2)$  for example: (3, 5), (5, 7), (11, 13), (17, 19).

Compare and contrast the following two pseudocode representations of an algorithm which finds all twin primes where both numbers are less than 40. Comment on their correctness and efficiency.

Algorithm 1

```
for i = 2 to 40 Step 1
  if (isPrime(i) AND isPrime(i + 2))
    Display i and i+2 as a twin prime pair
```

Algorithm 2

```
for i = 3 to 37 Step 2
  if (isPrime(i) AND isPrime(i + 2))
    Display i and i+2 as a twin prime pair
```

**(10 marks)**

**B10.**

- a) With reference to the following routine, explain what is meant by the programming term recursion.

```
int Fibonacci (int n)
{
    if (n == 0)
        return 0;
    else if (n == 1)
        return 1;
    else
        return (Fibonacci(n-1) + Fibonacci(n-2));
}
```

**(4 marks)**

- b) Write an iterative version of the above program generating the first 20 numbers of the Fibonacci series.

**(8 marks)****B11.**

- a) Describe **TWO** of the following sorting techniques using the unsorted array A{4, 3, 2, 10, 12, 1, 5, 6} to demonstrate the differences between them:

- i) Bubble Sort;
- ii) Merge Sort;
- iii) Insertion Sort.

**(8 marks)**

- b) Explain how the efficiency of a sorting algorithm is measured when deciding which sorting technique is the **MOST** efficient for a given set of data.

**(4 marks)****B12.**

- a) Describe each of the following software design techniques:

- i) Flow charts;
- ii) Mock ups.

**(6 marks)**

- b) Explain the purpose of **EACH** of the following software development techniques:

- i) Evolutionary prototyping;
- ii) Defensive programming.

**(6 marks)****END OF EXAMINATION****A2.**

- a) Write program code, in a language of your choice, that implements a function validPassword which accepts a string as an argument and returns true if the string contains a valid password and false if it does not. To do this you will need to implement the following rules:

- i) A password must have at least ten characters;
- ii) A password consists of only letters and digits;
- iii) A password must contain at least two digits;
- iv) A password must contain at least two letters.

**(15 marks)**

- b) Give **FIVE** strings that you would use to test a program written as an answer to part a). Explain the purpose behind each of the strings you suggest.

**(10 marks)**

- c) Discuss the importance of security as part of the software development process.

**(5 marks)****A3.**

Compare and contrast the following programming paradigms:

- i) Modular programming;
- ii) Object oriented programming;
- iii) Functional programming.

**(30 marks)****A4.**

- a) Rewrite the following code into a human readable form:

```
int array_nums[]={0,4,0,0,7,2,0,5};int
array_nums_length=sizeof(array_nums)/sizeof(array_nums[0]); int
k=0;for(int i=0;i<array_nums_length;i++)
if(array_nums[i]!=0)array_nums[k++]=array_nums[i];for(int
i=k;i<array_nums_length;i++)array_nums[i]=0;for(int
i=0;i<array_nums_length;i++)printf("%d ",
array_nums[i]);printf("\n");
```

**(10 marks)**

- b) List **FIVE** techniques for making code self-documenting. For each technique, give an example of its use.

**(10 marks)**

- c) Give a brief description of **FIVE** types of documentation that might be produced as part of a software development project.

**(10 marks)****[Turn Over]**

**SECTION B**

**Answer 5 questions (out of 8). Each question carries 12 marks.**

**B5.**

The authentication of credit cards is important to detect fraud and is performed on the digits\* that make up the unique credit card number.

**\*Please note for simplicity in this question the credit card number consists of 8 digits.**

The following algorithm describes a technique used to authenticate a credit card.

*Algorithm:*

*Step 1 Read the credit card digits into an array. For example:*

4 9 5 4 3 7 2 1

*Step 2 The second, fourth, sixth and eighth digits are each multiplied by 2. If the result of multiplication is greater than 10 then subtract 9 from it. For example:*

```
4 9 5 4 3 7 2 1 => selected digit in bold
9x2 = (18-9) = 9
4x2 = 8
7x2 = (14-9) =5
1x2 = 2
Sum = 24
```

*Step 3 Add together the other digits (first, third etc) to the results of step ii) above to give a Final Total:*

```
FinalTotal = Sum + 4 + 5 + 3 + 2
FinalTotal = 38
```

*Step 4 Divide (using integer division) the Finaltotal by 10 and return the remainder.R*

*In this example R = 8.*

*Step 5 Test If the remainder R is either 5, 6 or 7, then the credit card is NOT authentic. If R is <5 or R > 7 then it is authentic.*

Write a program using pseudocode or a programming language of your choice that implements the algorithm.

**(12 marks)**

**B6.**

- a) Given the following sample data, describe how a linear search method is used to find a particular item of data.

**Data {1, 54, 5, 71, 32, 12, 14, 3, 31, 52, 65, 45, 13, 89, 17}**

**(4 marks)**

- b) Express the linear search method in pseudocode assuming the data is stored in an array containing distinct values. The program outputs either the data item being searched does not exist, or if found returns the position of data item in the array.

**(8 marks)**

**B7.**

Write short notes on **EACH** of the following topics highlighting the key differences between the terms within **EACH** pair:

- i) Command Line and Graphical User Interface (Types of User Interface);
- ii) Class and Method (Concepts in Object Oriented Programming);
- iii) Stack and Queue (Linear data structures).

**(12 marks)**

**B8.**

- a) Explain in **ONE** sentence why it is important to perform software testing. **(2 marks)**

- b) A particular type of software testing is called unit testing and usually involves the production of test cases. Explain why test cases are an important part of unit testing. **(3 marks)**

- c) Explain briefly why the process of developing a software test case might reveal other problems in the software. **(2 marks)**

- d) Describe the documentation used to record the execution of a test case on a piece of software. **(5 marks)**

**B9.**

- a) What is meant by the term 'debugging'? **(4 marks)**

- b) Explain how debugging is undertaken in a simple programming environment where the programmer has only the standard output facilities of the programming language to use. **(4 marks)**

- c) Describe the additional tools and techniques that are available to assist in debugging in a traditional Integrated Development Environment (IDE) such as Visual Studio, Eclipse, NetBeans. **(4 marks)**

**[Turn Over]**