

BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 4 Certificate in IT

SOFTWARE DEVELOPMENT

Wednesday 5th October 2022 – Morning

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 any Section A questions you attempt in Answer Book A
Answer any 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 **NOT** allowed in this examination.

B10.

Using examples describe **each** of the following errors that often occur in program code and state what software tool/utility would detect and/or resolve the error:

- i) Syntax error (3 marks)
- ii) Type error (3 marks)
- iii) Logic error (3 marks)
- iv) Overflow error. (3 marks)

B11.

Examine the following (faulty) code. The code is supposed to find the maximum of three supplied integers.

```
def maxim(a,b,c):  
    max = 0  
    if b > a:  
        max = b  
    if c > a:  
        max = c  
    return(max)
```

- a) Produce a trace table showing the expected and actual results returned from the following function calls:

```
print ("max1= ", maxim(5,5,4))  
print ("max2= ", maxim(1,3,2))  
print ("max3= ", maxim(2,3,4))  
print ("max4= ", maxim(2,1,1))  
print ("max5= ", maxim(2,6,2))  
print ("max6= ", maxim(4,1,3))
```

(6 marks)

- b) State the error(s) in the above code and rewrite the code so that it works as expected. Your solution can be written in pseudocode or in a programming language of your choice.

(6 marks)

B12.

Give a brief definition of Quantum Computing and describe a real-world application that would benefit from a Quantum Computing approach.

(12 marks)

End of Examination

Section A

Answer 2 questions (out of 4) in Answer Book A. Each question carries 30 marks.

A1.

- a) What role does a compiler play in preparing a program for execution?
(5 marks)
- b) What role does an interpreter play in executing a program?
(5 marks)
- c) From the programmer's point of view, what are the strengths and weaknesses of developing software using a compiled language compared with using an interpreted language?
(5 marks)
- d) Explain what is meant by the term IDE (Integrated Development Environment).
(5 marks)
- e) Identify and describe **FIVE** features of a typical IDE that are intended to help programmers find any bugs in their code.
(10 marks)

A2.

Describe each of the following programming paradigms and explain the strengths and weaknesses of each approach:

- i) Structured programming **(8 marks)**
- ii) Object oriented programming **(8 marks)**
- iii) Functional programming **(8 marks)**
- iv) Concurrent programming. **(6 marks)**

B9.

- a) Using the sample code in Fig B9 as a source of examples explain the following object-oriented programming terms:
 - i) Classes **(2 marks)**
 - ii) Methods **(2 marks)**
 - iii) Objects. **(2 marks)**
- b) Briefly describe **TWO** benefits of adopting an object-oriented approach to software development. **(6 marks)**

Fig B9 Sample Code for question B9

```
class Bicycle {
    int cadence = 0;
    int speed = 0;
    int gear = 1;

    void changeCadence(int newValue) {
        cadence = newValue;
    }
    void changeGear(int newValue) {
        gear = newValue;
    }
    void speedUp(int increment) {
        speed = speed + increment;
    }
    void applyBrakes(int decrement) {
        speed = speed - decrement;
    }
    void printStates() {
        System.out.println("cadence:" +
            cadence + " speed:" +
            speed + " gear:" + gear);
    }
}

class BicycleDemo {
    public static void main(String[] args) {

        Bicycle bike1 = new Bicycle();
        Bicycle bike2 = new Bicycle();

        bike1.changeCadence(50);
        bike1.speedUp(10);
        bike1.changeGear(2);
        bike1.printStates();

        bike2.changeCadence(50);
        bike2.speedUp(10);
        bike2.changeGear(2);
        bike2.printStates();
    }
}
```

[Turn Over]

B7.

“An important aspect of software development is ensuring that a software product meets certain Software Quality Assurance standards.”

Discuss the above statement; explaining why software quality assurance is important, stating how it is achieved and what are the measurable aspects of high quality in a software product.

(12 marks)

B8.

A password checker is required that checks whether a password entered is sufficiently strong and robust to prevent malicious attempts to hack it.

a) Draw a Flow Chart that shows the processing steps required for a password checker that applies the following acceptance tests:

- TEST#1:
Password contains at least 8 ASCII characters and no more than 16 ASCII characters.
- TEST#2:
Each password character is checked to see if there is at least one occurrence of either:
 - An uppercase character (between A-Z)
 - A lowercase character (between a-z)
 - A digit character (0-9).

You can assume the following functions are available to process the string of password characters:

Length (string) returns the number of characters that the password contains;
Getchar(password, position) returns the character in position X in the password;
IsNumeric returns TRUE if the character is numeric in the range [0-9]
IsUpper returns TRUE if the character is the range [A...Z]
IsLower returns TRUE if the character is in range [a...z]

(10 marks)

b) Give an example of one additional measure that could be used to further improve the strength and robustness of a password checker.

(2 marks)

A3.

a) What is a stack? **(3 marks)**

b) Assume that you are working with a stack that has been implemented using an array. Write pseudocode for **each** of the following stack operations:

i) Push **(3 marks)**

ii) Pop **(3 marks)**

iii) Peek. **(3 marks)**

c) What is a queue? **(3 marks)**

d) Assume that you are working with a queue that has been implemented using an array. Write pseudocode for **each** of the following queue operations:

i) Enqueue **(3 marks)**

ii) Dequeue **(3 marks)**

iii) Peek. **(3 marks)**

e) How might stacks and queues be implemented using linked lists? **(6 marks)**

[Turn Over]

A4.

The bubble sort algorithm is so called because after each pass through the values to be sorted, one value 'bubbles' into its correct place in the final sorted sequence.

For example, if we begin with the following values:
9, 17, 11, 5, 15

After one pass of the standard algorithm. 17 which is the largest value 'bubbles' into its final place:
9, 11, 5, 15, 17

In the standard algorithm the highest value item is correctly placed after the first pass, the next highest after the second pass and so on until all the data items are in the correct sequence.

- a) Write a program which takes an integer array of five elements and applies the bubble sort technique so that the lowest value item is correctly placed after the first pass, the next lowest after the second pass and so on until all items are in the correct sequence.

In the example given above the order of the data after the first pass would be:
5, 9, 17, 11, 15

(10 marks)

- b) Amend the solution to part a) to implement code which allows a user to provide an array of five integer values and an integer number n in the range $0 < n < 5$. The code produces an array of five integers with the lowest n integers in their correct places in the sorted sequence and the remaining integers appearing in the same order as they did in the original sequence.

For example, if the data entered is 19, 17, 2, 3, 1 and the value of n is 3 then the program should output:
1, 2, 3, 19, 17

You may assume that there is no need to check that the input value n is in range and that the array will never contain duplicate values.

(20 marks)

Section B

Answer 5 questions (out of 8) in Answer Book B. Each question carries 12 marks.

B5.

Refer to Fig. B5 below a set of integers called elements. Each element is accessed by its row and column number (e.g., the element located in row=3 column=4 has a value of 172). Each element ranges in value from a minimum of 0 up to a maximum of 255.

Fig. B5 Set of integer values.

122	234	255	28
113	246	254	95
4	8	169	172
233	59	80	209
118	145	197	204
156	187	190	192
100	119	112	178
34	0	0	17

- a) Describe an internal data structure to store the data in Fig. B5 above.

(2 marks)

- b) Write a program using pseudocode or in a language of your choosing that adds or subtracts an integer value to the current value of each element in a row selected by the user.

The amount of increase or decrease is entered by the user and must not be less than -50 or not greater than +50 otherwise a default value of 0 is used.

Any update to a particular element is not allowed if it would result in the new value being greater than 255 or less than 0.

For example, if the row number is 8 and the amount to decrease is -6 then the following updates would be allowed and printed out:

Column 1 Row 8 updated from 34 to 28
Column 4 Row 8 updated from 17 to 11

Note that Elements in column 2 and 3 would not be updated and are not printed out.

(10 marks)

B6.

An array is used to store a sorted list of data items, for example:
34, 56, 57, 59, 121, 345, 461, 476, 478, 479, 485

- a) Describe how a **linear search** could be used to find a given item in the list.

(4 marks)

- b) Describe how a **binary search** could be used to find a given item in the list.

(4 marks)

- c) Comment on the relative efficiency of the search algorithms you described in parts a) and b).

(4 marks)

[Turn Over]