GCE A LEVEL

A500U10-1

S24-A500U10-1

MONDAY, 10 JUNE 2024 – AFTERNOON

COMPUTER SCIENCE – A level component 1
Programming and System Development

2 hours 45 minutes

A500U101
01

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Write your answers in the separate answer booklet provided.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question; you are advised to divide your time accordingly.

The total number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers.

Answer **all** questions.

1. (a) Explain the characteristics of a linked list data structure. [4]

(b) Explain the characteristics of a hash table data structure. [4]

(c) Below is a representation of a hash table named `scores`.

Key	Value
`Sixth`	`0`
`Fourth`	`40`
`Third`	`60`
`Second`	`80`
`First`	`100`

(i) Redraw the hash table after the data item "`Fifth`, `20`" has been added and "`Sixth`, `0`" has been deleted. [2]

(ii) State how you access the value `60`. [2]

2. Draw a truth table to prove the following Boolean expression: [6]

(A AND NOT B) OR (NOT A AND B) = A XOR B

3. Explain how current legislation impacts on:

(a) Data protection [4]

(b) Freedom of information [4]

4. A music streaming service has a search feature that allows users to search for songs by artist, album or song title. The search syntax must follow certain rules to ensure accurate results. The search feature supports the use of the logical operators AND, OR and NOT.

- Artist names, album titles and song titles are made up of alphabetical characters, numbers and spaces.
- Search criteria always start with either “artist:”, “album:” or “song:”
- Multiple search criteria can be combined using logical operators AND, OR and NOT.

Example: artist: "Elvis" AND album: "Blue Hawaii" OR song: "Can't Help Falling in Love"

Produce a Backus-Naur form (BNF) definition for the search criteria. [8]

5. Clearly showing each step, simplify the following Boolean expressions using Boolean algebra, identities and De Morgan's Law.

(a) $A.B + A.(1.C + \overline{C.1})$ [5]

(b) $X.Y + Z.(Y.Z + 0.X + 0)$ [5]

6. Explain, giving a suitable example for each, the following:

(a) Translation error [3]

(b) Execution error [3]

7. This is an algorithm which searches for a string (item) in a stack of strings (myStack) of length *n*. You can assume the array has already been populated with data and the search item is present.

```
1  declare myStack[] as string[]
2  declare top as integer
3  declare found as Boolean
4
5  input item
6
7  set found = FALSE
8  set top = len(myStack[]) - 1
9
10 while (top >= 0 AND found = FALSE)
11        if myStack[top] = item then
12              set found = TRUE
13        else
14              set top = top - 1
15        end if
16 end while
17
18 output ”item found = ” + found
```

(a) Evaluate the efficiency of the search algorithm and using Big O notation, determine the growth rate for time performance. [5]

(b) Identify the type of time complexity and draw a graph of the algorithm above to illustrate the order of time performance. Graph paper is not required. [4]

(c) Determine the growth rate of memory space during a single run of the algorithm. [2]

8. Write an algorithm in pseudo-code to calculate and output the count, sum and mean (average) of any odd values in an unsorted one-dimensional integer array (myArray). [9]

9. Describe the following principal stages involved in the compilation process:

(a) Lexical analysis [2]

(b) Syntax analysis [2]

(c) Semantic analysis [2]

10. Describe appropriate diagrammatic methods to show the flow of data and information processing in a system. [4]

11. This is an algorithm which calculates and outputs the circumference, area and diameter of a circle from a given radius.

```
1  Algorithm Circle
2
3  {declare constants and variables}
4
5  declare PI = 3.14159
6  declare radius is real
7  declare circumference is real
8  declare area is real
9  declare diameter is real
10
11 input radius    {input value for radius}
12
13 set circumference = 2 * PI * radius    {calculate circumference}
14 set area = PI * radius * radius        {calculate area}
15 set diameter = 2 * radius              {calculate diameter}
16
17 output "area = " + area                      {output area}
18 output "circumference = " + circumference    {output circumference}
19 output "diameter = " + diameter              {output diameter}
```

(a) Explain the use of variables and constants in this algorithm. [4]

(b) Explain the importance of self-documenting identifiers and annotation in this algorithm. [4]

12. Discuss the different approaches to development using Waterfall and Agile methodologies, and the methods of changeover that could be employed.

You should draw on your knowledge, skills and understanding from a number of areas across your Computer Science course when answering this question. [12]

END OF PAPER

BLANK PAGE

BLANK PAGE

BLANK PAGE