GCE A LEVEL

1500U30-1

Z22-1500U30-1

MONDAY, 13 JUNE 2022 – AFTERNOON

COMPUTER SCIENCE – A2 unit 3
Programming and System Development

2 hours

1500U301
01

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.
A calculator.

INSTRUCTIONS TO CANDIDATES

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.
Assessment will take into account the quality of written communication used in your answers.

Answer **all** questions.

1. (a) Explain, giving a suitable example, the operation of a stack data structure. [4]

(b) This is a graphical representation of a two-dimensional array:

alphabet[ ]

	0	1	2	3	4	5	6
0	'a'	'b'	'c'	'd'	'e'	'f'	'g'
1	'h'	'i'	'j'	'k'	'l'	'm'	'n'
2	'o'	'p'	'q'	'r'	's'	't'	'u'
3	'v'	'w'	'x'	'y'	'z'	' '	'.'

(i) Describe how you would update the value **'.'** to **'!'** in the alphabet array. [2]

(ii) Demonstrate how a two-dimensional array could be used to store pupil data in school. [2]

2. (a) Define the term algorithm. [2]

(b) Describe one method of defining algorithms. [2]

(c) Explain the benefits and drawbacks of recursive and non-recursive algorithms. [4]

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

(a) $(A + C).(A.C + A.\overline{C}) + A.C$ [6]

(b) $\overline{X.Y} .(\overline{X} + Y) + \overline{Z}$ [5]

4. Write a Binary Search algorithm to search for a value in an array of characters and output its position. You may assume that the search value exists in the array. [8]

5. The following is an algorithm.

```
1  declare subprocedure DivMod
2
3  x, y, a, b, c, ds is integer
4
5  output “Enter a three-digit integer (100 – 999): “
6  input x
7  if x > 99 AND x < 1000 then
8      a = x DIV 100
9      b = x MOD 100
10     c = x MOD 10
11     b = (b – c) DIV 10
12     output a
13     output b
14     output c
15     ds = (a + b + c)
16     output ds
17     y = ((a * 100) + (b * 10) + c)
18     output y
19 else
20      output “error“
21 end if
22
23 end procedure
```

(a) Select appropriate test data to dry run the algorithm and give all outputs. [6]

(b) Explain the purpose of the algorithm. [2]

6. (a) Describe the approach to analysis and design in the following software development methodologies:

(i) Waterfall [4]

(ii) Agile [4]

(b) (i) Describe **one** piece of documentation that should be produced during the analysis stage of software development. [2]

(ii) Describe **one** piece of documentation that should be used during the maintenance stage of software development [2]

7. Every book contains a unique 13-digit International Standard Book Number (ISBN). An ISBN comprises five parts: a GS1 assigned prefix, registration group, publisher, title and a check digit. Each individual part is separated with a space or hyphen.

- The GS1 assigned prefix must be 978 or 979.
- The registration group must be a number between 01 and 99
- The publisher must be a number between 00001 and 99999.
- The title must be a number between 01 and 99.
- The check digit must be a single digit.
- A separator of each part which can be either a space (‘ ’) or hyphen (‘-’).

Example: 978-11-08412-72-8
Produce a Backus-Naur Form (BNF) definition for a 13-digit ISBN. [6]

8. Functional programming and logic programming are both declarative programming paradigms. Explain these two paradigms, giving an example language in each case:

(a) Functional programming [3]

(b) Logic programming [3]

9. All computer languages should follow the same standards.

(a) Explain the need for standardisation of computer languages. [2]

(b) Describe two potential difficulties involved in agreeing these standards. [2]

10. Draw a truth table to prove the following:

B AND NOT (A NOR B) = B [4]

11. This algorithm duplicates a three-dimensional array of length *n*. You can assume the array (myArray) has already been populated with data.

```
1   declare i,j,k,n as integer
2   declare myArray[n,n,n]
3   declare myArrayCopy[n,n,n]
4
5   set i = 0
6   set j = 0
7   set k = 0
8
9   for i = 0 to n - 1
10
11        for j = 0 to n - 1
12
13              for k = 0 to n - 1
14
15                    set myArrayCopy[i,j,k] = myArray[i,j,k]
16
17              next k
18
19        next j
20
21  next i
```

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

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

(c) Identify the type of time complexity and draw a graph of the algorithm to illustrate the order of time performance. Graph paper is not required. [2]

12. Describe how data may be recovered if lost. [4]

13. Discuss the importance of codes of conduct in promoting professional behaviour throughout the software development stages.

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

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