GCE A LEVEL

1500U30-1

S24-1500U30-1

MONDAY, 10 JUNE 2024 – 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

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

Answer **all** questions.

1. (a) Explain, giving a suitable example for each, the difference between a two-dimensional and a three-dimensional array. [4]

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

july[n,n]

	0	1	2	3	4	5	6
0	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	01	02	03	04	05	06	07
2	08	09	10	11	12	13	14
3	15	16	17	18	19	20	21
4	22	23	24	25	26	27	28
5	29	30	31	X	X	X	

Describe how you would update the empty element in the array to `X`. [2]

(c) This is a representation of a two-dimensional integer array containing the values 1 to 9:

```
2D = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
```

Describe how you would change the value 8 to 10 in the `2D` array. [2]

2. Computer languages such as HTML and CSS are standardised.

(a) Describe the need for the standardisation of computer languages. [4]

(b) Explain, giving a suitable example, the potential difficulties involved in agreeing and implementing standards. [4]

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

(a) $(1.X + \overline{Y.Y}).\overline{X} + X.Z$ [6]

(b) $(\bar{A}.A + A.A).1 + B.C.0$ [6]

4. Write an algorithm to search an unsorted one-dimensional array of strings and replace any duplicate values with the string "X" and then output the array. [8]

5. This algorithm validates a password for a given string.

```
1    declare password as string
2    declare digits as char[]
3    declare special as char[]
4    declare length, i as integer
5    declare valid, w, x, y, z as Boolean
6    set digits = {'0','1','2','3','4','5','6','7','8','9'}
7    set special = {'!','@','£','*','?'}
8    set length = 8
9    set i, j = 0
10   set valid, x, y, z = FALSE
11
12   do
13       output "Enter a password: "
14       input password
15       if len(password) >= length
16            set x = TRUE
17       end if
18       for i = 0 to len(password) - 1
19            for j = 0 to len(digits) - 1
20                 if password[i] = digits[j]
21                      set y = TRUE
22                 end if
23            next j
24       next i
25       set j = 0
26       for i = 0 to len(password) - 1
27            for j = 0 to len(special) - 1
28                 if password[i] = special[j]
29                      set z = TRUE
30                 end if
31            next j
32       next i
33       if NOT x OR NOT y OR NOT z then
34            output "message 1"
35       else
36            output "message 2"
37            set valid = TRUE
38   while valid = FALSE
```

(a) Using a table, select **three** appropriate pieces of test data to dry-run the algorithm and trace the variables `x`, `y`, `z`, `valid` and the expected output. [6]

(b) Suggest suitable text for `message 1` and `message 2`. [2]

6. When evaluating computer-based solutions, there are several criteria that can be considered.

Describe the following criteria when evaluating computer-based solutions and give suitable examples:

(a) Usability [2]

(b) Performance [2]

(c) Scalability [2]

(d) Security [2]

7. A website URL is made up of a protocol, a domain name, and an optional file path.

- The protocol can only be “http” or “https”.
- The domain name can only consist of alphanumeric characters, hyphens and full stops.
- The protocol and domain name must be separated by a colon and two forward slashes.
- The optional file path must start with a forward slash and can only contain alphanumeric characters and forward slashes.

Example: https://www.wjec.co.uk/home/

Produce a Backus-Naur form (BNF) definition for a valid website URL. [6]

8. Explain program version management. [6]

9. Explain, using suitable examples, recursive and non-recursive sorting algorithms. [8]

10. This is a signed 8-bit integer:

$$00001111_2$$

Include this integer in a worked example to demonstrate how masking can be used to determine the sign of the integer. [3]

11. This algorithm merges two one-dimensional arrays of length *n*. Assume the arrays (`myArray1` and `myArray2`) have already been populated with data.

`num(array)` returns the number of elements currently in the array.

```
1    declare i,j as integer
2    declare myArray1[n]
3    declare myArray2[n]
4    declare myArray3[]
5
6    set i = 0
7    set j = 0
8
9    for i = 0 to len(myArray1) - 1
10        set myArray3[num(myArray3)] = myArray1[i]
11   next i
12
13   for j = 0 to len(myArray2) - 1
14        set myArray3[num(myArray3)] = myArray2[j]
15   next j
16
17   output myArray3
```

(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. Explain, giving a suitable example, the shortest path algorithm. [4]

13. Discuss the potential use of natural language interfaces in human-computer communication to address the problem of communicating with computers.

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

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