GCE A LEVEL

A500U10-1

O21-A500U10-1

WEDNESDAY, 6 OCTOBER 2021 – MORNING

COMPUTER SCIENCE – A level component 1
Programming and System Development

2 hours 45 minutes

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

Write your answers in the separate answer booklet provided.

INFORMATION FOR CANDIDATES

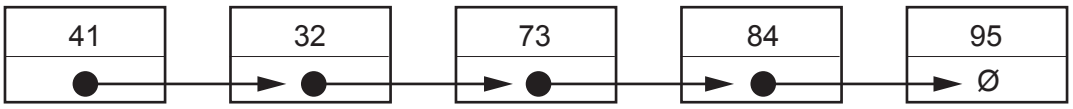
The number of marks is given in brackets at the end of each question or part-question; you are advised to divide your time accordingly.

The total number of marks available is 100.

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

Answer **all** *questions.*

1. This is a diagram of an unsorted linked list data structure.



(a) Describe the characteristics of the linked list. [4]

(b) Redraw the linked list with the data item 55 added. [2]

(c) Redraw the amended linked list with the data item 73 deleted. [2]

2. Describe the criteria used to evaluate computer-based solutions. [8]

3. This is an algorithm which sorts integers into descending order in an array (myArray) of length n. Assume the array has already been populated with data.

```
1    declare myArray[]
2    declare i, n as integer
3    declare f as Boolean
4    set n = len(myArray[]) - 1
5    repeat
6          set f = FALSE
7          set i = 0
8          while i < n
9                if myArray[i] < myArray[i + 1]
10                  set myArray[i] = myArray[i] + myArray[i + 1]
11                  set myArray[i + 1] = myArray[i] - myArray[i + 1]
12                  set myArray[i] = myArray[i] - myArray[i + 1]
13                  set f = TRUE
14               end if
15               set i = i + 1
16         end while
17   until f = FALSE
```

(a) Evaluate the efficiency of the search 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 opposite to illustrate the order of time performance. Graph paper is not required. [4]

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

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

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

5. Describe **four** procedures for backing up data giving reasons why they are used. [8]

6. A high-level programming language uses strict syntax which all variable identifiers must follow. Every variable identifier must start with a lowercase letter, a dollar sign or an underscore. The next character must be a lowercase letter. The remaining characters in the variable identifier can only be digits, lowercase letters, uppercase letters or underscores. There is no limit to the length of the variable identifier.

- Lowercase letter a – z
- Uppercase letter A – Z
- Digit 0 – 9
- Dollar sign ($)
- Underscore (_)

Example: $variable_XY_axis_01

Produce a Backus-Naur Form (BNF) definition for the variable identifier. [6]

7. A cloud storage solution uses binary trees for its file system. The file structures can be traversed using a variety of methods.

Describe the following methods of traversal and give an example of how each method could be used in the file system.

(a) In-order traversal [3]

(b) Post-order traversal [3]

(c) Pre-order traversal [3]

8. Describe the types of software tools used to assist in the following:

(a) System analysis [2]

(b) System design [2]

(c) Version management [2]

(d) System testing [2]

9. This is a signed eight-bit integer:

$$11001100_2$$

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

10. Write a quicksort algorithm in pseudo-code that will sort the contents of a one-dimensional integer array (myArray) in ascending order. [9]

11. Draw a truth table to prove the following Boolean rules:

(a) NOT (X NAND Y) = X AND Y [4]

(b) A OR (A NOR B) = A OR NOT B [4]

12. Explain the purpose, and give examples of, programming paradigms and describe the use of compilers and interpreters, distinguishing between them.

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