



GCE A LEVEL

A500U10-1



WEDNESDAY, 7 OCTOBER 2020 – MORNING

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

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 sorting algorithm can be either recursive or non-recursive.
- (a) Giving an example, describe the characteristics of a recursive sorting algorithm. [4]
- (b) Describe **two** advantages of non-recursive sorting algorithms. [2]
2. Clearly showing each step, simplify the following Boolean expressions using Boolean algebra, identities and De Morgan's Law.
- (a) $\bar{Z} + (\overline{Z + X}) + X + Y + \bar{Z} \cdot \bar{Y}$ [5]
- (b) $A \cdot (A + C) \cdot B \cdot (B + C) + A$ [5]
3. Giving **one** example for each, describe why the following are important in programs:
- self-documenting identifiers
 - annotation
 - program layout
- [8]
4. Draw a truth table to prove the following Boolean rules:
- (a) $A \text{ OR } (A \text{ AND } B) = A$ [2]
- (b) $(A + B) \cdot (A + C) = A + (B \cdot C)$ [6]

5. This algorithm searches for a data item in an unsorted two-dimensional square array:

```
Algorithm Search

declare searchKey as integer
declare i as integer
declare j as integer
declare n as integer
declare found as Boolean
declare myArray[n,n]

input searchKey
set i = 0
set j = 0
found = FALSE

for i = 0 to n - 1
    for j = 0 to n - 1
        if myArray[i,j] = searchKey then
            output myArray[i,j]
            found = TRUE
        end if
    next j
next i

if found <> TRUE then
    output searchKey, "not found"
end if
```

- (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 above to illustrate the order of time performance. Graph paper is not required. [4]

6. A smart device uses a unique filename for each digital image it captures. The filename comprises the date and GPS location of when and where the image was taken, separated by an underscore. The GPS location comprises longitudinal and latitudinal coordinates where underscores are used in place of decimal points.
- The date is stored in the format DDMMYYYY
 - Underscore (_)
 - Longitudinal coordinates are within the range of -180.0 to 180.0 with an accuracy of six decimal places
 - Latitudinal coordinates are within the range of -90.0 to 90.0 with an accuracy of six decimal places
 - All digital images are stored with a PNG file extension.

Example: 01JAN2020_51_494435_-3_212469.PNG

Produce a Backus-Naur Form (BNF) definition for the filename. [5]

7. An online music streaming service stores all its songs in a binary tree alphabetically. The online service also needs to store sequential playlists of songs.
- (a) Draw a representation of an unbalanced binary tree using suitable example key values. [2]
 - (b) Describe the most efficient way to traverse the above binary tree when searching for a song. [3]
 - (c) Other than an array, select and justify an appropriate data structure to store each playlist. [4]
8. Describe Agile and Waterfall approaches to analysis and design. [8]
9. (a) Describe the advantages and disadvantages of using an object-oriented paradigm. [4]
- (b) Describe what is meant by a class and an object and explain the relationship between them. [4]
 - (c) Describe what is meant by the term method and explain the relationship between object and method. [2]
10. Write a Binary Search algorithm in pseudo-code that will search the contents of a one-dimensional string array (`myArray`) for a key value, and if found output the contents. [9]

11. This is an algorithm that validates an email address:

```

Algorithm Validate

declare email as char[]
declare i as integer
declare count1 as integer
declare count2 as integer

input email
set i = 0
set count1 = 0
set count2 = 0

if len(email) > 1 then
    for i = 0 to len(email) - 1

        if email[i] = '@' then
            set count1 = count1 + 1
        end if
        if email[i] = '.' then
            set count2 = count2 + 1;
        end if

    next i

    if count1 <> 1 then
        output "error message 2"
    elseif count2 < 1 then
        output "error message 3"
    else
        output "valid"
    end if

else
    output "error message 1"
end if

```

Select appropriate test data to dry run the algorithm which will produce each output message. [4]

12. Discuss the factors that need to be considered when proposing a new computer system and the methods of changeover that could be used in its implementation.

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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