



GCE A LEVEL – NEW

A500U10-1



COMPUTER SCIENCE – A level component 1
Programming and System Development

FRIDAY, 16 JUNE 2017 – MORNING

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 smart phone repair business uses over 600 different phone components. Their stock control system applies a hashing algorithm to a seven-digit component number to generate disk storage addresses.
 - (a)
 - (i) Describe **one** problem that would arise if the seven-digit component numbers were used as disk addresses. [1]
 - (ii) Explain how the hashing algorithm could be used to overcome this problem. [2]
 - (b) The stock control system provides a disk block for each component's data. Describe how the system could handle data for **two** stock items which hash to the same disk address. [2]

2. Inheritance is a fundamental concept of object-oriented programming.
 - (a) Explain, with reference to classes, the concept of inheritance. [4]
 - (b) Identify **two** other fundamental concepts of object-oriented programming. [2]

3. Compilers and interpreters translate source code into code that can be executed.
 - (a) Compare the translation process carried out by a compiler with the translation process carried out by an interpreter. [3]
 - (b) Explain why a compiled program takes more time to debug than an interpreted one. [2]
 - (c) Describe, giving an example of each, **two** types of translation error. [4]
 - (d) Below is a segment of a source program that is to be compiled:


```
input basicCost
VAT = basicCost * vatRate
totalCost = basicCost + VAT
output totalCost
```

Construct a reserved word table and an identifier table that could be used to translate this segment of code into a stream of Hex tokens. [5]

4.
 - (a) Using the laws of Boolean algebra and De Morgan's theorem simplify the following Boolean expression:

$$A . (\overline{A . B})$$
 [4]
 - (b) Simplify the following Boolean expression:

$$\bar{A}.B.C + A.B.\bar{C} + A.B.C + \bar{A}.B.\bar{C}$$
 [4]

5. Computer systems will need maintenance to prolong their useful lifetime.

- (a) Corrective maintenance involves fixing errors discovered whilst the system is in use. Describe the nature and use of **two** other types of system maintenance. [4]
- (b) Annotated listings and algorithms are two components of program maintenance documentation. Identify **two** other components that should be included in program maintenance documentation. [2]

6. Below is an algorithm.

```

Algorithm Pythagoras
declare function Square(x)
    {user defined function to calculate the square of a number}
Answer is real

startfunction
    set Answer = x * x
    return Answer
endfunction

declare subprocedure MainProg
a is real
b is real
hypotenuse is real

startproc
output "Type in the length of the first side of the triangle"
input a
output "Type in the length of the second side of the triangle"
input b

hypotenuse = SQRT(Square(a) + Square(b))

output "The length of the hypotenuse is ", hypotenuse
endproc

start
    call MainProg
end
  
```

- (a) Identify a variable and a parameter used in the algorithm. [2]
- (b) Explain when a value parameter is preferable to a reference parameter. [2]
- (c) The algorithm uses a standard function, SQRT (square root), to calculate the length of the hypotenuse. This function will produce the required length as a real number:
- $$\begin{aligned}
 \text{Hypotenuse} &= \text{SQRT}(3^2 + 9^2) \\
 &= \text{SQRT}(90) \\
 &= 9.4868
 \end{aligned}$$

Describe truncation and rounding and explain the effect of each on the accuracy of this calculation, when given to two decimal places. [4]

7. (a) Draw a truth table to show the value of **P** for all possible values of **A**, **B** and **C** for the following Boolean expression:

$$\mathbf{P = (A \text{ NAND } B) \text{ NOR } C} \quad [4]$$

- (b) Using the data in the 8 bit register below, design a mask and use it to demonstrate how a logical operation can be used to extract the value of bit 4 and bit 5. [3]

Bit number	7	6	5	4	3	2	1	0
Register contents	1	1	1	0	0	0	1	1

8. The email addresses of students at Parkwood College are made up of surname plus three digits, followed by @parkwood.ac.uk

Surnames comprise one or more letters only. All letters are lower case.

- (a) Produce a syntax diagram to define a Parkwood College student's email address. [3]
- (b) Produce a Backus-Naur Form (BNF) definition for a Parkwood College student's email address. [4]

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

10. Below is part of an algorithm that sorts an array named X that contains N integers, where MaximumInteger is the largest integer that can be stored.

```

Algorithm sort

Start = 0

for i = 1 to N - 1
    Smallest = MaximumInteger

    for j = Start to N
        if X(j) < Smallest then
            Smallest = X(j)
        endif
    next j

    swap Smallest with X(Start)
    Start = Start + 1

next i

```

- (a) Evaluate the efficiency of the algorithm and, using Big O notation, determine the growth rate for the time performance. [5]
- (b) Determine the growth rate of memory space used by the algorithm. [2]
11. An electrical retailer's stock control system stores details of televisions in a binary tree structure. The tree structure uses brand names as key values.
- (a) Draw a representation of the binary tree using the following key values:
Philips, Samsung, Blaupunkt, Toshiba, Techwood, Sony, Panasonic, LG [3]
- (b) Add *Hisense* to the binary tree. [1]
- (c) List the key values sorted in the order that a pre-order traversal of the tree would produce. [2]

12. Natural languages present ambiguities.

- (a) Describe ambiguity and explain why high level programming languages must be unambiguous. [3]
- (b) Describe other difficulties programmers have had to overcome to create a natural language interface for a personal computer. [4]

13. Explain, using examples of possible situations or applications where they may be used, the nature of procedural and non-procedural programming languages.

You should draw on your knowledge, skills and understanding from a number of areas across your Computer Science course when answering this question. [10]

END OF PAPER

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