GCE A LEVEL

A500U10-1

eduqas
Part of WJEC

wjec cbac

COMPUTER SCIENCE – A level component 1
Programming and System Development

MONDAY, 11 JUNE 2018 – MORNING

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. Complete the following truth table. [4]

A	B	A + B	A.B	(A+B).(A+B)	(A.B) + (A.B)
0	0				
0	1				
1	0				
1	1				

2. One stage of the compilation process is code generation. During this stage code is optimised.

   (a) (i) Describe what is meant by code optimisation. [2]

   (ii) Identify the main objectives of the optimisation process. [4]

   (b) The following section of code has not been optimised.

   ```
   Repeat
        item = 10
        value = value + item
   Until value > 100
   ```

   Explain why this code is not optimised. [2]

3. Systems analysts carry out feasibility studies and investigate existing computer systems using various methods, including questionnaires and interviews.

   (a) Explain the purpose of a feasibility study. [4]

   (b) Identify **two** other methods that can be used to investigate existing systems. [2]

4. *(a)* Complete the following Boolean identities:

   (i) $A + 1 =$ [1]

   (ii) $A.\overline{A} =$ [1]

   (iii) $A + 0 =$ [1]

   (b) Simplify the following Boolean expression:

   $$B.C.(\overline{C} + D) + C.D + C + \overline{A}$$

   [5]

5. Describe the advantages of using a procedural language to write a program based on an algorithm. [4]

6. *(a)* Explain what is meant by a shortest path algorithm. [2]

    (b) The routing costs for a network of 8 nodes are stored in a two dimensional array, as shown below (0 indicates there is no route between the nodes).

	A	B	C	D	E	F	G
A	0	5	3	0	0	0	0
B	5	0	0	7	2	0	0
C	3	0	0	6	0	4	0
D	0	7	6	0	0	1	4
E	0	2	0	0	0	0	6
F	0	0	4	1	0	0	6
G	0	0	0	4	6	6	0

    (i)   Draw a labelled diagram of the network. [3]

    (ii) State the shortest path from node A to node G and calculate its cost. [2]

7. *(a)* Describe a stack data structure. [5]

    (b) Write an algorithm to add an item to a stack. [2]

    (c) Write an algorithm to remove an item from a stack. [2]

8. A stock control system used in the main warehouse of a large online retailer uses a unique product code for each product stored. The product code comprises the manufacturer's ID followed by an aisle number from 00 - 99, followed by a shelf reference. E.g. MANT_58A100.

    • Manufacturer IDs comprise a minimum of two letters
    • Underscore
    • Aisle numbers are within the range 00 - 99
    • Shelf references comprise a single letter within the range A - H, followed by a number, within the range 0 - 100
    • All letters are upper case

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

Turn over.

9. Programming languages use constructs to control the order in which commands are carried out.

  (a) Describe the effect of the use of a selection construct. [2]

  (b) Explain, with reference to selection constructs, what is meant by the term nested. [2]

10. All employees who earn more than a certain amount must pay National Insurance, which is calculated as a percentage of their earnings.

Monthly wage	National Insurance
< £671 (Threshold)	No payments
£672 to £3,583	12% of earnings over £672
> £3,583 (Upper Earnings Limit)	2% of earnings over £3,583 plus 12% of £3,583

A company wants a program to calculate the National Insurance contributions of its employees, output in ascending order.

Write an algorithm to calculate employees' National Insurance contributions per month in ascending order. [9]

11. A car dealership's stock control system stores details of cars in a binary tree structure. The tree structure uses manufacturers' names as key values.

  (a) Draw a representation of the binary tree using the following key values in this order:
 *Peugeot, Ford, Vauxhall, Mercedes, BMW, Audi, Renault, Toyota.* [3]

  (b) Add *Jaguar* to the binary tree. [1]

  (c) List the key values sorted in the order that a post-order traversal of the tree would produce. [2]

12. Big O notation is a method for describing the order of efficiency of an algorithm.

Size of data
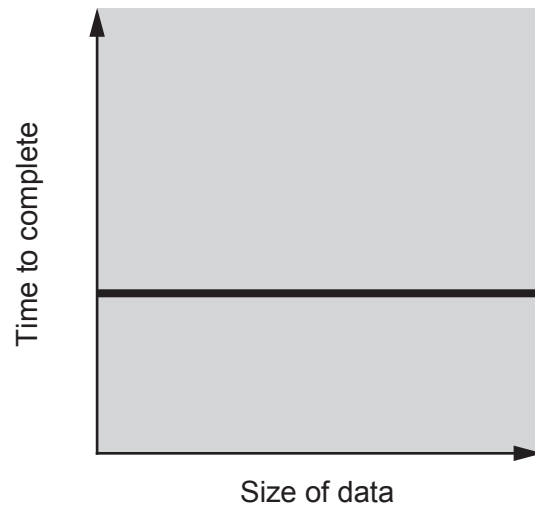
(a) (i) Identify the order of efficiency of the algorithm illustrated by the above graph. [1]

(ii) Give an example of an algorithm with this order of efficiency. [1]

(b) Draw a graph of an algorithm with an order of efficiency O(N).
Graph paper is not required. [3]

(c) Describe an example of an algorithm with an order of efficiency $O(N^2)$. [2]

(d) Explain the relationship between the size of the input data and the time required to complete the algorithm shown in the graph below. [3]

Size of data
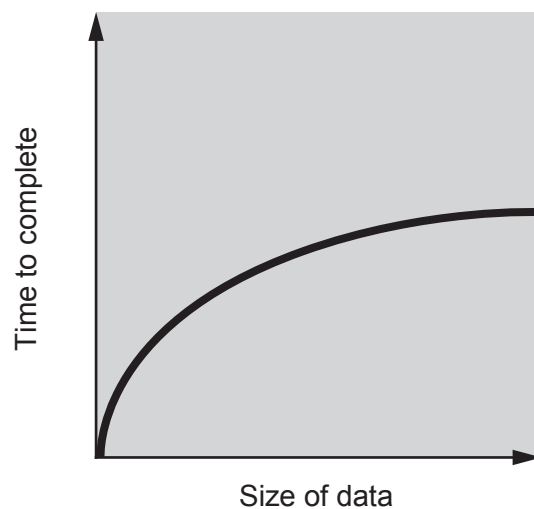
13. Below is a segment of code from a high level language.

```
Input radius
area= Pi * radius * radius
Output (area)
```

(a) Construct a reserved word table used by a compiler and an identifier table that could be used by the compiler to translate the segment of code into a stream of Hex tokens. [4]

(b) Use the above tables to translate the following line of code.

```
area = Pi * radius * radius
```
[1]

14. Describe the main stages in program production that take place between the investigation of an existing system and the carrying out of acceptance testing.

You should draw on your knowledge, skills and understanding from a number of areas across your Computer Science course when answering this question. [15]

END OF PAPER

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