GCE A LEVEL

wjec cbac

A500U20-1

S23-A500U20-1

eduqas
Part of WJEC

MONDAY, 19 JUNE 2023 – MORNING

COMPUTER SCIENCE – A level component 2
Computer Architecture, Data, Communication and
Applications

2 hours 45 minutes

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

Use black ink or black ball-point pen.

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.

2

Answer **all** questions.

1. Quick Response (QR) codes provide a simple method to input data to a digital device, where it can be processed.

   (a) Identify **three** advantages offered by QR codes over traditional barcodes. [3]

   (b) A QR code can be used to input a URL, which when scanned could be used by the device's browser to open a webpage.

   Describe **two** other uses of QR codes. [4]

2. Pre_insight.co.uk provide predictive analytics for organisations working in the leisure and tourism industry.

   (a) Explain the predictive analytics service provided by Pre_insight.co.uk [4]

   (b) Identify **two** sources of unstructured data that Pre_insight.co.uk could use to provide this service. [2]

3. Database systems used by Pre_insight.co.uk are managed to avoid data redundancy, and to ensure data consistency and independence.

   (a) Explain what is meant by data redundancy, data consistency and data independence.
   [6]

   (b) A particular holiday booking system allows customers to book flights to a wide range of destinations. The customer may make many bookings and the system allows the customer to choose between many destinations. Each airline serves a range of destinations.

   (i) Produce an entity relationship diagram for the booking system described. [3]

   (ii) Design a database structure in third normal form for the booking system. [4]

4. In a typical holiday apartment, the air conditioning system is set to regulate the temperature at 21°C. If the temperature rises above the required temperature, the system will be switched on to lower the temperature.

A control program for the air conditioning system is to be written in assembly language. The acceptable temperature is stored in memory location **num1**. The required algorithm is:

```
LOOP continuously
        input current temperature
        subtract the value stored in location num1 from the current temperature
         IF the remainder is greater than zero THEN
                output value 1 {to switch on air conditioning}
        ELSE
                LOOP
END LOOP
```

The assembly language used by the microprocessor has an instruction set, which includes the following commands:

Assembly Language Command	Description
INP	Input the current temperature
STA Y	Store input number in location Y
LDA W	Load the contents of location W into the accumulator
OUT X	Output a numeric value X
SUB Z	Subtract the numeric value in location Z from the accumulator, leaving the result in the accumulator
BRP LABEL	Jump to LABEL if the contents of the accumulator are zero or greater than zero
BRA LABEL	Jump unconditionally to LABEL

Using the given algorithm and assembly language instruction set write a program to control the air conditioning system. [6]

5. (a) Describe the purpose and process of CPU scheduling. [4]

(b) A priority based scheduling algorithm can be used to select jobs for execution.

Describe a disadvantage of priority based scheduling and explain how this may be overcome. [4]

4

6. (a) Explain the purpose of a hashing algorithm. [2]

(b) This is a simple hashing algorithm for calculating data storage positions in a hash table:

Position K = T MOD 99

where T is the total of the ASCII codes of all characters in an alphanumeric key.
(ASCII codes 1 = 33, 2 = 34…….9 = 41; A = 65, B = 66 …….Z = 90)

Calculate position K for the key fields B7AD and 3ZZ3W. [4]

(c) Identify **two** methods for storing the calculated data storage positions, K, of both key fields given in part (b) in a hash table. [2]

7. A travel agency, that specialises in luxury holidays in East Asia, uses a database system to manage its bookings.

This is a description of a database table:

Destination (destinationCode, destinationName, hotelName, emailAddress, costPerNight)

(a) Write an SQL command that will create the table using appropriate data types and sizes. [4]

(b) The Destination table is then populated with the following data:

destinationCode	destinationName	hotelName	emailAddress	costPerNight
TH12	Thailand	Blue Horizon	bluehorizon@hotel.com.th	250.00
SP34	Singapore	The Towers	thetowers@nova.com.sg	450.00
HK05	Hong Kong	Harbour View	harbourview@ing.com.hk	375.00

A Booking table has already been created in the database and contains this data:

bookingNo	customerName	passengers	destinationCode	departureDate	holidaytCost
BK00001	Mr A Chan	6	TH12	07/07/2023	5212.50
BK00002	Mrs J Jones	2	SP34	17/06/2023	3480.20
BK00006	Mr A Chan	3	HK05	05/09/2023	2187.50
BK00011	Mr A Perry	4	TH12	08/07/2023	4312.50

(i) Write an SQL command to insert this record into the Booking table: [1]

BK00012   Ms P Evans   6   HK05   09/09/2023   6575.00

(ii) Write an SQL command to change the cost of a night at the Blue Horizon to £275.50. [1]

    (iii)   Write an SQL command to output the destination code and email address of each destination in alphabetical order. [2]

    (iv)   Write an SQL command to output the bookingNo and customerName of all customers with bookings in July with 4 or more passengers. [2]

8. (a) Convert the hexadecimal numbers 9_{16} and B_{16} into two 8-bit binary numbers.
Calculate, using binary addition, the total that would result from adding the two binary numbers.
You must show all of your working. [4]

(b) Copy the table below into your answer booklet. Complete the table to demonstrate the effect of carrying out an arithmetic shift right of two places of the 8-bit binary representation in two's complement of -44_{10}. [3]

								-44_{10}
								Shift 1
								Shift 2

(c) In a certain computer system, real numbers are stored in floating point form, using 16 bits as shown.

Mantissa	Exponent
12 bits in two's complement form. The binary point in the mantissa is immediately after the left bit.	4 bits in two's complement form.

Clearly showing your working, convert 65.75_{10} into this format. [3]

(d) In a different computer system, real numbers are stored in floating point form, with an 8-bit signed mantissa and a 4-bit signed exponent.

Clearly showing your working, calculate the decimal value of $0.1101001\ 0101_2$. [3]

6

9. (a) Describe the process carried out by this algorithm. [3]

```
1   Define MyFunction (text, s)
2
3   for i = 0 to Len (text)
4       myarray [i] = substring (text,i,1)
5   next i
6
7   for i = 0 to Len (myarray)  'for uppercase characters
8   if myarray [i] is upper
9               myresult [i] = (ascii (myarray [i]) + s)
10              if myresult [i] > 90 then
11                  myresult [i]= myresult [i] - 26
12              endif
13          else
14              myresult [i] = (ascii (myarray [i]) + s)
15              if myresult [i] >122 then
16                  myresult[i] = myresult [i] - 26
17              endif
18          endif
19  for i = 0 to len (myarray)
20      myreturn = Char (myresult [i])
21  next i
22
23  return myreturn
24
25  main program
26
27  a = "Algorithm Testing"
28  b = 4
29
30  Call MyFunction a, b
31
32  output "Plain Text:", & text
33  output "Output :", & myreturn
34
35  end main program
```

(b) Typical outputs from the algorithm are shown.

Output 1	Output 2
Plain Text : Algorithm Testing	Plain Text : Algorithm Testing
Output : **Epksvmxlq$Xiwxmrk**	Output : **ltowzqbpu(Bmabqvo**

Explain the change in the algorithm that has replaced 'X' in output 1 with 'B' in output 2. [3]

10. (a) Describe the importance and use of TCP/IP protocols. [2]

(b) When an email is sent using TCP, a connection is established, a 3-way handshake is made, and the email is transmitted. Describe this communication process. [4]

11. The transfer speeds between the nodes of a network have the values shown in this diagram.
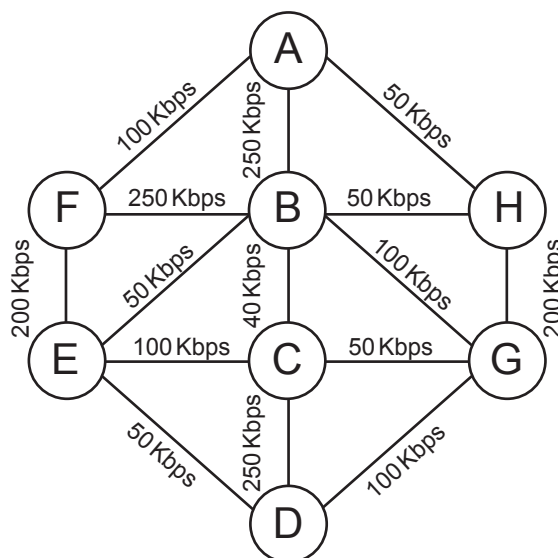
The cost for routing data between nodes is calculated by dividing 1Mbps by the transfer speed of the link. For example:

$$\text{Cost for the link A to B} = \frac{1\text{Mbps}}{250\text{Kbps}} = \frac{1\,000\,000}{250\,000} = 4$$

Data are transmitted between source and destination by the route which has the lowest total cost.

(a) Copy the table below into your answer booklet. Complete the table to show the cost and transmission route that would be taken from source to destination. [4]

Source	Destination	Cost	Route
A	F		
E	G		

(b) Calculate, to the nearest second and showing all of your working, the time required to transfer 220 KB (Kilo Bytes) of data from node G to node H. [4]

12. Partitioning of main memory is a responsibility of the operating system's memory management function.

Explain the need for partitioning of main memory, the different methods that can be used for partitioning and possible consequences associated with these methods. [9]

END OF PAPER