GCE A LEVEL

A500U20-1

O21-A500U20-1

TUESDAY, 12 OCTOBER 2021 – AFTERNOON

COMPUTER SCIENCE – A level component 2

Computer Architecture, Data, Communication and Applications

2 hours 45 minutes

A500U201
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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. Multitasking and multiprogramming are two types of operating system.
Explain the terms multitasking and multiprogramming. [4]

2. Parkwood Vale Kennels provide morning and afternoon day care sessions for dogs. Details of each session are recorded, including the cost and date of the session. The kennels record the booking for each dog that will attend each session. Owners can book their dogs in for both sessions each day of the week.

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

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

(c) Describe an advantage of structuring data in third normal form. [2]

3. *(a)* Describe the role of **three** registers used in the Fetch-Decode-Execute cycle. [6]

(b) In a certain computer the following assembly language instruction set is available.

Command	**Description**
INP	Input a numeric value which will be stored in the accumulator
STA X	Stores the numeric value currently in the accumulator in location X
OUT	Output the numeric value currently in the accumulator
LDA X	Loads the numeric value in location X to the accumulator
SUB Y	Subtract the numeric value in location Y from the accumulator, leaving the result in the accumulator
JZG LABEL	Jump to LABEL if the contents of the accumulator are zero or greater than zero
JNG LABEL	Jump to LABEL if the contents of the accumulator are less than zero
JMP LABEL	Jump unconditionally to LABEL
HLT	End

A program requires input of numeric values less than 100. A validation routine is required to ensure that inputs are reasonable.

Using the assembly language commands from the instruction set, write a program to validate the input data and output the original data if invalid. [4]

(c) Identify the changes to the program that would be required to ensure that the input value was greater than or equal to 50. [2]

4. A company offers training courses to teachers on the use of mobile devices in schools. The company uses a database system to manage its bookings.

The following describes a database table:

Booking (<u>bookingNo</u>, schoolCode, bookingDate, trainingDate, delegates, cost)

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

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

bookingNo	schoolCode	bookingDate	trainingDate	delegates	cost
BK00783	M77	18/03/2022	18/04/2022	6	212.50
BK00786	P75	18/03/2022	15/04/2022	7	248.00
BK00785	M77	15/05/2022	25/06/2022	5	187.50
BK00784	B82	17/02/2022	16/04/2022	9	312.50

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

schoolCode	schoolName	Street	City	telephoneNo	postCode
B82	Evans School	54 Stoke Lane	Bath	01632327071	BA23 1FG
M77	The School	78 Rhiwbina Hill	Chester	01632270772	CH72 8AB
P75	Primary One	98 Thomas Road	Aberdeen	01632628988	AB81 7KS

(i) Write an SQL command to output the schoolName and telephoneNo of all the schools in ascending order of postcode. [2]

(ii) Write an SQL command to output the bookingNo and schoolCode of schools with bookings in April with 7 or more delegates. [2]

(iii) Write an SQL command to output the schoolCode and postCode of schools with a trainingDate before 20/04/2022. [2]

5. The operating system manages main memory and data transfers.

(a) State the purpose of partitioning main memory and identify the main characteristics of fixed, variable and dynamic partitions. [4]

(b) Describe memory buffering and explain, giving an example, why double buffering is used. [4]

6. Explain the terms data mining and predictive analytics. [6]

7. If increase in speed due to parallel processing = 1 / (S + P/N)

where P = parallel fraction, N = number of processors and S = serial fraction. (S = 1 – P):

(a) Calculate the missing values to complete this table. [2]

N	P = 0.5	P = 0.9
10	1.82	5.26
1000		9.91
100000	1.99	

(b) Discuss the performance of the systems indicated by the results shown in the table. [4]

8. Computer Aided Design (CAD) and computer-generated animations are widely used in industry.

(a) Describe the role of the computer in CAD. [2]

(b) Describe the use of computer-generated animations in **two** areas not connected with entertainment. [4]

9. An advertising agency uses email, Internet forums and VoIP to promote its clients' products. Describe the distinguishing characteristics of each of these communication applications. [9]

10. Binary and hexadecimal notations are used in computer science.

(a) Showing your workings carry out these calculations:

(i) Convert the hexadecimal numbers -16_{16} and $1A_{16}$ into two 8 bit binary numbers, using two's complementation and calculate the binary number that would result from their addition. [4]

(ii) A certain computer uses the 12-bit floating point representation shown in the table. Calculate the denary value of 01101011 0101. [3]

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

(iii) A certain computer uses a 16 bit floating point representation with a 12 bit mantissa and a 4 bit exponent, both in two's complement form. Calculate the normalised binary representation of 37.625_{10}. [3]

(b) Using a relevant example explain why it is not always possible to represent denary numbers accurately using floating point representation. [3]

11. An advertising agency is considering moving its data to cloud storage and is investigating which provider to use. It is concerned about security, download speeds and migration time.

Details of three alternative providers are shown in the table.

	Upload (Mbps)	**Overhead per file (s)**	**Download (Mbps)**
Provider 1	150	2.0	300
Provider 2	100	1.5	200
Provider 3	200	2.5	250

The company's current directory of high-resolution images and video clips contains 50 000 files and totals 1.5 TB.

Assume that 1KB = 1,000 Bytes, 1MB = 1,000,000 Bytes, 1Mb = 125,000 Bytes.

(a) Calculate the time that would be required (hours) to upload the directory to each provider. [6]

(b) The variation in overhead generally arises from the complexity of the encryption algorithm used by the provider.

Assuming prices are similar and considering all available information select a provider for the agency and justify your choice. [2]

12. A cyber-attack is an attempt to damage, disrupt or gain unauthorised access to a computer system.

Discuss the implications of cyber-attacks on individuals and society and describe measures that can be taken to prevent these attacks. [9]

END OF PAPER