GCE A LEVEL

A500U20-1

S24-A500U20-1

TUESDAY, 18 JUNE 2024 – 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

Use black ink or black ball-point pen.

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) Describe the function of the Program Counter in the Von Neumann fetch-execute cycle. [2]

(b) Describe the role of three other special CPU registers in the fetch-execute cycle. [6]

2. In a certain computer, real numbers are stored in floating point form using 16 bits as shown:

Mantissa	**Exponent**
10 bits in two's complement form. The binary point in the mantissa is immediately after the most significant bit.	6 bits in two's complement form.

(a) Convert the number 5.75_{10} into this floating point form. Your final answer should be normalised. [3]

(b) $5.25_{10} \times 24.50_{10} = 128.625_{10}$. The result of this calculation needs to be converted to an integer. Two methods are considered.

Method 1: Multiply the decimal numbers, then round the final result to an integer.

Method 2: Multiply the decimal numbers, then truncate the final result to an integer.

(i) Calculate the absolute errors which would occur with each of these methods in comparison to the full accuracy of the decimal calculation. [2]

(ii) Discuss the relative accuracies of each of the two methods. [2]

(c) Integers are stored in a different computer system in 16 bits using two's complementation. Demonstrate, showing your working, how the computer would store the value -152_{10}. [3]

3. TCP and UDP are protocols that enable data transmission on a network.

Explain why internet banking applications use TCP, whereas online games use UDP. [4]

4. The table shows a design for storing a day's tennis court bookings in a database.

Name	MemberNumber	CourtNo	TimeSlot
Dan Evans	418	2	16.00
Naiktha Wilson	341	10	14.00
Dan Evans	214	8	10.00
Katie Silva	233	10	12.00
Heather Davies	359	5	18.00
Paul Chen	433	6	16.00 and 18.00

(a) Identify two aspects of the design likely to cause problems when searching or sorting the table. [2]

(b) The tennis club has decided to further develop the database to hold records of Bookings, Members, Timeslots and Courts in separate tables.

(i) Produce an entity-relationship diagram to show the relational links between the proposed tables. [3]

(ii) Assume members individually book the courts and that the duration of all timeslots is the same. Design a database in third normal form for the booking system. [4]

(iii) Suggest measures that could be incorporated in the database to prevent double bookings. [3]

5. The fleet manager of a delivery firm arranges for each of their delivery vans to be checked on a regular basis. The checks are carried out by in-house staff and are intended to identify any safety or maintenance issues of concern. The manager keeps records of the checks in a database.

Two tables in the database are:

VANCHECK

CheckNo	Date	RegNo	Comment	StaffID
66	28 Mar 24	BD71 SMR	None	PV
67	29 Mar 24	AB21 TTV	Oil level low	MS
68	29 Mar 24	CU22 MNB	Tyre worn	PV
69	2 Apr 24	FD22 KKJ	Faulty headlight	JO
70	2 Apr 24	DJ72 LLJ	None	MS

STAFF

StaffID	Surname	FirstName
JO	Owens	John
MS	Sanderson	May
PV	Patel	Veer

(a) Write an SQL command to output the CheckNo and Comment only for all of the checks. [1]

(b) Write an SQL command to output the RegNo for all checks allocated to StaffID MS. [1]

(c) Write an SQL command to reallocate CheckNo 67 to StaffID JO. [2]

(d) Write an SQL command to output the Date and StaffID for all checks allocated to Veer Patel. [2]

(e) Write an SQL command to create a new table E_VANS to contain the Make, Registration Number and ChargeTime (hrs, mins : 0,00) for each of the new electronic vehicles. [4]

6. Encryption, which can be symmetric or asymmetric, is important in preventing unauthorised access to online Personally Identifiable Information (PII).

(a) (i) Describe the process of symmetric encryption. [4]

(ii) Explain, giving an example, reasons for using symmetric encryption. [3]

(b) In a certain cypher method of encryption characters are changed using shifts and MOD functions. Each character in a word is moved forward in the alphabet by a different shift.

The change of the first two characters of a word are shift[1] = 4 and shift[2] = 3. Therefore, if the first character in the word is 'W' then the encrypted character will be 'A'.

The shift for each following character in the word is calculated with the formula:

shift[N] = (3 * shift[N-1]) MOD 26,

where N is the position of the character in the word

Encrypt the word VIRUS using this cypher. [3]

7. Explain what is meant by distributed processing, giving an example to illustrate its operation. [6]

8. Well organised and structured data is easier to process.

(a) Compare the use of fixed and variable length records. [4]

(b) Describe the organisation and process of using a random access file to store data. [6]

9. An assembly language application processes the results of an online platform game. A series of positive numbers is entered which represent the time (minutes) taken to complete a level.

A negative rogue value is used to terminate the game if a level is failed. The program then outputs a total (time) and count (levels completed) for the values captured.

For example: input 6 3 10 9 -1 output 28 4

The processor has registers R, S and T. Commands available in the assembly language instruction set are:

Command	Description
LOD R, X	Load register R with the numerical value X
MOV R, S	Copy the contents of register R to register S
ADD R, S	Add the contents of register R to register S, leaving the result in register R
INC R	Add 1 to the contents of register R
DEC R	Subtract 1 from the contents of register R
JGE R, LABEL	Jump to LABEL if the contents of register R are equal to or greater than zero
JLZ R, LABEL	Jump to LABEL if the contents of register R are less than zero
JMP LABEL	Jump unconditionally to LABEL
IN R	Input a numerical value and store in register R
OUT R	Output the contents of register R

Using appropriate commands from the instruction set, write a program to calculate the total and count of a series of input data values, terminated by a negative rogue value. [6]

10. (a) Explain, using an example, what is meant by the term biometric data. [4]

(b) Explain the process for using biometric data to control access to a secure area or system. [4]

(c) Explain why there may be objections to the use and storage of biometric data. [4]

11. A modelling system is to be used to monitor and help predict demands on local hospitals. The system uses data collected from many hospitals over many years.

The model is complex and takes 5 hours to run on a single processor, therefore, parallel processing is to be used.

(a) If the linear fraction of the process = 20% calculate the run time of the model using 5 processors and using 20 processors. [2]

(b) Describe the limitations of parallel processing that are demonstrated by the calculations. [2]

12. Expert systems are widely used by organisations for a variety of purposes. Describe the benefits and possible disadvantages to an organisation of using an expert system. [8]

END OF PAPER

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