GCE A LEVEL

1500U40-1

FRIDAY, 24 JUNE 2022 – MORNING

COMPUTER SCIENCE – A2 unit 4
Computer Architecture, Data, Communication and Applications

2 hours

ADDITIONAL MATERIALS

A WJEC pink 16-page answer booklet.
A calculator.

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.
Assessment will take into account the quality of written communication used in your answers.

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Answer **all** questions.

1. A file manager program provides an interface to a computer's file system.

    (a) Describe how files may be organised and managed using a file manager program.   [3]

    (b) Files may be organised using a hashing algorithm. Explain the purpose of a hashing algorithm.   [3]

2. Interrupts are often generated in a computer system.

    (a) Identify a situation in which a high-priority interrupt may be generated.   [1]

    (b) Describe the procedure for dealing with an interrupt with a higher priority than the interrupt that is currently being processed.   [3]

3. An assembly language program is required to check a four digit numeric code against a code stored in location Y.

    If the code is entered correctly then the program should output 1. If the code entered is incorrect the program should output 2 and should allow the user to re-enter a code.

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

Assembly Language Command	Description
INP	Input numeric value to the accumulator
OUT X	Output a numeric value X
STA X	Copy contents of accumulator to memory location X
LDA X	Load accumulator with contents of memory location X
HLT	End
SUB Y	Subtract the numeric value in location Y from the accumulator, leaving the result in the accumulator
JZE LABEL	Jump to LABEL if the contents of the accumulator are equal to zero
JMP LABEL	Jump unconditionally to LABEL

    Using the instruction set, write a program to check the code entered.   [6]

4. The Internet enables the use of many communication applications. Describe the distinguishing characteristics of these communication applications:
   • Podcast
   • Blog
   • Instant messaging
   • Webcast   [8]

5. A certain computer uses this 16 bit floating point representation:

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

   (a) Convert the number 7.1875_{10} into this floating point representation.   [3]

   (b) Determine the most accurate representation possible for 19.3_{10} using this floating point representation.   [2]

   (c) Calculate the absolute and relative errors in denary for this floating point representation of 19.3_{10}.   [4]

   (d) Describe the relationship between the size of the mantissa and exponent in the representation of a floating point number.   [3]

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03

6. In a certain computer network the protocol used to determine lowest cost routes is based on transfer rates and delays. Transfer rates are based on bandwidth of network links. Delays represent the overhead arising from the time taken for a router to process, queue and transmit a data packet.

The total route cost is calculated as the cost of each link multiplied by the total of the delay factors of each intermediate router visited.

This is a diagram of the network. The delay at each intermediate router = 1.2.

A
E
2
2
5
C
10
D
5
2
2
B
F
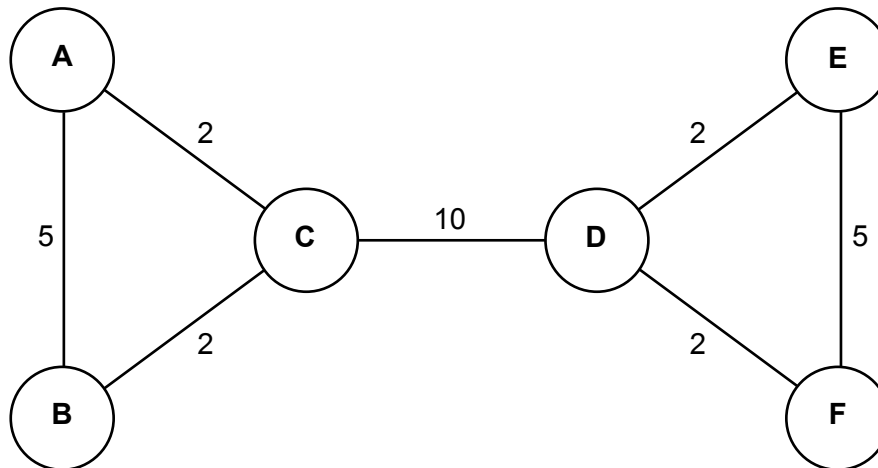
(a) Calculate the lowest cost route from router A to router F. [2]

(b) (i) A new link of bandwidth cost = 14 is to be added from B to F. Re-calculate the lowest cost route from router A to router F. [2]

(ii) The link from router C to router D is then upgraded to a network cost of 5. Describe the effect the upgrade will have on overall network costs. [2]

7. Phishing is the most common cyber-attack vector.

(a) Explain what is meant by the term 'cyber-attack vector'. [2]

(b) Describe **two** other cyber-attack vectors. [4]

8. Penetration testing is an important aspect of computer security.

(a) State what is meant by the term penetration testing. [1]

(b) Describe **three** penetration testing strategies. [6]

9. A community craft group that sells jewellery to the general public is creating a database to manage its sales.

This is a design for a database table it intends to use:

Customer (customerID, surname, orderDate, itemNo, orderQuantity)

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

[4]

The Customer table is then populated with the following data:

customerID	surname	orderDate	itemNo	orderQuantity
C00001	Heald	01/06/2021	CT00016	3
C00002	Munden	03/06/2021	CT00017	6
C00001	Heald	08/06/2021	CT00014	4

An Item table has already been created in the database and contains this data:

itemNo	stockLevel	itemName	price
CT00011	7	Bracelet	101
CT00014	11	Necklace	123
CT00016	4	Ring	81
CT00017	12	Necklace	80

(b) Write an SQL command to add this record to the Item table. [2]

CT00111	13	Earrings	97

(c) Write an SQL command to change the price of itemNo CT00016 to 93. [1]

10. (a) Describe what is meant by the term relational database. [2]

(b) Describe the advantages of database normalisation. [4]

A health care company is creating a relational database to manage its dental surgeries located in different towns across Wales.

Each dental surgery employs **dentists** who will only work in that **surgery**. **Patients** will be registered with one of the dentists and will only be treated by that dentist. Patients will book **appointments** to see their dentist.

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

(d) Design a database structure in third normal form for the system. [3]

11. The increase in speed due to parallel processing can be calculated as:

$$\frac{1}{S + \dfrac{P}{N}}$$

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

(a) Calculate the increase in speed due to parallel processing using 10 processors and the increase in speed of doing the same task using 1000 processors, where the parallel fraction P is equal to:
- 0.5 for 10 and 1000 processors
- 0.9 for 10 and 1000 processors [4]

(b) Discuss the effect that increasing the parallel fraction of the task will have on the speed due to parallel processing. [3]

12. Describe the advantages of using a distributed database. [4]

13. Cryptography may be based on symmetric or asymmetric algorithms. Describe the advantages of using asymmetric encryption. [6]

14. A local hospital needs to ensure that access to its medical laboratories is restricted to authorised personnel. It is considering using biometric technologies to identify and restrict access to authorised personnel only.

Describe the biometric options available to the hospital and explain the main benefits and drawbacks of biometric security technologies. [9]

END OF PAPER

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