



GCE A LEVEL

A500U20-1



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

TUESDAY, 11 JUNE 2019 – 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

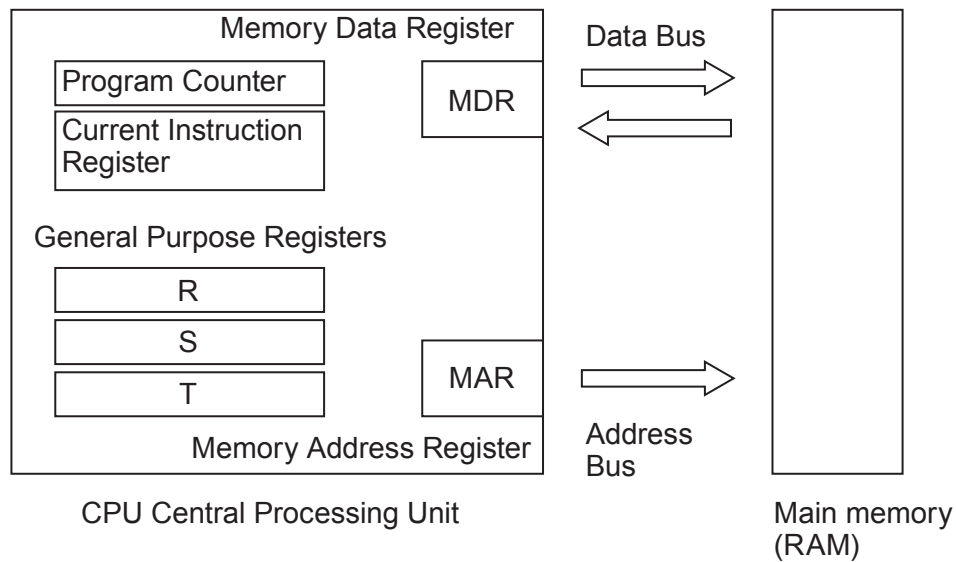
The number of marks is given in brackets at the end of each question or part-question; you are advised to divide your time accordingly.

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. The diagram shows the principal registers for a particular computer processor:



The computer has just completed a Fetch-Execute cycle in which a numerical value has been calculated and placed in a general purpose register R.

Explain how the control unit will:

- (a) Fetch the next program instruction. [2]
- (b) Execute the instruction, which requires that the numerical value in register R is stored at main memory address 02B6. [3]

2. (a) A certain computer uses a floating point representation:

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

- (i) It is not possible to store 139.6_{10} with complete accuracy. Find the most accurate representation possible for 139.6_{10} using this floating point representation. [3]
- (ii) Calculate the absolute and relative errors in denary for this floating point representation of 139.6_{10} . [3]

- (b) (i) In a certain computer, integers are stored using two's complement representation and eight binary digits. The leftmost bit is set to zero for a positive integer.

Showing all your working, demonstrate that 18_{10} is the result of the binary addition of -19_{10} and 37_{10} .

Give your result in binary format in 8 bits. [3]

- (ii) The result obtained in part (i) is to be multiplied by 4. Show how this can be done by using a binary shift operation. [1]

3. Describe the main features of the following modes of operation and identify applications that would be suitable for each one.

- Batch processing
- Real time transaction processing [6]

4. Describe the functions of the following components in a network:

- Switch
- Router
- Multiplexor [9]

5. A store room in a factory has an electronic door lock which is opened by entering a code number, e.g. 8696, on a keypad.

A copy of the correct door entry code is stored in a computer at memory location **02A0**.

The door is opened when the computer sends a numeric value of **-1** to the electronic lock mechanism.

A control program for the lock is to be written in assembly language. The required algorithm is:

```
Repeat
    input a code number from the keypad
    subtract the value stored in 02A0 from the input
Until the remainder is zero
output -1
```

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

Assembly Language Command	Description
IN	Input a numeric code from the keypad to the accumulator
OUT R	Output a numeric value R to the electronic door lock
ADD N	Add the numeric value in location N to the accumulator, leaving the result in the accumulator
SUB N	Subtract the numeric value in location N from the accumulator, leaving the result in the accumulator
JGZ LABEL	Jump to LABEL if the contents of the accumulator are greater than zero
JZE LABEL	Jump to LABEL if the contents of the accumulator are equal to zero
JMP LABEL	Jump unconditionally to LABEL

Using assembly language commands and the algorithm above, write a program to control the electronic door lock. [6]

6. (a) Describe, giving an example, a way in which robotics are used in manufacturing. [2]
- (b) Discuss the advantages to users of products produced by robotic methods. [2]
- (c) Identify problems which can arise for a company using robotic production methods. [2]

7. Describe the principles of high-level scheduling making reference to the three basic states of a process and the role of time-slicing and polling. [7]
8. (a) Explain why searching and updating records may be carried out more quickly with fixed length records than with variable length records. [4]
- (b) Describe a situation in which a programmer may choose to use variable length records in a program. [2]
9. A forestry organisation uses a database to monitor and plan activities taking place. Two tables in the database are:

FOREST_BLOCK

BlockID	Location	Hectares	Species	YearPlanted
108	Little Sutton	460	Sitka Spruce	1986
112	Denham Bridge	780	Scots Pine	2002
134	Gresham	590	Oak	1994
196	Little Sutton	275	Beech	2006

ACTIVITY

ActivityID	ActivityDescription	BlockID	StartDate
6291	Felling	108	03 Mar 2019
7821	Road construction	112	17 Aug 2019
9215	Planting	108	09 Sep 2019
9851	Drainage work	196	22 Oct 2019

- (a) Write an SQL command to list the **Species** and **YearPlanted** only for each FOREST_BLOCK record. [2]
- (b) Write an SQL command to list the **ActivityDescription** and **StartDate** only for all activities taking place at the **Location** 'Little Sutton'. [3]

An additional table is required to record the workers employed in the forest. The required fields, with examples of records, are shown below:

WORKER

WorkerID	Surname	Initial	TractorQualified
6291	Hughes	R	TRUE
7821	Anderson	W	FALSE
9215	Moritz	C	TRUE

- (c) Write an SQL command to create this table using suitable data types. [3]
- (d) Extra records are to be entered into the WORKER table as shown above:

Michael Smith is allocated **WorkerID** 5221. He is not qualified to drive a tractor.
Gurvinder Singh is allocated **WorkerID** 8312. He is qualified to drive a tractor.

Write SQL commands to add these records to the table. [2]

10. A canal boat rental company has a number of boatyards. Boats are allocated to a particular boatyard and must be returned to the boatyard where they were collected.

A customer may make several bookings during the year for canal holidays, which may be for different boats at different boatyards.

A booking is for a single boat only. A boat may appear on several bookings during the year.

- (a) Draw an entity-relationship diagram in third-normal form to illustrate the scenario described above. [3]
- (b) Produce a design for the database, clearly indicating the fields which link the tables. [5]
11. Describe a range of conditions or events that would generate an interrupt and explain how they would be dealt with. Give examples to illustrate your answer. [7]
12. (a) Describe the main features of an effective expert system. [5]
- (b) An expert system is being developed to help A-level students choose careers and higher education courses. The expert system will be available to students in addition to face-to-face interviews with a careers advisor. Discuss the advantages of this approach. [4]

13. You work as a computer security consultant. The manager of a hotel has asked you to examine their computer system and advise them on processes that protect the security and integrity of data.

The hotel receives bookings via the Internet and stores data about guests and staff.

Write a brief report, advising the manager on the steps you consider necessary to ensure the security of the hotel's computer system. Explain why it is important to carry out these steps. [11]

END OF PAPER

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