THE ASSOCIATED EXAMINING BOARD

for the General Certificate of Education

June Examination, 1978—Advanced Level

COMPUTER SCIENCE **643/1**

Paper 1

Tuesday, 13 June, 2.00 p.m. to 5.00 p.m.

3 hours allowed

Answer **five** *questions.*

All questions carry equal marks.

The marks for parts of each question, where appropriate, are shown in brackets at the end of each section.

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1. (*a*) Define what is meant by a *last in – first out* stack.

Describe, with the aid of a diagram, how a set of storage locations may be organised to store data items in the form of a stack and explain how an item of data is placed on the stack or removed from it. (8)

(*b*) Explain the difference between *direct access* and *serial access* with reference to auxiliary on-line storage naming a typical device in each case. State two of the factors which influence the rate of transfer of information between the immediate access store and a serial access storage device. (6)

(*c*) A computer has a word length of 36 bits and each word can be used to store one of the following types of data:

(i) characters,

(ii) signed integers represented in binary coded decimal form using 8–4–2–1 weightings,

(iii) binary floating point numbers,

(iv) binary integers.

Show how each type of data may be represented in a storage word. (6)

2. (*a*) Explain, with the aid of a flow diagram, how the control unit of a computer makes use of a sequence control register to execute the instructions of a stored program one by one in the intended order, including how it deals with conditional and unconditional transfer of control. Give an example of a conditional transfer of control in any high level programming language you know and describe, in words, what it causes the computer to do. (14)

(*b*) Explain the purpose of a buffer area of store in a central processor, giving an example of how it is used. (6)

3. (*a*) Describe the technique of *direct encoding* stating **one** advantage **and one** disadvantage of using a direct encoding device. (6)

(*b*) "Magnetic discs are replacing magnetic tapes." Comment on the validity of this statement. (6)

(*c*) What is meant by *mark sensing?* Explain how this technique differs from *optical mark reading*. Describe the steps involved when a school utilises computing facilities by means of mark sensing equipment. (8)

4. (*a*) Define what is meant by (i) a machine code, and (ii) an assembly language. Briefly discuss how they are related in a computer system. (6)

(*b*) Explain what is meant by *return link address* in connection with the use of a closed subroutine. Describe **two** methods of arranging a return from a closed subroutine to the correct address in the main program. Give the meaning of any mnemonics or assembly language instructions used. (10)

(*c*) Discuss the ways in which the address field of an instruction in an assembly language may refer to a single operand. Give **one** example of an instruction at this level in which the address field does *not* refer to data. (4)

5. (*a*) Explain the difference between an analog device and a digital device giving an example of each. How are an analog device and a digital device combined to enable them to operate in conjunction with each other? Describe an example of an analog device and a digital device working in conjunction in this way. (9)

(*b*) The weighting of bits in a binary coded decimal representation may be 4–2–2–1. Explain the advantage of using these weightings as compared to using the normal binary weightings 8–4–2–1.

Describe **two** binary coded decimal representations other than the two mentioned above. (6)

(*c*) Explain, with examples, what is meant by (i) an arithmetic shift instruction, and (ii) a logical shift instruction. (5)

6. (*a*) A four bit register is capable of holding integers in the range -8 to $+7$ using twos complement representation of negative numbers.

Draw a logic diagram, consisting of NOR elements only, to detect if a number held in this register lies between -4 and $+3$ inclusive. (14)

(*b*) Simplify each of the following boolean expressions:

(i) $\overline{\overline{A} + B} + \overline{A + \overline{B}}$

(ii) $A + AC + B + \overline{A}B$ (6)

7. (*a*) Some computers can hold and execute two or more programs concurrently. Explain how this is done and what effect it has on the use of the central processor. (6)

(*b*) Discuss the term *relocatable* with reference to the movement of programs within the store of a machine. (6)

(*c*) Write brief notes on **two** of the following:

(i) multi-access,

(ii) software,

(iii) peripheral transfers,

(iv) direct and indirect addressing. (8)

8. (*a*) Distinguish between fixed point and floating point working in a computer, stating briefly their relative advantages and disadvantages. (8)

(*b*) Give the representation of the decimal number 325.65625 in octal, in binary and in hexadecimal form. (6)

(*c*) The format of a register from left to right is made up of a sign symbol followed by four decimal digits followed by two decimal digits. Assuming the four decimal digits represent the argument of a decimal floating point number where the argument is in the range 0.1000 to 0.9999 inclusive and the two decimal digits represent the exponent, explain how you would define the exponent so that this register could be made to represent a range of numbers from very small positive and negative fractions to very large positive and negative integers. How might zero be represented? (6)

9. (*a*) Explain **one** method which may be used to indicate to the operating system that an interrupt requires servicing and which particular servicing routine is required. (8)

(*b*) Discuss the meaning of the word *priority* in connection with the scheduling of programs by a computer.

Two programs are submitted for processing within a single multiprogramming run. One has low C.P.U. usage and high peripheral usage while the other has high C.P.U. usage and low peripheral usage. What priorities would you expect them to have and why? (6)

(*c*) Write a few brief notes on the facilities provided by operating systems as they progress from simple to complex. (6)