

THE ASSOCIATED EXAMINING BOARD

for the General Certificate of Education

June Examination, 1978—Advanced Level

COMPUTER SCIENCE

643/2

Paper 2

Monday, 19 June, 2.00 p.m. to 5.00 p.m.

3 hours allowed

All questions carry equal marks. Answer five questions only, three from Section A and two from Section B.

The marks for parts of each question, where appropriate, are given in the right-hand margin.

Section A

1. Describe how a file on a direct-access medium should be organised so that it can be accessed indexed sequentially and state another method by which a file so organised could be accessed. (8)

An indexed sequential file consists of 3000 fixed length records; each record contains 100 characters, the first four characters of which are a numeric key. The blocks (or buckets) contain 1000 characters and the packing density is 80%. State the number of blocks required to store the file and draw a flowchart to show how you would access a record with a given key, assuming there are no records in the overflow blocks. (12)

2. (a) A chain store has five branches, each retailing 1000 standard items. Every week, the branch manager has to supply the following information about sales:

Item number (in the range 1 to 1000),

Number sold,

Number delivered to the branch.

(Nil returns on items are not required.)

The information is punched onto cards, together with another field giving the branch number (in the range 1 to 5). All cards are batched with a last card containing a branch number 0.

The stock levels for each branch are held in a (5×1000) array called STOCK and there is a corresponding array, REORDER, containing the stock level at which a branch should re-order an item.

Draw a flowchart to read the data, update the array STOCK and print the branch number and item number for those items requiring re-ordering. (6)

(b) Another company, having 500 branches, wants to use this system and decides that the arrays will have to be held on magnetic tape.

Explain how you would organise the two arrays and draw a flowchart to show how you would carry out the processing in this case. (14)

3. Name a programming language in each of the following categories and outline, with examples, the facilities available for arithmetic, decisions, looping and data description.

(a) scientific, (7)

(b) business orientated, (7)

(c) assembly code. (6)

In each case, state which of the facilities is most characteristic of the language and why.

4. In the development of a program, explain the importance of

(a) program segmentation, (6)

(b) flowcharts, (4)

(c) compiler diagnostic messages, (4)

(d) post-mortem and trace facilities. (6)

5. Describe the data required, explaining how it is collected, input, stored and accessed for **two** of the following application areas:

- (a) a payroll system, (10)
- (b) a process control system, (10)
- (c) an information retrieval system. (10)

Section B

6. A building society holds records on magnetic tape relating to deposit accounts, each record containing the following fields:

- Account Number,
- Name and Address,
- Balance in account.

The records are sequenced on Account Number.

Every week, the following information is punched onto cards:

- Account Number,
- Code: W – withdrawal,
D – deposit,
- Amount withdrawn or deposited.

These cards are also sequenced on Account Number.

Draw a flowchart for updating the magnetic tape file and print those records having a negative balance. (You may assume there is not more than **one** transaction per Account in any week.) (20)

7. A library has a computer system for processing issues and returns.

Each borrower is assigned a code, consisting of a letter followed by a six-digit number.

Each book has a standard book number, which is a ten-digit number, including a modulo 11 check digit.

The system uses three files:

NAMEFILE – records contain code number and name and address;
record key is code number;
stored on disc, organised randomly.

BOOKFILE – records contain book number, title and author;
record key is book number;
stored on disc, organised index sequentially.

LOANFILE – records contain book number, borrower code number,
date due for return;
stored on magnetic tape, sequenced on book number.

When a book is borrowed, a paper tape record is prepared, consisting of book number, borrower code number and the return date.

When a book is returned, a paper tape record is prepared, giving book number and borrower code number.

The tapes are validated and valid data are written to two magnetic tapes which are sorted on book number and merged to produce a single transaction file. This file is used to update LOANFILE by deleting records relating to returned books and adding new records for issued books.

For books that are overdue, the name and address of the borrower is printed, together with the title of the book.

- (a) Draw a system flowchart for the system. (10)
- (b) Give a detailed description of how you would check that a book number is valid. (3)
- (c) Describe other validation checks you would carry out on the input data. (3)
- (d) Explain what further errors could occur and how they would be detected. (4)

8. Explain the functions of the following personnel in a computer installation and outline how their jobs inter-relate.

- (a) Computer Manager, (4)
- (b) Systems Analyst, (6)
- (c) Programmer, (5)
- (d) Computer Operator. (5)

9. (a) Explain what is meant by *absolute error* and *relative error* in the representation of a number. (3)

(b) Two numbers x and y have absolute representational errors e_1 and e_2 respectively. Find expressions for the absolute and relative errors in the evaluation of:

$$(i) xy \quad (ii) x - y \quad (iii) (x - y)/x \quad (iv) \sqrt{y} \quad (12)$$

(You may neglect terms involving products of errors.)

(c) If numbers are represented to three decimal places, give the maximum representational error, stating whether it is absolute or relative. (5)

Given $x = 0.333$, $y = 0.250$ correct to three decimal places, obtain the maximum relative errors in the evaluation of:

$$(i) x - y \quad (ii) (x - y)/x \quad (iii) \sqrt{y}.$$

10. (a) Show that the equation

$$x^4 - 2x - 4 = 0$$

has one positive root and, starting with suitable approximations, draw a flowchart for the secant method for finding this root accurate to 4 decimal places. (13)

State two advantages this method has over Newton-Raphson's method.

(b) Show that Newton-Raphson's method for finding the real root of $x^3 - a = 0$ gives rise to

$$x_{n+1} = \frac{2x_n}{3} + \frac{a}{3x_n^2}$$

Draw a flowchart for finding $\sqrt[3]{a}$ correct to 6 decimal places. (7)

11. Particles leave a piece of radioactive material such that the inter-emission times (i.e. times between the particles leaving) have a frequency distribution given by the following table.

Inter-emission time (in time units)	1	2	3	4	5	6	7	8	9	10
Frequency	0.40	0.25	0.15	0.08	0.04	0.03	0.02	0.01	0.01	0.01

(a) Given a subroutine RAND, which generates a pseudo-random number in the range $[0,1]$ from a uniform distribution, draw a flowchart to generate a number from the above distribution. (7)

(b) The following experiment is to be simulated:

The particles from the material are constrained to move in a plane but are emitted at random angles between 0° and 180° . They will only be detected if they are emitted at angles between 75° and 105° .

Draw a flowchart for the simulation, lasting for 100 time units and print the number of particles emitted and the number detected. (13)