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| Centre Number       |  |  |  |  |  | Candidate Number |  |  |  |  |  |
| Candidate Signature |  |  |  |  |  |                  |  |  |  |  |  |

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General Certificate of Education  
 January 2004  
 Advanced Level Examination



**COMPUTING** **CPT4**  
**Unit 4 Processing and Programming Techniques**

Thursday 22 January 2004 Morning Session

**No additional materials are required.**  
 You may use a calculator.

Time allowed: 1 hour 30 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 65.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

| For Examiner's Use  |      |        |      |
|---------------------|------|--------|------|
| Number              | Mark | Number | Mark |
| 1                   |      |        |      |
| 2                   |      |        |      |
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| Total (Column 2)    | →    |        |      |
| TOTAL               |      |        |      |
| Examiner's Initials |      |        |      |

**CPT4**

Answer **all** questions in the spaces provided.

1 The binary pattern 1011 0111 0110 can be interpreted in a number of different ways.

(a) State its hexadecimal representation: .....  
(1 mark)

(b) State its value in denary if it represents an unsigned fixed point number with four bits after the binary point.

.....  
(2 marks)

(c) (i) State its value in denary if it represents a two's complement floating point number with an eight bit mantissa followed by a four bit exponent.

.....  
.....  
.....  
(3 marks)

(ii) This floating point number is said to be *normalised*.  
How does the bit pattern indicate that this number is normalised?

.....  
.....  
(1 mark)

(iii) Why should floating point numbers be stored in normalised form?

.....  
.....  
(1 mark)

2 In a logic programming language, clauses are written as a series of facts and rules. To declare logical relationships for a family tree program the facts that Kate is female and a parent of Tom would be written as:

female (kate).  
parent (kate, tom).

The rule, that X is the mother of Y if X is female and X is parent of Y, would be written as

mother (X, Y) IF female (X) AND parent (X, Y).

(a) Write down the fact needed to express that Peter is male.

.....  
(1 mark)

(b) Write down the rule needed to express that X is the father of Y.

.....  
.....  
(1 mark)

(c) What would be the rule to check whether X and Y are brothers?

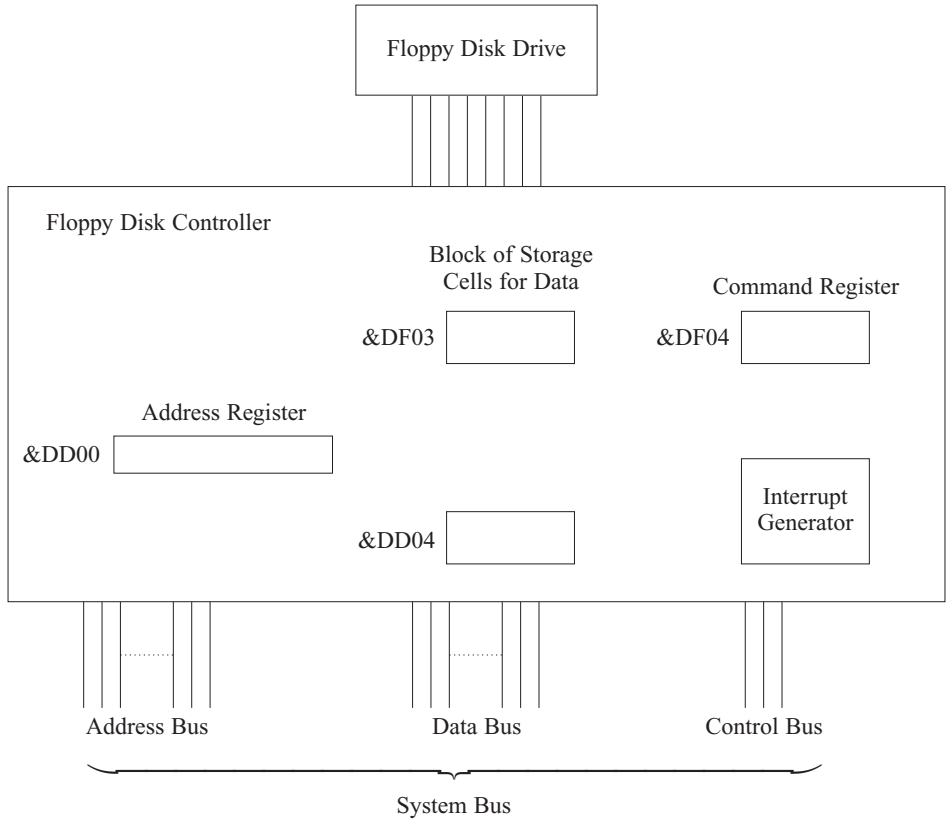
.....  
.....  
.....  
.....  
(3 marks)

5

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

3



The above diagram shows a simplified view of a floppy disc controller. A processor connected to the system bus uses this bus to move and control movement of binary words to and from the set of registers and storage cells (buffer) in the floppy disk controller.

(a) Each register and each storage cell in the floppy disk controller has a unique machine address. For example, the command register has the machine address &DF04. The symbol ‘&’ denotes a hexadecimal number.

(i) Translate &DD00 into denary.

.....  
 .....  
 (1 mark)

(ii) How many bits are required to represent &DD00 in binary?

.....  
 (1 mark)

(iii) How many address lines will the system bus require if it is to convey the binary equivalent of &DD00?

.....  
 (1 mark)

(iv) Calculate the number of data cells from addresses &DD04 to &DF03, inclusive, in the floppy disk controller.

.....  
.....

(1 mark)

(b) When a data transfer into the floppy disk controller is complete this data must be copied into the main memory of the computer system.

(i) What is an interrupt?

.....  
.....  
.....

(2 marks)

(ii) To what part of the system bus is the interrupt generator in the floppy disk controller connected?

.....

(1 mark)

(iii) At what stage of the data transfer into the controller buffer will this interrupt generator generate an interrupt?

.....

(1 mark)

(iv) Describe the steps that the processor will follow on receipt of any interrupt.

.....  
.....  
.....  
.....  
.....

(3 marks)

**TURN OVER FOR THE NEXT QUESTION**

4 (a) Give **two** reasons why some software is still developed in an assembly language.

1 .....

.....

2 .....

.....

*(2 marks)*

(b) Using the table below, write the assembly language equivalent of the following.

```
x ← 0
While Not (x=999)
  Do x ← x + 1
EndWhile
```

| Label | Opcode | Operand(s) | Comment |
|-------|--------|------------|---------|
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |
|       |        |            |         |

*(7 marks)*

- 5 A *recursively-defined* procedure B, which takes an integer as its single parameter, is defined below. The operators DIV and MOD perform integer arithmetic.  $x \text{ DIV } y$  calculates how many times  $y$  divides exactly into  $x$ . For example  $7 \text{ DIV } 3 = 2$   $x \text{ MOD } y$  calculates the remainder that results. For example  $7 \text{ MOD } 3 = 1$ .

```

Procedure B (Number)
  If (Number = 0) OR (Number = 1)
    Then Print (Number)
  Else
    B (Number DIV 2)
    Print (Number MOD 2)

  EndIf
EndProcedure
    
```

- (a) What is meant by recursively-defined?

.....  
 .....  
 (1 mark)

- (b) Why is a stack necessary to execute procedure B recursively?

.....  
 .....  
 (1 mark)

- (c) Dry run the procedure call  $B(53)$  showing clearly the values of the parameter and the printed output for the six calls of  $B$ .

| Call Number | Parameter |
|-------------|-----------|
| 1           | 53        |
| 2           | 26        |
| 3           | 13        |
| 4           |           |
| 5           |           |
| 6           |           |

Printed Output: .....

(6 marks)

- (d) What process does procedure B describe? .....

(1 mark)

Turn over ►

6 Write down the comparisons needed to look up *Newcastle* using a binary search on the following list:

Birmingham, Coventry, Liverpool, Manchester, Newcastle, Sheffield, York.

.....  
.....  
.....  
.....  
.....

(3 marks)

7 (a) High level languages can be classified as: *imperative, declarative, event-driven*. What is meant by **each** of these terms? Give an example of each language.

(i) Imperative

.....  
.....

Example..... (2 marks)

(ii) Declarative

.....  
.....

Example..... (2 marks)

(iii) Event-driven

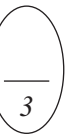
.....  
.....

Example..... (2 marks)

(b) (i) In object-oriented programming, what is meant by encapsulation?

.....  
.....

(1 mark)





- (ii) For an object-oriented program to store and display personal details of members of a golf club, a Member class needs to be declared with the properties Surname, First Name, Telephone Number, Handicap (must be a whole number).

Write a class definition for the class Member to allow the program to use objects of this class to add a new member's details, amend a member's details, display a member's details. No other form of access is to be allowed.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)



**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ►

8 Single user operating systems can be *multi-tasking* operating systems and use *virtual memory*.

(a) (i) What is multi-tasking?

.....  
.....  
.....  
.....  
(2 marks)

(ii) What is meant by virtual memory?

.....  
.....  
.....  
(2 marks)

(iii) How does virtual memory work?

.....  
.....  
.....  
(2 marks)

(b) A multi-tasking operating system may use *multi-threading*.

(i) What is a thread?

.....  
.....  
(2 marks)

(ii) Give **one** advantage of using multi-threading over separate processes.

.....  
.....  
(1 mark)

**END OF QUESTIONS**