General Certificate of Education
June 2005
Advanced Level Examination

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

Tuesday 21 June 2005 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.

CPT4

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

1 Write down the comparisons needed to look up *Pascal* using a binary search on the following alphabetically sorted list:

Basic, Fortran, Java, Lisp, Pascal, Prolog, Smalltalk.

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(3 marks)

2 The binary pattern 1000 1100 0100 can be interpreted in a number of different ways.

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

....
(2 marks)

(b) (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) The floating point number 1000 1100 0100 is said to be normalised.
How does the bit pattern indicate that this number is normalised?

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....
(1 mark)

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

....

....
(1 mark)

3 The contents of a computer word is shown in a debugger as &D15A, where the symbol '&' denotes a hexadecimal number.

(a) What binary pattern does this represent?

....
(2 marks)

(b) If this represents a memory address, how many address lines will the system bus require if it is to convey the binary equivalent of &D15A?

....
(1 mark)

<div style="text-align: right">$\dfrac{}{3}$</div>

4 (a) What is an interrupt?

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(2 marks)

(b) Describe the steps that the processor will follow on receipt of an interrupt using the vectored interrupt mechanism.

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(5 marks)

<div style="text-align: right">$\dfrac{}{7}$</div>

Turn over ▶

5 In a logic programming language, clauses are written as a series of facts and rules. To declare logic relationships for a family tree program the facts that John is male and a parent of James would be written as:

>   male (john).
>   parent (john, james).

The rule, that F is the father of X if F is male and F is a parent of X, would be written as

>   father (F,X) IF male (F) AND parent (F,X).

(a) Write down the fact needed to express that Helen is female.

....
(1 mark)

(b) Write down the rule needed to express M is the mother of X.

....

....
(1 mark)

(c) (i) The relationship that S is a sibling (brother or sister) of X could be written as

>   sibling (S,X) IF parent(Z,S) AND parent (Z,X).

However, this rule would also return half-brothers and half-sisters. Rewrite the rule so that only brothers and sisters are returned who have **both** parents in common.

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(2 marks)

(ii) Extend your rule above to exclude someone being listed as their own sibling.

....
(1 mark)

(d) P's grandfather is the father of P's mother or father.
Write down the rule(s) to express the above relationship.

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(3 marks)

6 (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:

Count ← 0
Repeat
   X←X + X
   Count ← Count + 1
Until X >= 999

You can assume that the Program Counter will contain the address of location Start to execute your code.

Label	Opcode	Operand(s)	Comment
X		15	Location X contains value 15
Count			This location is reserved to store the value of Count
Start			

(9 marks)

Turn over ▶

M/0205/CPT4

7 (a) In object-oriented programming, what is meant by inheritance?

....

....

(1 mark)

(b) An object-oriented program is required to handle details of a lending library's books and CDs.

Some fields required for the books are:
Title,
Author,
ISBN,
OnLoan,
DateAcquired.

Some fields required for the CDs are:
Title,
Artist,
PlayingTime,
OnLoan,
DateAcquired.

Some methods required are:
SetLoan,
DisplayDetails

This could be implemented by declaring two separate classes Book and CD. This would result in a lot of repetitive code. Making use of inheritance, **write** class definitions for one superclass **StockItem** and two subclasses **Book** and **CD**.

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(7 marks)

$$\frac{}{8}$$

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

8 A *recursively-defined* procedure **Process**, which takes an integer as its single parameter, is defined below.

(a) What is meant by recursively-defined?

....

....

(1 mark)

(b) Describe how a stack is used in the execution of procedure **Process**?

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....

....

....

(2 marks)

(c) Dry run the procedure call **Process(1)**, using the data in the table below, showing clearly the order the values are printed.

```
Procedure Process (P)
  Print (P)
  If Table[P].Left <> 0
    Then Process (Table[P].Left)
  EndIf
  Print (Table[P].Data)
  If Table[P].Right <> 0
    Then Process (Table[P].Right)
  EndIf
EndProcedure
```

	Table	
Data	**Left**	**Right**
[1] Jones	3	2
[2] Smith	0	0
[3] Bremner	5	4
[4] Fortune	0	0
[5] Bird	0	0

Printed Output: ....

....

(6 marks)

(d) What does procedure **Process** describe?

....

(1 mark)

10

9 Single user operating systems may use *virtual memory*.

(a) (i) Where is virtual memory located?

....

(1 mark)

(ii) Why is virtual memory used?

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....

....

....

(2 marks)

(iii) How is virtual memory used?

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(2 marks)

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

(i) What is a thread?

....

....

(1 mark)

(ii) What distinguishes one thread from another?

....

....

(1 mark)

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

....

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(1 mark)

END OF QUESTIONS

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