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| Surname | | | | | Other Names | | | | |
| Centre Number | | | | | Candidate Number | | | | |
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| For Examiner's Use |
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General Certificate of Education
 January 2008
 Advanced Level Examination



COMPUTING
Unit 4 Processing and Programming Techniques

CPT4

Wednesday 23 January 2008 9.00 am to 10.30 am

You will need no other materials.
 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.
- Answer the questions in the spaces provided.
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 65.
- The marks for questions are shown in brackets.
- The use of brand names in your answers will **not** gain credit.
- You are reminded of the need for good English and clear presentation in your answers.

| For Examiner's Use | | | |
|---------------------|------|----------|------|
| Question | Mark | Question | Mark |
| 1 | | 5 | |
| 2 | | 6 | |
| 3 | | 7 | |
| 4 | | | |
| Total (Column 1) | | | |
| Total (Column 2) | | | |
| TOTAL | | | |
| Examiner's Initials | | | |



2 The scheduler of an operating system that supports both *interactive* and *batch processing* maintains a list of runnable processes. When the scheduler requires a process to run it selects an interactive process from the list of runnable processes in preference to a batch process.

(a) Give **two** ways in which interactive and batch processing differ.

1

2

(2 marks)

(b) State **three** items that could be specified by job control statements for each batch job.

1

2

3

(3 marks)

(c) Describe **two** distinct situations that would lead to the scheduler suspending a running process.

1

2

(2 marks)

(d) Name an appropriate data structure for storing the list of runnable processes.

.....

(1 mark)

8

Turn over for the next question

Turn over ►



3 (a) Three numbers are required to specify the exact physical location (address) of data on a multi-surface hard disk. What are these **three** values?

1

2

3

(3 marks)

(b) The operating system may use a buffer in the transfer of data to or from a disk.

(i) What is a disk buffer?

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.....

.....

(2 marks)

(ii) Why is it necessary?

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.....

(1 mark)



(c) During the process of accessing the data the hard disk controller may generate an interrupt.

(i) Give **two** situations that would cause such an interrupt to be generated.

1

2

(2 marks)

(ii) Describe the vectored interrupt mechanism.

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

(3 marks)

(iii) How does this mechanism make the use of interrupts more flexible?

.....
.....

(1 mark)

12

Turn over for the next question

Turn over ►



4 A library system uses three classes, **BookCopy**, **Borrower** and **Loan**. A BookCopy object represents a book, a Borrower object represents someone who borrows books and a Loan object represents the loan of a single BookCopy to a Borrower.

(a) Draw a class diagram to represent the relationships between these classes.

(3 marks)

(b) The Borrower class has data fields Name and Address. The class definition for Borrower is

```
Borrower = Class
    Public
        Procedure AddNewBorrower
        Procedure AmendBorrowerDetails
        Procedure GetBorrowerDetails
    Private
        Name : String
        Address : String
    End
```

The BookCopy class has data fields Title, Author, OnLoan and ISBN. The class definition for BookCopy is

```
BookCopy = Class
    Public
        Procedure AddNewBookCopy
        Procedure ChangeLoanStatus
        Procedure GetBookDetails
    Private
        Title : String
        Author : String
        OnLoan : Boolean
        ISBN : String
    End
```

The Loan class needs operations (methods) to create a loan, delete a loan and get loan details. The data fields are the person, the book loaned, the date of the loan and the date of return.



Write the class definition for the Loan class.

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(4 marks)

(c) The library has decided to introduce short-loan books in addition to standard-loan books. How would you modify the BookCopy class to allow for this change?

.....

.....

(2 marks)

9

Turn over for the next question

Turn over ►



5 A computer system has the following assembly code instructions that you are to use in this question:

| Opcode | Operand(s) | Description |
|--------|------------|--|
| AND | #nn | Logical AND the accumulator with hexadecimal value nn |
| OR | #nn | Logical OR the accumulator with hexadecimal value nn |
| LD | nnnn | Load contents of hexadecimal address nnnn into the accumulator |
| ST | nnnn | Store contents of the accumulator into hexadecimal address nnnn |
| ADD | #nn | Add the hexadecimal value nn to the accumulator |
| ADD | nnnn | Add the contents of hexadecimal address nnnn to the accumulator |
| MUL | #nn | Multiply the accumulator by the hexadecimal value nn |
| MUL | nnnn | Multiply the accumulator by the contents of the hexadecimal address nnnn |

(a) (i) Explain the operation of the AND instruction.

.....

.....

.....

(1 mark)

(ii) Given that the ASCII code for '0' is the binary value 00110000, write an AND instruction to convert any numeric digit stored in the accumulator in the form of an ASCII code to its 8-bit binary integer equivalent.

.....

(1 mark)



6 A binary search tree has the following functions defined:

RootValue(T) Returns the value stored in the root node of the tree T

LeftChild(T) Returns the left child (subtree) of the root node of the tree T

RightChild(T) Returns the right child (subtree) of the root node of the tree T

A recursively-defined procedure P with a tree as a parameter is defined below.

```

Procedure P(T)
  If RightChild(T) exists
    Then P(RightChild(T))
  Output RootValue(T)
  If LeftChild(T) exists
    Then P(LeftChild(T))
EndProc

```

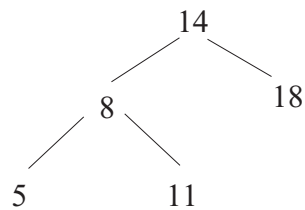
(a) What is meant by a recursively-defined procedure?

.....

.....

(1 mark)

(b) (i) Complete **Table 1** by dry running the procedure call P(T) for the tree T given below.



7 A logic program is used to represent, as a set of facts and rules, details of students and their parents. The set of facts are shown below in clauses labelled 1 to 18.

- 1. student(nick).
- 2. student(caroline).
- 3. student(roy).
- 4. student(usha).
- 5. parent(anita,nick).
- 6. parent(frank,nick).
- 7. parent(roy,caroline).
- 8. parent(janet,caroline).
- 9. parent(burhan,usha).
- 10. female(caroline).
- 11. female(anita).
- 12. female(janet).
- 13. female(usha).
- 14. male(frank).
- 15. male(nick).
- 16. male(roy).
- 17. male(burhan).
- 18. father(X,Y) IF male(X) AND parent(X,Y).

| Clause | Meaning |
|--------|---|
| 1 | nick is a student. |
| 5 | anita is a parent of nick. |
| 11 | anita is female. |
| 14 | frank is male. |
| 18 | X is the father of Y if X is male and X is a parent of Y. |

(a) A new male student called jim who has a mother called rachel is to be added to the knowledge base. Write the extra facts required to represent this information.

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(3 marks)

(b) Complete a rule that could be used to list mothers.

mother(X,Y)

(2 marks)

(c) Complete a rule that could be used to list grandfathers.

grandfather(X,Y)

.....

.....

(3 marks)

END OF QUESTIONS

