Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2007
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 24 January 2007 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.
- All working must be shown.
- 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. Quality of Written Communication will be assessed in all answers.

For Examiner's Use			
Question	Mark	Question	Mark
1		5	
2		6	
3		7	
4		8	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 The binary pattern 0100 0000 1110 can be interpreted in a number of different ways.

(a) State its hexadecimal representation. .....

(1 mark)

(b) State its value as a decimal number if it represents a signed binary integer using two's complement representation.

.....

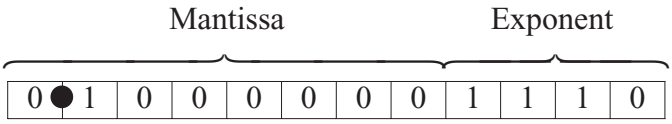
(1 mark)

(c) State its value as a decimal number if it represents an unsigned fixed point number with four bits after the binary point.

.....

(2 marks)

(d) (i) State its value as a decimal number 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)

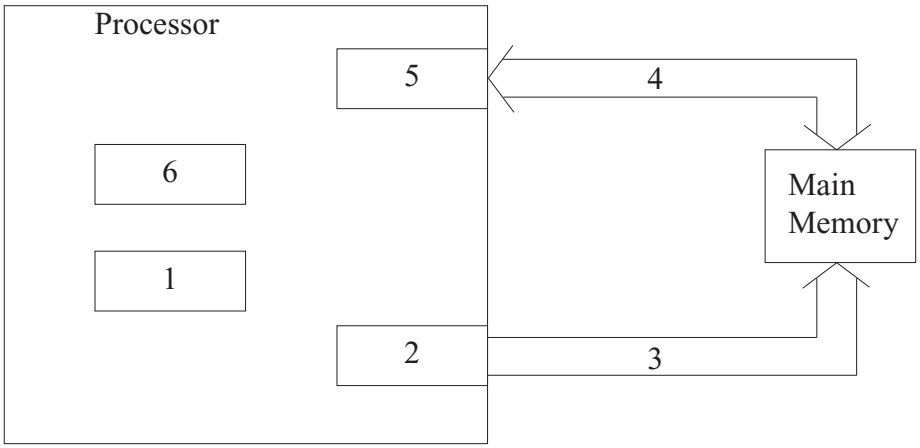
(iii) What is the largest positive value that can be stored in this floating point representation?

.....

(2 marks)

10

2 **Figure 1**



As part of the fetch-execute cycle of a computer system the processor has to fetch the next instruction. **Figure 1** shows the main components used. They are used in the sequence 1, 2, 3, 4, 5, 6 to fetch the next instruction. Name the components by completing **Table 1** below.

Table 1

Component	Name
1	Program Counter
2	
3	
4	
5	
6	

(5 marks)

5

Turn over for the next question

3 A logic program is used to represent, as a set of facts and rules, personal details. The set of facts is shown below in clauses labelled 1 to 14.

```
1.   hall (deansgate)
2.   hall (wilson)
3.   resident (laura, deansgate)
4.   resident (jayesh, deansgate)
5.   resident (elliott, deansgate)
6.   resident (kylie, deansgate)
7.   resident (tanya, wilson)
8.   resident (kevin, wilson)
9.   studies (laura, computing)
10.  studies (jayesh, mathematics)
11.  studies (elliott, english)
12.  studies (kylie, computing)
13.  studies (tanya, mathematics)
14.  studies (kevin, computing)
```

Clause	Meaning
1	There is a university hall of residence called deansgate.
3	There is a resident of deansgate called laura.
9	There is a student called laura who studies computing.

(a) There is a student named richard who is studying computing and is resident in kingston hall. Write the extra clauses required to represent these facts.

.....

.....

.....

(3 marks)

(b) The clause `studies (laura, Subject)` would return the result `computing`.

Write the result returned by the goal `studies (Name, mathematics).`

.....

(2 marks)

(c) Complete a rule that could be used to list the students who study a given subject and who live in a given hall.

```
subjectandhall (Name, Subject, Hall)IF
```

.....

.....

.....

(3 marks)

4 (a) *Batch* and *interactive* are two different modes of operation of a computer system. What is meant by these terms?

(i) Batch .....

.....

(1 mark)

(ii) Interactive .....

.....

(1 mark)

(b) A batch process may be controlled by Job Control Language (JCL). The JCL will normally contain a *batch header*. Name **three** items of control that may be required in a batch header.

1 .....

2 .....

3 .....

(3 marks)

(c) (i) Should batch processes or interactive processes be given higher priority by the operating system?

.....

(1 mark)

(ii) Give a reason for your choice.

.....

.....

.....

(1 mark)

(iii) Give **two** other features that may affect the priority of a process.

1 .....

2 .....

(2 marks)

9

Turn over for the next question

5 A computer system has the following assembly code instructions, some of which you are to use in this question.

Label	Opcode	Operand	Description
label	DEFB		Allocate a byte of memory for a variable
label	DEFB	#nn	Allocate a byte of memory for a variable and initialise it to the hexadecimal value nn
	AND	#nn	Logical AND the accumulator with hexadecimal value nn
	OR	#nn	Logical OR the accumulator with hexadecimal value nn
	LD	#nn	Load the hexadecimal value nn into the accumulator
	LD	label	Load contents of the labelled memory into the accumulator
	ST	label	Store contents of the accumulator into the labelled memory
	ADD	#nn	Add the hexadecimal value nn to the accumulator
	ADD	label	Add the contents of the labelled memory to the accumulator
	SUB	#nn	Subtract the hexadecimal value nn from the accumulator
	SUB	label	Subtract the contents of the labelled memory from the accumulator
	MUL	#nn	Multiply the accumulator by the hexadecimal value nn
	MUL	label	Multiply the accumulator by the contents of the labelled memory
	DIV	#nn	Divide the accumulator by the hexadecimal value nn
	DIV	label	Divide the accumulator by the contents of the labelled memory
	CMP	#nn	Compare the accumulator with hexadecimal value nn
	CMP	label	Compare the accumulator with the contents of the labelled memory
	JP	label	Jump unconditionally to the label
	JE	label	Jump to the label if the result of a compare shows the accumulator to be equal to the operand
	JG	label	Jump to the label if the result of a compare shows the accumulator to be greater than the operand
	JGE	label	Jump to the label if the result of a compare shows the accumulator to be greater than or equal to the operand
	JL	label	Jump to the label if the result of a compare shows the accumulator to be less than the operand
	JLE	label	Jump to the label if the result of a compare shows the accumulator to be less than or equal to the operand

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

1 .....

.....

2 .....

.....

(2 marks)

(b) Using **Table 2** below, complete the assembly language equivalent of the following.

```
X ← 0
FOR COUNT ← 1 TO 5
    X ← X + COUNT
ENDFOR
```

Table 2

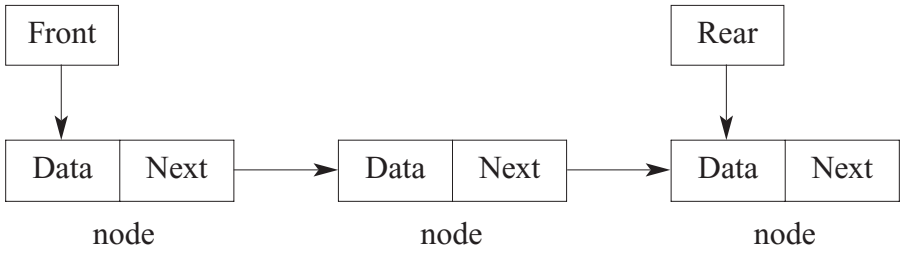
Label	Opcode	Operand	Comment
X	DEFB		Declare variable X
COUNT	DEFB		Declare variable COUNT

(8 marks)

10

Turn over ▶

6 **Figure 2**



(a) Assume a queue is implemented as a linked list using pointers as in **Figure 2**.

Give the **three** steps required to remove a node from the front of the queue and recover the memory space occupied by the node.

1 .....

2 .....

3 .....

(3 marks)

(b) A set of operations are defined to manipulate the contents of the queue. As well as *Remove* these include *FrontItem* and *IsQueueEmpty*.

Name another operation that would be essential to use this queue.

.....

(1 mark)

(c) The queue could be implemented using an array instead of a linked list.

(i) What additional operation will be required if the queue is implemented using an array?

.....

(1 mark)

(ii) Give **one** advantage of array implementation.

.....

(1 mark)

(iii) Give **two** disadvantages of array implementation.

1 .....

2 .....

(2 marks)

8

7 An integer array A contains the following items.

	A
[1]	3
[2]	5
[3]	11
[4]	12
[5]	18
[6]	21
[7]	26
[8]	29
[9]	32

The operator DIV performs integer division. x DIV y calculates how many times y divides exactly into x. For example 7 DIV 3 = 2.

(a) Dry run the following algorithm by completing the trace table, **Table 3**.

```
Number ← 12
Lower ← 1
Upper ← 9
While Lower<Upper
    Current ← (Lower+Upper)DIV 2
    If Number >= A [ Current]  Then Lower ← Current
    If Number <= A [ Current]  Then Upper ← Current
EndWhile
Return Current
```

Table 3

Number	Lower	Upper	Current

Value returned	

(8 marks)

(b) What is the purpose of this algorithm?

.....

(1 mark)

8 Many programs executed within a Graphical User Interface (GUI) environment are *object-oriented* and *event-driven*.

(a) Give an example of an event in this context.

.....

(1 mark)

(b) Describe how event-driven programs differ from non event-driven programs.

.....

.....

.....

.....

(2 marks)

(c) List **two** features of an object.

1 .....

2 .....

(2 marks)

(d) Name an object that might be part of a GUI.

.....

(1 mark)

6

END OF QUESTIONS

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