UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

COMPUTING **9691/33**

Paper 3 **October/November 2012**

2 hours

Candidates answer on the Question Paper.

No additional materials are required.

No calculators allowed.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
No marks will be awarded for using brand names for software packages or hardware.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

1 **(a)** In database design:

(i) Describe what is meant by a **primary key**.

....

....

....

.... [2]

(ii) Explain how keys are used to implement a one-to-many relationship between the two entities X and Y shown below:

Entity X ——————◁ Entity Y

....

....

....

.... [3]

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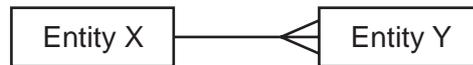
(b) A College library has a stock of books which are loaned to students.

- Each book has a BookID and other data about each book are recorded
- Each student has a StudentID starting with the year of entry e.g. 2010jamesd
- Other data about each student are also recorded

When a loan is made data are recorded. Any book may be loaned by a particular student more than once.

However, you can assume that the same book is never loaned out to the same student on the same day.

A table description can be expressed as:

```
TableName(Attribute1, Attribute2, Attribute3, ...)
```

The primary key is indicated by underlining one or more attributes.

(i) Describe the given data model by adding **two** attributes to the `Student` table and **two** attributes to the `Book` table.

Student (StudentID, ... , ...)

Book (BookID, ... , ...)   [2]

(ii) Give the attributes for the `Loan` table below, showing the primary key.
You should **not** create a LoanID for this table.

Loan (................... , ... , ... , ...)   [2]

(c) In database design, data inconsistency must be avoided.

Explain, using an example, what is meant by data inconsistency.

....

....

....

.... [2]

2 **(a)** Binary representation is used for many different data values.

Consider the binary pattern **1010 0110**

What is its value if it represents:

(i) an 8-bit two's complement integer?

.... [1]

(ii) an 8-bit sign and magnitude integer?

.... [1]

(iii) a hexadecimal number?

.... [1]

(b) Two integers are represented as 8-bit two's complement numbers. The numbers are to be added.

1	1	0	0	1	1	0	0	
1	0	0	0	0	1	1	1	+

(i) Show the result (in binary) in the table above. [2]

(ii) Comment on the result.

....

.... [1]

(c) A computer system stores real numbers in floating point format using 12 bits. T... 8 bits are the mantissa and the final 4 bits the exponent. Both the mantissa and... exponent use two's complement format.

Consider the binary pattern **0101 1000 0101**

(i) What is the exponent in denary?

.... [1]

(ii) What real number is being represented? (Show your working.)

.... [2]

3 (a) The sequence of operations below shows the fetch stage of the fetch-execute cycle in register transfer notation.

```
1. MAR ← [PC]
2. PC ← [PC] + 1
3. MDR ← [[MAR]]
4. CIR ← [MDR]
```

Note:
- **[register]** denotes the contents of the specified register
- Step 1 above is read as 'The contents of the Program Counter are copied to the Memory Address Register'.

(i) Explain what is happening at step 4.

....

.... [1]

(ii) Explain what is happening at step 3.

....

.... [1]

(b) A programmer writing low-level code has the choice between machine code and assembly language.

(i) Describe **one** advantage of using machine code.

....

.... [1]

(ii) Assembly language will require the use of assembler software.

Describe **three** specific tasks done by the assembler software.

1 ....

....

2 ....

....

3 ....

.... [3]

(c) A processor will allow the use of a variety of modes of addressing.

Explain these terms, using an example in each case. You may wish to illustrate your answer with a diagram.

(i) Direct addressing ....

....

....

....

....

....   [2]

(ii) Relative addressing ....

....

....

....

....

....   [2]

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4   Two types of software which are used to translate high-level programs are a compil
     an interpreter.

(a) Name **two** outputs produced by the compiler.

1 ....

....

2 ....

.... [2]

(b) Describe **two** advantages of using an interpreter rather than a compiler.

1 ....

....

2 ....

.... [2]

(c) Describe what happens during the syntax analysis stage of translation.

....

....

....

....

....

.... [3]

(d) Explain why linkers and loaders may be required to produce the final executable
    program file.

....

....

....

.... [2]

5 (a) Describe the operation of a linear queue data structure.

....

.... [1]

(b) A linear queue is to be implemented to store data using the following variables.

Identifier	Data Type	Description
MyQueue	ARRAY[100]: STRING	Stores the data values
HeadOfQueue	INTEGER	Stores the index position of the item currently at the head of MyQueue
TailOfQueue	INTEGER	Stores the index position of the item currently at the tail of MyQueue
NewItem	STRING	Stores a data value to be added to MyQueue

The diagram shows the state of MyQueue, HeadOfQueue and TailOfQueue after four values (Owl, Lion, Giraffe and Camel) have been inserted and one value (Owl) has been deleted.
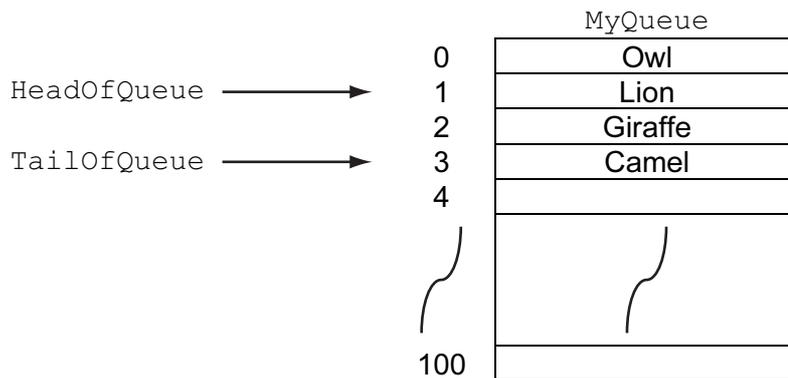
Inserting and deleting a single item to/from the queue are to be implemented with two procedures AddToQueue and RemoveFromQueue respectively.
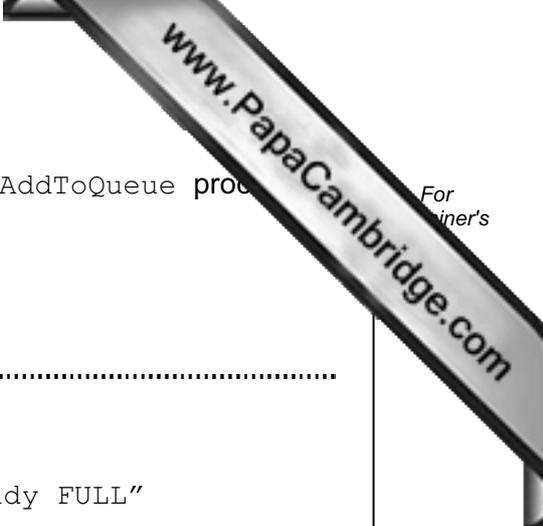
(i) Shown below is the incomplete pseudocode for the `AddToQueue` pro... Using the variables given, fill in the missing code.

```
PROCEDURE AddToQueue

    IF  .....................................................................................................

        THEN

            OUTPUT "Refused - Queue is already FULL"

        ELSE

            INPUT NewItem

            TailOfQueue ←  ...........................................................................

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

    ENDIF

ENDPROCEDURE                                                                        [4]
```

(ii) Write the algorithm for the `RemoveFromQueue` procedure, using the variables given.

```
PROCEDURE RemoveFromQueue
```

....

....

....

....

....

....

....

.... [2]

(c) Describe an application in the operation of a computer system where a queue data structure would be required.

....

....

....

.... [2]

6 The operating system for a computer which supports multiprogramming must mana[ge] allocation of processor time. This is done by the scheduler.

(a) Describe **two** scheduler strategies for the allocation of processor time amongst the various programs loaded into main memory.

1 ....

....

....

....

2 ....

....

....

.... [4]

(b) A processor is capable of receiving and handling interrupts. Each interrupt has a priority.

(i) State **two** possible sources of an interrupt. Give a reason for each.

Source 1 ....

Reason ....

....

Source 2 ....

Reason ....

.... [4]

(ii) Describe the sequence of steps the processor would carry out after recei... interrupt.

....

....

....

....

....

....

....

....

....

.... [5]

7 (a) Describe **two** different media used for the transmission of data across a Local Area Network (LAN).

1 ....

....

2 ....

.... [4]

(b) A retail shop has a Local Area Network of four computers and a fifth computer which acts as a print server.
The network is arranged as a bus topology.

(i) Draw a labelled diagram showing this Local Area Network.

[3]

(ii) The shop is connected to its head office in a different town over a Wide Area Network (WAN).

Explain what is meant by a Wide Area Network.

....

....

....

.... [2]
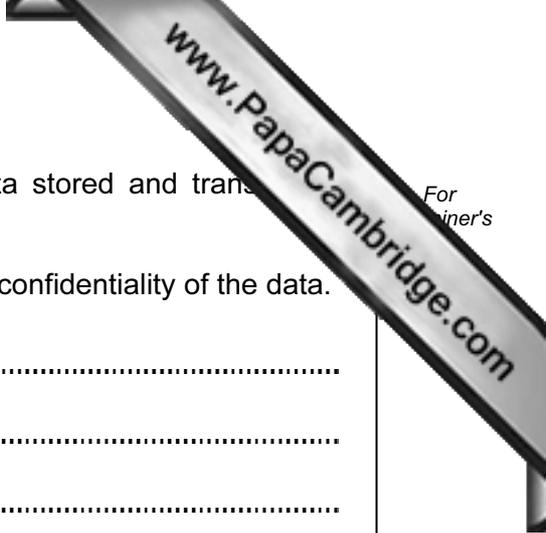
(iii) The shop is concerned about the confidentiality of data stored and trans[...] across the LAN and the WAN.

Name and describe **three** measures taken to protect the confidentiality of the data.

1 ....

....

....

....

2 ....

....

....

....

3 ....

....

....

.... [6]

8 (a) A high-level programming language has the following built-in function Sum defined as follows:

```
SumRange(ThisInteger1: Integer, ThisInteger2: Integer) RETURNS
Integer

will return the integer value calculated as the sum of all integers between and including
MyInteger1 and MyInteger2.

For Example:

SumRange(11, 14) will return 50

An error is generated if:
•  The function is not properly formed, or
•  MyInteger2 is less than MyInteger1
```

(i) State the function identifier and parameters for the above function.

Function identifier ....

Parameters ....

.... [2]

What value is returned from the following function calls?

(ii) SumRange(1, 3)

.... [1]

(iii) SumRange("31", "33")

.... [1]

(iv) SumRange(1.5, 4.5)

.... [1]

(v) SumRange(78, 71)

.... [1]

(b) Describe a difference between a user-defined function and a procedure.

....

.... [1]

9 A hotel has a variety of accommodation (ACCOMMODATION). The accommoda[tion is] designated as either:

- standard room (STANDARD)
- luxury room (LUXURY)

Data is to be recorded for the hotel accommodation and modelled with an object-oriented design.

(a) Draw the inheritance diagram for this scenario.

[3]

(b) Explain the terms class and object.

Class ....

....

Object ....

.... [2]

(c) The ACCOMMODATION class is to include a RoomNo property.

Explain encapsulation in terms of how this property value would be stored and retrieved.

....

....

....

.... [2]

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