



**ADVANCED GCE**  
**COMPUTING**  
 Advanced Computing Theory

**F453**

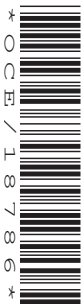
Candidates answer on the Question Paper

**OCR Supplied Materials:**  
 None

**Other Materials Required:**  
 None

**Wednesday 27 January 2010**  
**Afternoon**

**Duration: 2 hours**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **120**.
- This document consists of **20** pages. Any blank pages are indicated.

1 (a) (i) Explain why interrupts are used in a computer system.

.....  
.....  
.....  
..... [2]

(ii) State **two** sources of interrupts and explain why these sources have different priorities.

Source 1: .....  
Source 2: .....  
Explanation: .....  
.....  
.....  
..... [4]

(b) (i) Describe **two** reasons why scheduling is used.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

(ii) Explain why jobs are given different priorities when in a job queue.

.....  
.....  
.....  
..... [2]

2 (a) Languages used in computing include assembly language and machine code.

(i) Describe the term assembly language.

.....  
.....  
.....  
..... [2]

(ii) Describe the term machine code.

.....  
.....  
.....  
..... [2]

(iii) State **three** of the tasks performed by an assembler when producing machine code.

.....  
.....  
.....  
.....  
.....  
..... [3]

(b) Either an interpreter or a compiler may be used with a high-level language program.

(i) Describe **one** feature of an interpreter.

.....  
.....  
.....  
..... [2]

(ii) State **two** features of a compiler.

.....  
.....  
.....  
..... [2]



3 (a) State the three stages, in order, of the machine cycle in classic Von Neumann architecture.

.....  
 .....  
 ..... [2]

(b) Two computer architectures are Reduced Instruction Set Computer (RISC) and Complex Instruction Set Computer (CISC) architectures.

(i) Complete the table to show how the statements apply to these architectures.

	RISC only (✓)	CISC only (✓)	both RISC and CISC (✓)
Has many addressing modes			
Many instructions are available			
Uses one or more register sets			
Uses only simple instructions			

[4]

(ii) Compare the number of machine cycles used by RISC and CISC to complete a single instruction.

.....  
 .....  
 .....  
 ..... [2]

(c) An array processor is used in some systems.

(i) Explain the term array processor.

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 .....  
 .....  
 ..... [2]

(ii) Give **one** example of the type of task for which an array processor is most suitable.

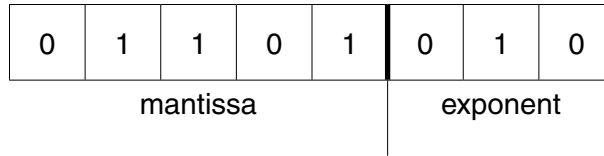
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 ..... [1]

4 In each part of this question, all working must be shown.

A real binary number may be represented in normalised floating point binary notation using 5 bits for the mantissa and 3 bits for the exponent, both in two's complement binary.

(a) Convert each of the following binary numbers to denary.

(i)



.....

.....

.....

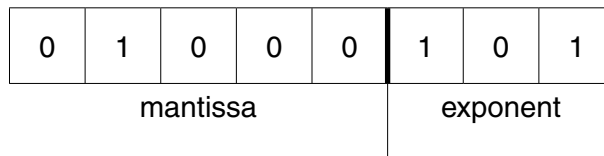
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..... [3]

(ii)



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..... [3]

(b) If, instead, 3 bits are used for the mantissa and 5 bits for the exponent, state the effect on the accuracy and range of the numbers that can be represented.

.....

.....

.....

..... [2]

5 (a) A list of cities is:

Aberdeen, Belfast, Cardiff, Glasgow, Oxford, York.

(i) Show the steps of a serial search for York in the list.

.....  
.....  
.....  
..... [2]

(ii) Show the steps of a binary search for York in the list.

.....  
.....  
.....  
.....  
.....  
..... [3]

(b) Explain **one** advantage of a binary search compared with a serial search when searching for an item in any large set of data.

.....  
.....  
.....  
..... [2]

(c) A stack contains a number of data items.

List the steps needed to attempt to add one data item to the stack.

.....  
.....  
.....  
.....  
..... [3]



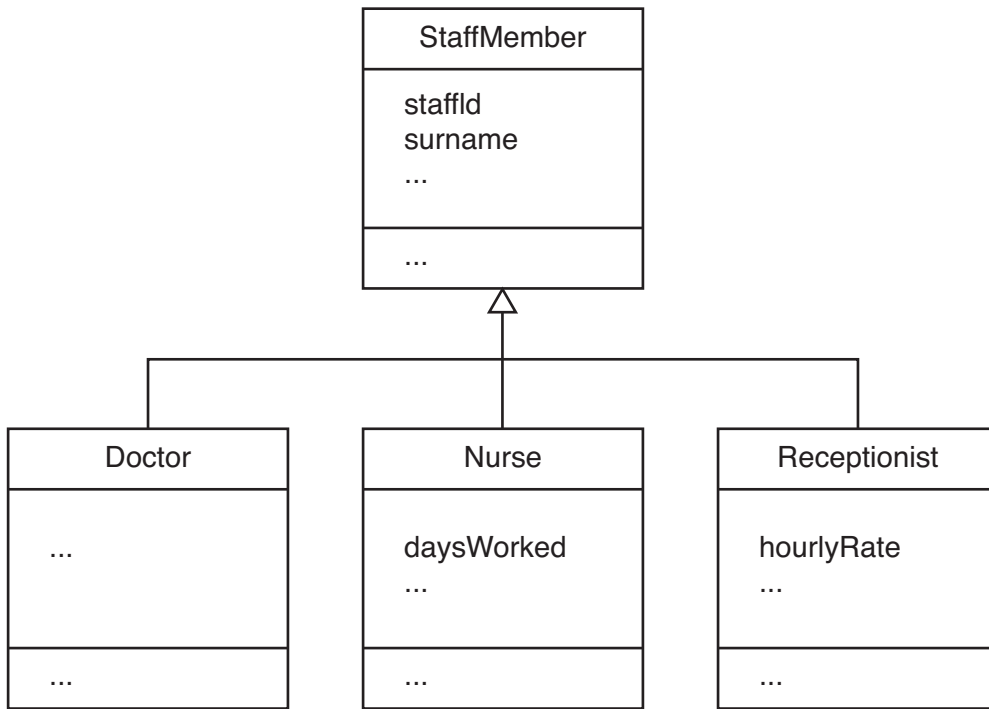


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6 The UML class diagram shows some of the information about staff working in a health centre.



(a) (i) Using the class diagram above, explain the term inheritance.

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.....

.....

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.....

.....

..... [3]

(ii) Dr Connor is a doctor at the health centre.

From the diagram, explain why his attributes include surname but do not include hourlyRate.

.....

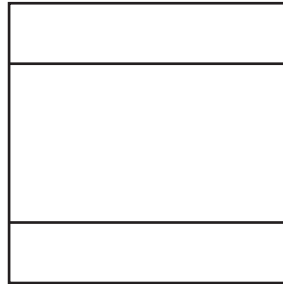
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..... [2]

- (b) Cleaning staff should be included in the class diagram. A cleaner needs the attribute hoursWorked and operation getHours( ).

Show this information on the diagram below.



[3]

- (c) Mrs Jones is employed as a cleaner at the same health centre. The following program code may be used.

```
oneCleaner = Cleaner new  
oneCleaner.giveSurname: 'Jones'
```

Use the information given to explain the terms object and class. Give an example of each.

- (i) object

.....  
.....  
.....  
.....  
.....  
..... [3]

- (ii) class

.....  
.....  
.....  
.....  
..... [3]

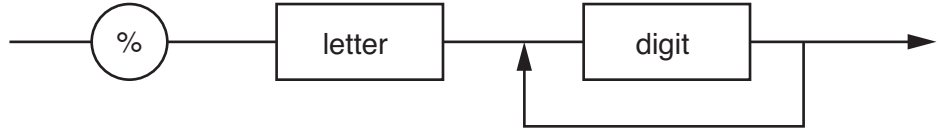
7 (a) For a particular programming language, the following features are defined:

digit is a single digit: 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9

letter is any single lower case letter of the alphabet: a, b, c, ...z

The syntax diagram shown below is used to define a variable in the language.

variable:



(i) For each example, give **one** reason why the expression is **not** a variable.

%xy2 .....

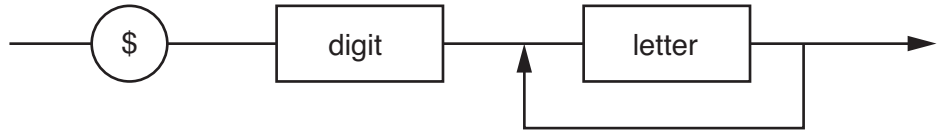
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%34 .....

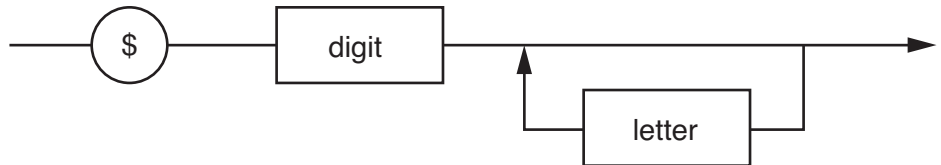
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(ii) With the help of examples, explain the difference between the following definitions of identifiers.

identifierA:



identifierB:



.....

.....

.....

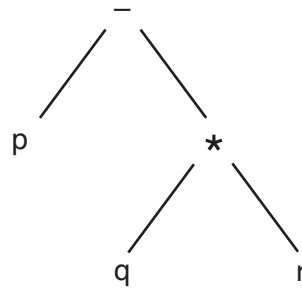
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..... [3]

- (b) (i) The binary tree shows operands p, q and r with operators – and \*.



Obtain the reverse Polish form of the expression.

.....

.....

.....

..... [2]

- (ii) State the type of traversal that should be used to obtain the reverse Polish form from a binary tree.

.....

..... [1]

- (iii) An expression in reverse Polish notation is  $tu^*v+$   
 Showing how you obtain your answer, evaluate this expression when  $t = 2$ ,  $u = 3$  and  $v = 10$ .

.....

.....

.....

..... [2]

- (iv) State what data structure, other than a binary tree, may be associated with reverse Polish notation.

.....

..... [1]

- (v) State a symbol, often used in mathematical expressions, that is not required when working with reverse Polish notation.

.....

..... [1]

8 A program in a particular assembly language includes the instructions

```
        JMP CD          jump to instruction labelled 'CD'
        .
        .
CD      ADN 41         add the number 41 to the number in the accumulator
```

(a) Explain the term opcode and give **one** example from the information given.

.....  
.....  
.....  
..... [2]

(b) State the type of addressing used by the instruction ADN 41.

.....  
..... [1]

(c) State the meaning of the term symbolic addressing and give **one** example from the information given.

.....  
.....  
.....  
..... [2]

(d) Explain the purpose of the accumulator.

.....  
.....  
.....  
..... [2]

(e) Describe indexed addressing.

.....  
.....  
.....  
.....  
.....  
..... [3]

(f) (i) State the meaning of direct addressing.

.....  
..... [1]

(ii) Explain why it is **not** possible to use **only** direct addressing in assembly languages.

.....  
.....  
.....  
..... [2]

9 An animal hospital is run by a team of vets. Owners may take their pets for treatment at any time. A relational database is used to store all the data needed in the hospital.

(a) Data is stored about pets and their owners. Each pet has only one owner, but an owner may have one or more pets.

Complete the entity-relationship (E-R) diagram to show this relationship.



[2]

(b) Data stored includes the following:

PET (PetId, Name, Breed, Colour...)

OWNER (OwnerId, Surname, Forename, ...)

(i) Explain the use of primary keys in this database.

.....  
.....  
.....  
..... [2]

(ii) Explain the use of a foreign key in this database.

.....  
.....  
.....  
.....  
.....  
..... [3]



(c) The database management system (DBMS) includes a data dictionary.

Explain the term data dictionary and give **two** examples of the information stored.

.....  
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.....  
.....  
.....  
.....  
..... [4]

(d) It has been decided to start selling pet toys. Details of toys and their suppliers need to be added to the database.

State the type of language used to create the table TOY.

.....  
..... [1]

(e) Give **three** benefits of a relational database compared with flat files.

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..... [3]

**END OF QUESTION PAPER**

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