



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

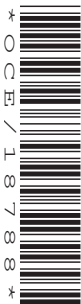
**F453**

Candidates answer on the Question Paper

**OCR Supplied Materials:**  
None

**Other Materials Required:**  
None

**Monday 14 June 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. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

**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) One feature of an operating system is memory management.

(i) State **two** reasons why memory management is necessary.

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

(ii) State why virtual memory may be needed.

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

(iii) Describe how virtual memory is used.

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

(iv) Describe the problem of disk thrashing.

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

3

(b) An operating system also uses scheduling.

Describe **one** method of scheduling.

.....

.....

.....

..... [2]

2 Various types of translator may be used when writing and preparing a new computer program.

(a) Explain the main purpose of a translator.

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

(b) Some compilers produce intermediate code instead of executable code.

(i) Explain why intermediate code may be more useful than executable code.

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

(ii) State what additional software is needed to run the intermediate code.

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

(iii) State **one disadvantage** of using intermediate code.

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

(c) When a compiler is used to produce executable code, code generation includes optimisation.

Describe what optimisation does.

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

3 (a) One feature of Von Neumann architecture is the use of the fetch-execute cycle.

State **two** other features of Von Neumann architecture.

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

(b) The program counter is one register used by the processor.

Give the names of **three** other registers used by the processor.  
(Do not use abbreviations)

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

(c) (i) Describe the fetch-execute cycle.

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

(ii) Describe how a jump instruction is executed.

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..... [2]

(d) In some computer systems, a co-processor may be used.  
Explain the term co-processor.

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..... [3]

4 A real binary number may be represented in normalised floating point binary notation using 6 bits for the mantissa and 2 bits for the exponent, both in two's complement binary.

(a) Convert the following binary number to denary.

Show your working.

0	1	0	1	1	0	0	1
---	---	---	---	---	---	---	---

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..... [3]

(b) Write, in binary, the largest positive number that can be represented in this format.

.....

..... [2]

(c) For this part of the question, **4 bits** are used for the mantissa and **4 bits** for the exponent.

(i) Two numbers, A and B, have been written in binary. Only one of the numbers has been normalised.

number A

1	0	0	1	0	1	1	0
---	---	---	---	---	---	---	---

number B

0	0	1	1	1	0	1	0
---	---	---	---	---	---	---	---

State which of the numbers has been normalised giving a reason for your answer.

.....

..... [1]

(ii) Give **two** reasons why binary numbers should be normalised.

.....

.....

.....

..... [2]

- (iii) Convert the denary number +3.5 to binary, giving your answer as a normalised floating point number using 4 bits for the mantissa and 4 bits for the exponent.

Show your working.

.....

.....

.....

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.....

.....

..... [3]



5 (a) An array is an example of a static data structure.

(i) State the meaning of the term static in this context.

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

(ii) State **one** advantage of using a static data structure compared with a dynamic data structure.

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

(b) (i) Show the result of merging the following data files.

File A: Anna, Cleo, Helen, Pritti  
File B: Billy, Ian, Omar, Rob, Tom

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

(ii) Write an algorithm to merge two sorted files, stating any assumptions you make.

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..... [6]

6 (a) The table shows some statements about types of programming language.

Tick the boxes to show the type of programming language for which each statement is correct.

	Low-level	Object-oriented	Procedural
Data is only accessible through methods			
Each instruction usually represents one machine code instruction			
Inheritance may be used			
Local variables may be used			
Mnemonics are used			

[5]

(b) (Any examples you give must be taken from the information listed here.)

The following statements use a language where facts and rules state what to do but not how to do it.

```

cat (tom)           {Tom is a cat}
cat (leo)
cat (snowy)
mouse (jerry)      {Jerry is a mouse}
    
```

chases (A, B) if cat (A) and mouse (B)

chases (X, Y)?

Part of the solution to chases (X, Y)? includes the following steps:

```

step 1    attempt to solve cat (X)
step 2    finds                               X = tom
step 3    set X = tom
step 4    attempt to solve mouse (Y)
step 5    finds                               Y = jerry
step 6    a solution is                       X = tom, Y = jerry
step 7    attempt to solve cat (X)
step 8    finds                               X = leo
    
```

(i) Give the correct name for this type of programming language.

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

(ii) Give **one** example of a fact.

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

(iii) Give **one** example of a rule.

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

(iv) Give **one** example of a goal.

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

(v) Give **one** example of instantiation.

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

(vi) Explain the term backtracking and give **one** example of backtracking.

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

7 (a) Explain how functions and procedures may be used to develop a program in a structured way.

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

(b) A particular high level language uses local variables, global variables and parameters.

Discuss and compare the use of local variables, global variables and parameters.

(The quality of written communication will be assessed in your answer to this question.)

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..... [8]

(c) (i) State what data structure is used when procedures are called during program execution.

..... [1]

(ii) State the purpose of using this data structure.

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

**Turn over for next question**

8 (a) State the need for BNF (Backus-Naur form).

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

(b) In a large company, each employee is given a staff code. Using BNF, the definition of a staff code is

```
<DIGIT> ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9  
<LETTER> ::= A | B | C | D | E  
<STAFF_CODE> ::= <LETTER> <DIGIT> | <STAFF_CODE> <DIGIT>
```

State how the rules have been broken by each of the following invalid staff codes.

(i) A2C

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

(ii) G45

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

(c) After changes in the company, it is decided to allocate new codes. Write a definition for NEW\_CODE which has one or more digits followed by zero or more letters. For example, 1234 and 3AB are valid but A25 is not valid.

(You may assume that DIGIT and LETTER are still defined as in part (b).)

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

9 (a) An assembly language uses mnemonics.

Explain the term mnemonics.

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

(b) Describe relative addressing.

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

(c) Describe indexed addressing.

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

(d) Give the correct names for **two** other modes of addressing.

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

(e) One feature of assembly language is flow-control. Explain the term flow-control.

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

10 A shop sells classical music CDs. The shop uses a relational database to store information about its products. Data stored about each CD includes the name of the composer, the title, the name of the artiste or orchestra, the price and the number in stock.

(a) State why the name of the composer is **not** suitable as a primary key.

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

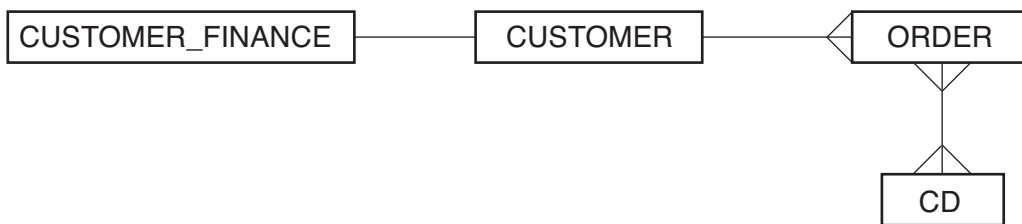
(b) Explain the use of a secondary key from the information given.

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

Customers are able to register their details and buy CDs from the shop’s website.

The entity-relationship (E-R) diagram below shows

CUSTOMER\_FINANCE includes customer’s bank details  
 CUSTOMER includes name and address  
 ORDER details of an order made by a customer, including the date  
 CD data about a CD, as described at the start of the question



(c) (i) State the type of relationship between CUSTOMER\_FINANCE and CUSTOMER on the E-R diagram.

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

(ii) Give **one** reason why CUSTOMER\_FINANCE and CUSTOMER are stored separately.

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

(iii) Explain **one** reason why CUSTOMER and ORDER are stored separately.

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



(iv) State **one** problem with the relationship between ORDER and CD on the diagram.

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

(v) Draw an improved version of the E-R diagram which corrects this problem.

[3]

(d) Some of the Structured Query Language (SQL) used for this database is

```
SELECT CustomerId, AmountOwed, CreditLimit  
FROM CUSTOMER_FINANCE  
WHERE AmountOwed > 80  
ORDER BY CreditLimit
```

Describe the purpose of this code.

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

11 (a) Explain why the Unified Modelling Language (UML) is used.

.....

.....

.....

..... [2]

Figures 1, 2 and 3 show parts of some UML diagrams for a security system.

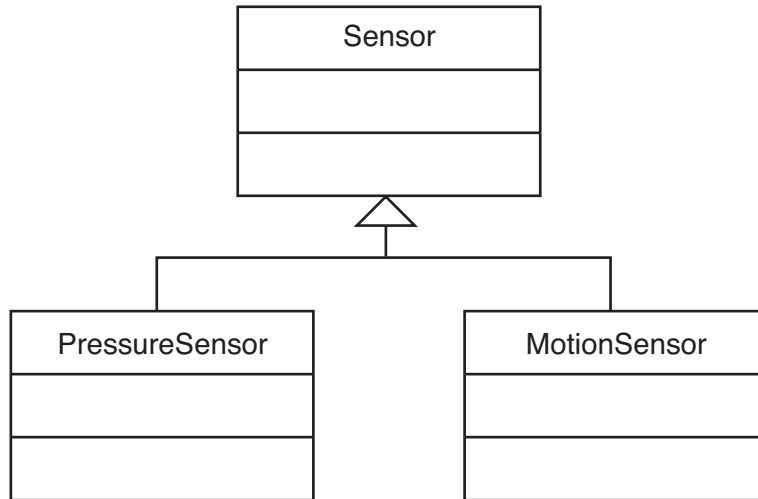


Figure 1



Figure 2

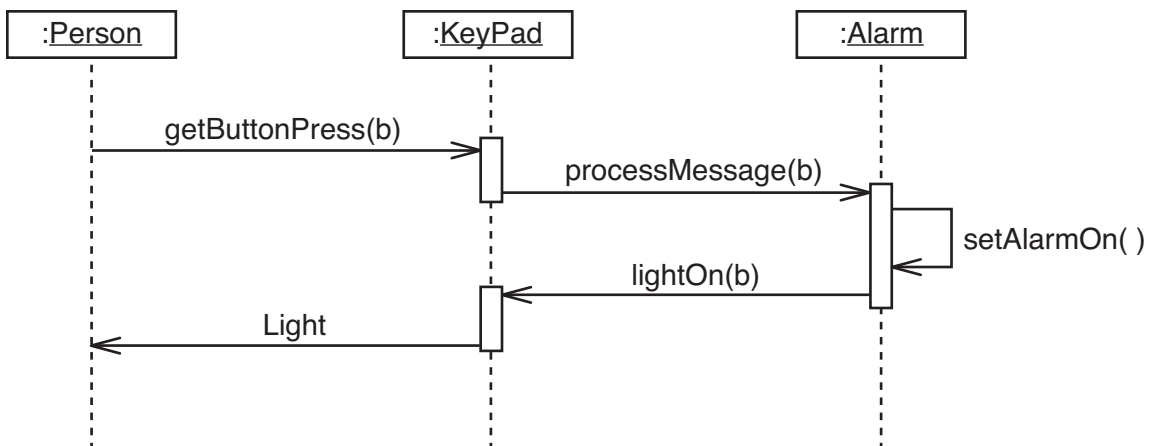


Figure 3

(b) Give the correct name for each type of UML diagram.

Figure 1 .....

Figure 2 .....

Figure 3 .....

[3]

(c) State the feature of object-oriented languages which is shown by the arrow in Figure 1.

..... [1]

(d) Taking your information from Figures 1, 2 and 3, give **one** example of each of the following.

(i) an object

..... [1]

(ii) a class

..... [1]

(iii) a message

..... [1]

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