

**ADVANCED GCE
 COMPUTING**

2509

Systems Software Mechanisms, Machine Architecture,
 Database Theory and Programming Paradigms

THURSDAY 5 JUNE 2008

Afternoon
 Time: 1 hour 30 minutes

Candidates answer on the question paper

Additional materials: No additional materials are required



Candidate Forename

Candidate Surname

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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 answer space is available on the lined pages at the back of this booklet. Answers on these pages **must** be clearly numbered.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **90** of which 4 marks are allocated to the assessment of the quality of written communication.
- No marks will be awarded for using brand names of software packages or hardware.

| FOR EXAMINER'S USE | |
|--------------------|--|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| QWC | |
| TOTAL | |

This document consists of **16** printed pages, **3** lined pages and **1** blank page.

Answer **all** questions.

1 (a) One feature of an operating system is memory management.

Give **four** functions of memory management.

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2.....
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3.....
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4.....
.....[4]

(b) Explain the purpose of the file allocation table (FAT) and how it is used in a typical PC (Personal Computer) operating system.

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2 (a) One stage of compilation is lexical analysis.

(i) Give the correct name for each of the other **two** stages.

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(ii) Describe what happens during lexical analysis.

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(b) Explain the purpose of linkers.

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(c) Explain why a program is usually compiled before being offered for sale.

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5
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3 (a) Describe how the program counter is used during the fetch-execute cycle.

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(b) While an instruction is being executed, an interrupt occurs.

Describe how the processor handles the interrupt.

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(c) Explain the term pipelining.

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- 4 (a) The diagram shows a linked list used to store data in alphabetical order.

| |
|-----------|
| Start = 5 |
| Free = 8 |

| Position | Data | Pointer |
|----------|------------|---------|
| 1 | Edinburgh | 4 |
| 2 | Durham | 1 |
| 3 | Manchester | 6 |
| 4 | London | 3 |
| 5 | Bath | 7 |
| 6 | York | 0 |
| 7 | Cardiff | 2 |
| 8 | | 9 |
| 9 | | 10 |
| 10 | | 0 |

Complete the diagram to show the same linked list after the data for Durham is deleted.

| |
|---------|
| Start = |
| Free = |

| Position | Data | Pointer |
|----------|------|---------|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

[3]

(b) (i) List the steps used when attempting to add **one** new data item to a stack data structure.

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.....[3]

(ii) State **one** use of a stack in a computer system.

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.....[1]

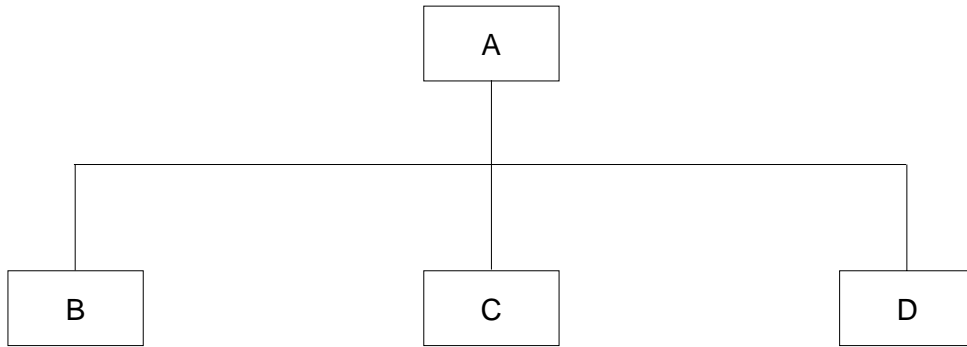
5 (a) Part of a Jackson Structured Programming (JSP) diagram is shown.

Add the following information to the diagram.

(i) B consists of P followed by Q. [1]

(ii) C consists of R which is repeated a number of times. [1]

(iii) D consists of a choice between S and T. [2]



(b) A college issues each new student with a password for its computer system. Valid passwords are defined using Backus-Naur Form (BNF).

$\langle \text{UP} \rangle ::= A \mid B \mid C \mid D \mid E$
 $\langle \text{LOW} \rangle ::= p \mid q \mid r \mid s$
 $\langle \text{DIGIT} \rangle ::= 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$
 $\langle \text{SYMBOL} \rangle ::= \%$
 $\langle \text{PASSWORD} \rangle ::= \langle \text{UP} \rangle \langle \text{LOW} \rangle \langle \text{SYMBOL} \rangle \mid \langle \text{PASSWORD} \rangle \langle \text{DIGIT} \rangle$

Using the definitions, give a reason why each of the following examples is **not** a valid password.

(i) Aq4

[1]

(ii) Brs%3

[1]

(iii) Cr%28A

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.....[1]

To improve security, students are told to replace their passwords with a code, where CODE has at least three DIGITs, followed by one UP, one LOW, then any number (including 0) of DIGITs.

For example, 123Ap and 1234Bq5 are valid codes, but 67Cp8 and 678DD5 are not valid.

(iv) Define VALUE, where VALUE has at least three DIGITs.

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.....[2]

(v) Using your definition of VALUE, define CODE.

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.....[2]

6 A relational database is used in a shop that sells electrical goods such as radios and televisions.

Two of the tables used are Product and Supplier. The tables include

Product (ProductCode, ProductName, Colour, Price, SupplierCode, NumberInStock)

Supplier (SupplierCode, SupplierName, Address, PhoneNumber)

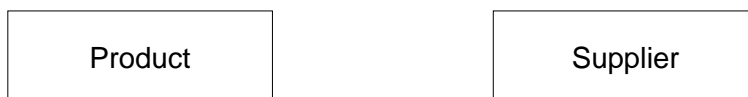
(a) State the meaning of the term primary key and give **one** example from this database.

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.....[2]

(b) State the meaning of the term foreign key and describe its use in this database.

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(c) Complete the entity-relationship (E-R) diagram to show the relationship between Product and Supplier.



[2]

- (d) In the shop, customers are allowed to use a computer to look up the price and number in stock for items they are considering. The database provides a view of data for customers' use.

Give **two** reasons why a view of data is used for this.

Reason 1

Reason 2[2]

- (e) At different times, the same salesperson may have read-write access or read-only access to the Product table.

Explain why both types of access are required.

read-write.....

read-only.....[2]

7 A car dealer sells cars to members of the public. Data is stored using an object-oriented language. Some examples of program code are given, with their meanings.

| Example | Meaning |
|------------------------|--|
| hisCar = new Car | hisCar is defined as an instance of car |
| hisCar.setPrice: 12000 | The price of hisCar is stored as £12000 |
| hisCar.setReg: XX57YYY | The registration number of hisCar is stored as XX57YYY |
| hisCar.showColour | Displays the colour of hisCar, e.g. red |

(a) Define the terms and give an example of each from the information given.

(i) Object

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[2]

(ii) Class

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[2]

(iii) Method

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[2]

(iv) Encapsulation

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.....[2]

(b) Using the information given in the question, write program code for each of the following tasks.

(i) Create an instance of Car called myCar.

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.....[1]

(ii) Store the price of myCar as £13500.

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.....[1]

(iii) Display the colour of myCar.

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.....[1]

8 A number is written in binary as 10010001.

(a) If the number 10010001 is an unsigned integer, calculate its denary value.

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.....[1]

(b) Normalised floating point binary is used. The first 5 bits are the mantissa and the last 3 bits are the exponent. Both are in two's complement binary form.

(i) Calculate the value of the binary number 10010001 in denary.

Show your working.

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.....[3]

(ii) Calculate the normalised floating point binary form of the denary value 2.5.

Show your working.

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(iii) In this binary form, the largest positive number is 01111011.

Compare this value with the largest number using 4 bits for the mantissa and 4 bits for the exponent.

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(iv) Give **one** reason why binary numbers should be normalised.

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.....[1]

