OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

COMPUTING 2509

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

Tuesday **21 JUNE 2005** Morning 1 hour 30 minutes

No additional materials required.
Candidates answer on the question paper.

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre Number and Candidate Number in the boxes above.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

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 90 (86 + 4 written communication).
- You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.
- No marks will be awarded for using brand names of software packages or hardware.

FOR EXAMINER'S USE	
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TOTAL	

This question paper consists of 12 printed pages.

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[Turn over

1 The data

Essex, Kent, Cumbria, Dorset, Surrey, Norfolk

are to be entered in the order given into a binary sort tree. Draw a diagram to show the tree obtained.

[3]

2 **(a)** Explain the process of booting on a typical personal computer.

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.....[3]

(b) Memory management can use paging and segmentation. Explain the terms *paging* and *segmentation*.

Paging .....

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Segmentation .....

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.....[6]

(c) Explain the term *disk threshing*.

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.....[2]

3 **(a)** High level language programs may be translated using an interpreter or a compiler. Explain the terms *interpreter* and *compiler*.

Interpreter .....

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Compiler .....

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.....[6]

(b) State the first **two** stages of compilation.

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(c) The third stage of compilation is code generation. Describe this stage.

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(d) Explain the term *optimisation*.

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4 **(a)** Describe a stack data structure.

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(b) Ignoring interrupts, state, in order, the stages of the fetch-execute cycle.

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(c) Describe how an operating system processes an interrupt. Your answer should indicate how a stack is used.

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5 Using 8 bits for a floating point binary number, the number 3 could be converted to either of the two forms shown below. Only one of these forms is normalised. In each form, the mantissa and exponent are both written in two's complement binary notation.

00110	011
mantissa	exponent

01100	010
mantissa	exponent

(a) Explain why floating point binary numbers should be normalised.

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(b) State which of the examples shows a normalised value, giving a reason for your choice.

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(c) By doing a suitable calculation, explain why the value 9 cannot be converted and written in this normalised floating point binary form.

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6 **(a)** A procedural programming language uses local variables and global variables.

(i) Explain the term *procedural programming language*.

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(ii) Explain the term *local variable*.

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.....[2]

(iii) Explain the term *global variable*.

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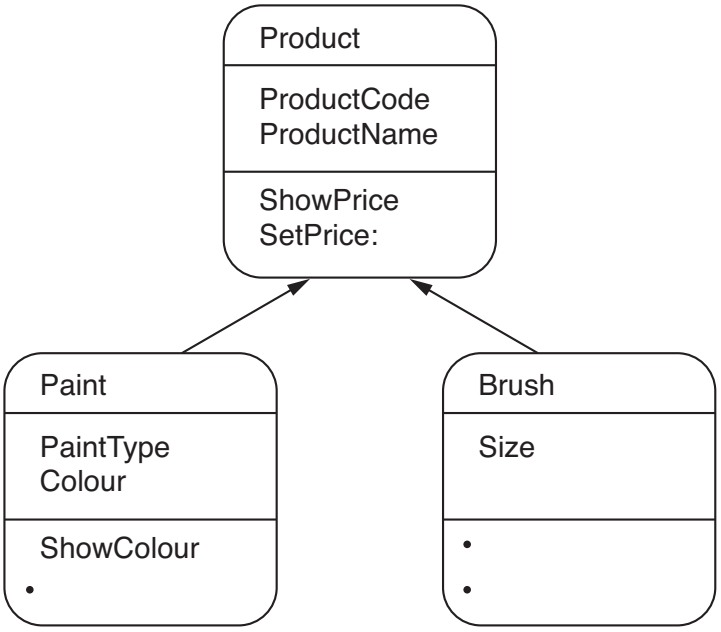
(b) A shop sells art materials. The shop's computer system uses an object-oriented language. Some classes used for stock control in the shop are Product, Paint and Brush. These classes and some of their methods are shown on the diagram below.



Using examples from the diagram, explain the terms

(i) Class .....

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.....[2]

(ii) Derived class .....

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.....[2]

(iii) Object .....

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.....[2]

(iv) Data encapsulation .....

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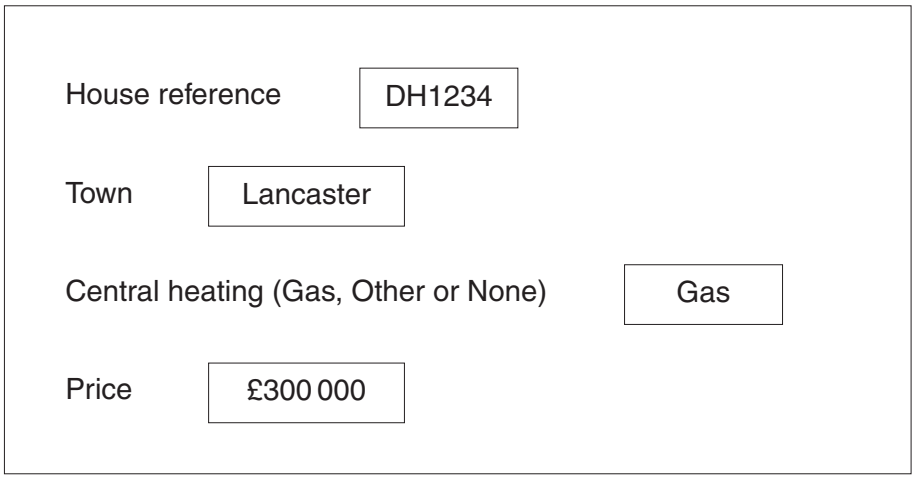
.....[2]

7 An estate agency sells houses. This agency stores data in a relational database.

(a) The data for the House table is entered on a form on a computer screen. The diagram shows the form with data for one house.



Staff at the agency want to improve this data entry form. State **three** ways to improve the form design, giving a reason for each. (Do not add or remove any attributes.)

Improvement 1 .....

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Improvement 2 .....

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Improvement 3 .....

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(b) State the purpose of the attribute HouseReference in the House table.

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(c) The agency also stores a Customer table containing details of people who want to buy houses. The Customer table includes the attribute CustomerReference.

A customer may visit many houses, and each house may be visited by many customers. On the entity-relationship (E-R) diagram below, show the relationship between Customer and House.

[2]

(d) It is decided to store details about customers visiting houses by adding a table Visit. The Visit table has attributes CustomerReference, HouseReference and DateOfVisit.

(i) Draw an E-R diagram to show the relationships between Customer, House and Visit.

[4]

(ii) Name one foreign key in the database and explain its use.

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(e) State **two** reasons why views of data may be used in the database.

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8 **(a)** Declarative programming languages use backtracking and instantiation.

(i) Explain the term *backtracking*.

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.....[1]

(ii) Explain the term *instantiation*.

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.....[1]

(b) In a declarative language the following are given:

food(lettuce).	{lettuce is food}
rabbit(bob).	{bob is a rabbit}
likes(bob, lettuce).	{bob likes lettuce}
eats(X,Y) := likes(X,Y), food(Y).	{X eats Y if X likes Y and Y is food}

Use the same notation to write

(i) thumper is a rabbit

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.....[1]

(ii) thumper likes carrots

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.....[1]

(iii) From all the information given, give a reason why thumper does not eat carrots.

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.....[1]

(c) Read the following recursive function SUM(N).

```
SUM(N)
        IF N = 1 THEN
                SUM = 1
        ELSE
                SUM = N + SUM(N – 1)
        ENDIF
END
```

(i) State why this is a recursive function.

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.....[1]

(ii) Using this example, explain the meaning of tail recursion.

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.....[1]

(iii) Using the above algorithm as a guide, write a recursive algorithm for PROD(N) that calculates the product of the first N integers (1 × 2 × 3… × N)

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.....[2]

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