Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

ADVANCED GCE

F453

COMPUTING

Advanced Computing Theory

WEDNESDAY 26 JANUARY 2011: Afternoon
DURATION: 2 hours

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

None

READ INSTRUCTIONS OVERLEAF

DC (NF/SW) 11MEP01248 41300/1

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **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).**
- **Answer ALL the questions.**

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.**

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1 (a) In the context of printing, describe spooling and explain why it is used. [4 marks]

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(b) An operating system may use segmentation or paging when managing memory.

(i) State TWO ways in which segmentation and paging are similar. [2 marks]

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(ii) State ONE difference between segmentation and paging. [1 mark]

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(iii) Explain ONE problem that may occur when using paging and segmentation. [2 marks]

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2 One stage of compilation is syntax analysis.

(a) Give the correct name for each of the other TWO stages. [2 marks]

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(b) Describe what happens during syntax analysis. [5 marks]

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(c) Some compilers produce intermediate code. Explain the term intermediate code and its use. [3 marks]

3 In classic Von Neumann architecture, a number of registers are used.

(a) (i) Explain the term register. [2 marks]

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(ii) Give the correct names for TWO of the special registers used. (Do NOT use abbreviations.) [2 marks]

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(b) Explain the advantages and disadvantages of parallel processor architecture compared with Von Neumann architecture. [5 marks]

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

(a) Three numbers P, Q and R are written in the format described but are not normalised.

P = 00100 010
Q = 00010 011
R = 00001 100

By converting each of P, Q and R to denary, show which represents a different value.
SHOW ALL WORKING. **[4 marks]**

(b) (i) State the format of the mantissa of a normalised floating point binary number. [1 mark]

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(ii) Give the normalised version of the number Q = 00010 011. [2 marks]

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(c) Consider the normalised floating point number 01111 011 in the format described. Explain why this number is important. [2 marks]

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(d) Using the same format, convert the denary number +2.25 to a normalised floating point binary number.
SHOW ALL WORKING. **[3 marks]**

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5 (a) A tree is a dynamic data structure.

(i) State the meaning of the term dynamic when applied to data structures. [1 mark]

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(ii) State ONE DISADVANTAGE to the programmer of using dynamic data structures compared with static data structures. [1 mark]

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(iii) State ONE type of data structure which must be static. [1 mark]

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(b) Draw a diagram to show the binary sort tree obtained by adding the words

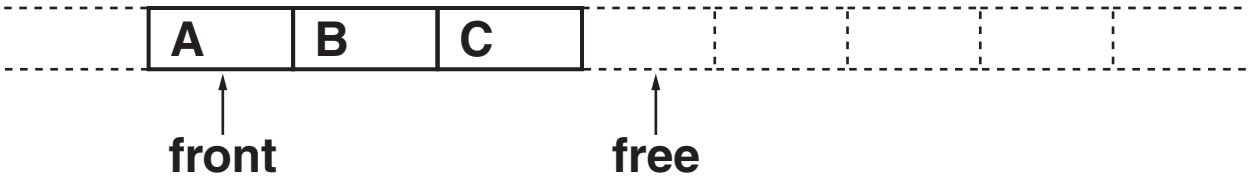
orange, red, yellow, pink, green, blue

to an empty tree in the order given so that they can be sorted into alphabetical order. [3 marks]

(c) List the steps needed to add one new data item to an existing binary tree, stating any assumptions you make. [6 marks]

(d) The diagram shows a data structure storing data items A, B and C. Two pointers are used:

front	points to the first item in the structure
free	points to the free space immediately after the structure



Data items can only be removed from the front of the structure, while data items must be added to the other end.

(i) State the correct name for this type of data structure. [1 mark]

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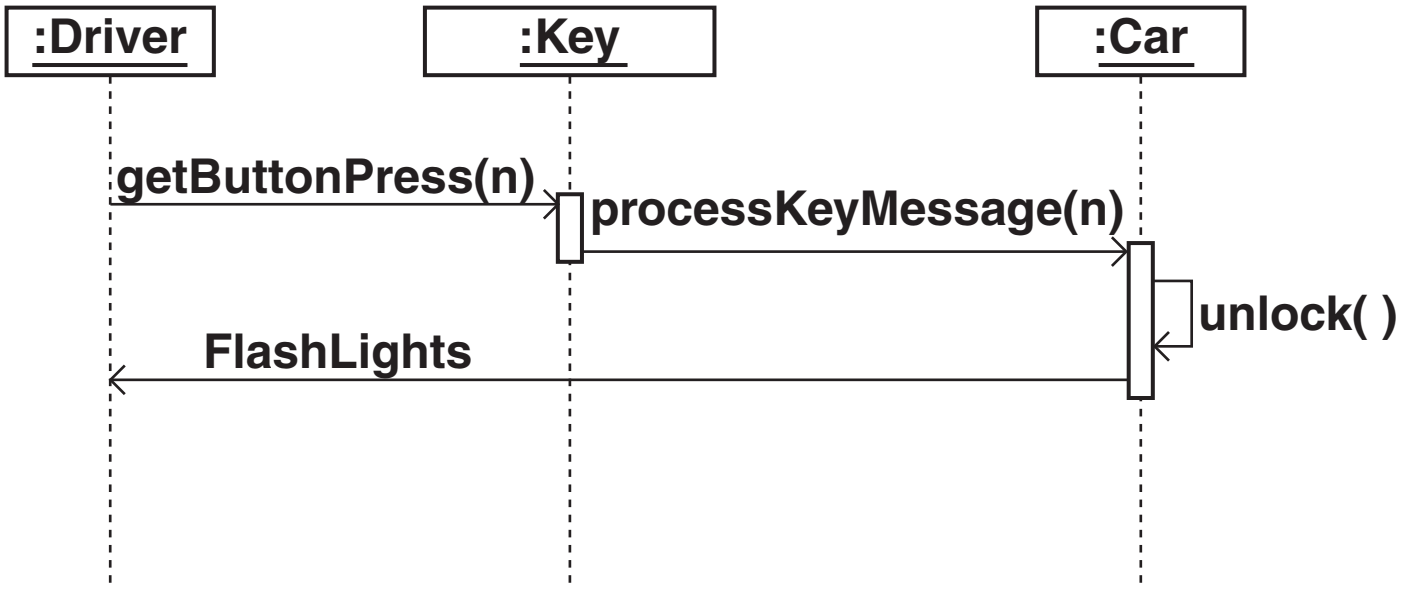
(ii) Complete the diagram below to show the result of removing ONE data item and adding TWO new data items X and Y in that order. [3 marks]

6 High level languages include procedural and object oriented languages.

(a) Describe the features of a procedural high level language. [4 marks]

(b) The Unified Modelling Language (UML) sequence diagram shows what happens when a driver uses a remote control key to unlock his car.



From the diagram, state

(i) a message [1 mark]

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(ii) a class [1 mark]

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(iii) a signal [1 mark]

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(iv) another type of UML diagram included within the sequence diagram [1 mark]

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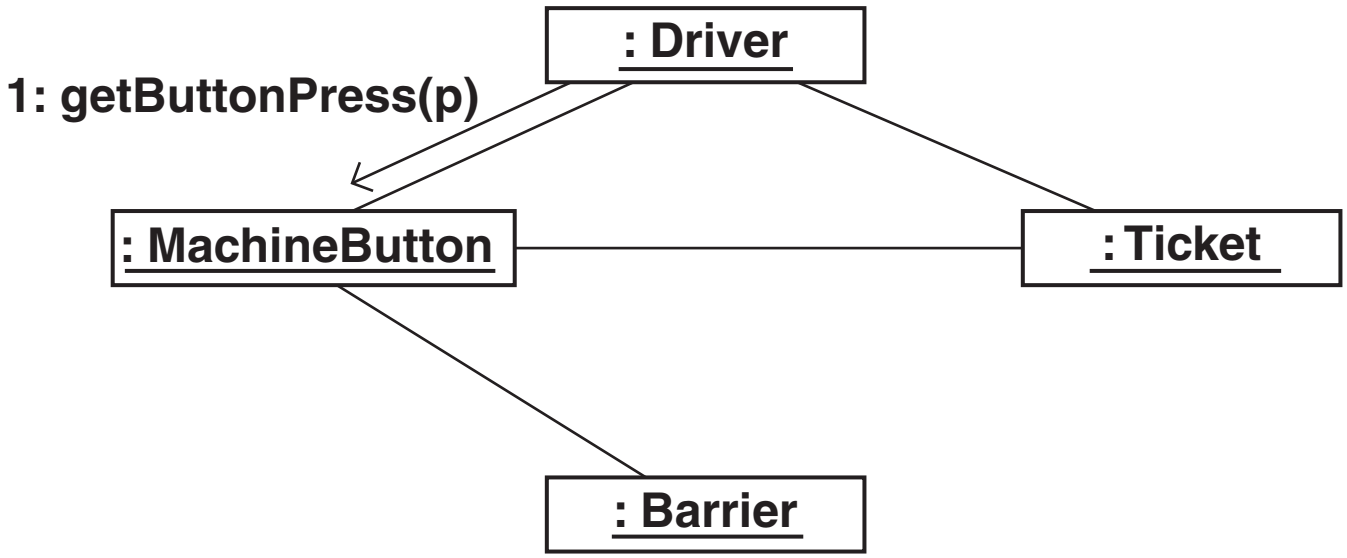
(c) At the entrance to a car park, a car driver has to stop at the barrier and press a button on the ticket machine. The machine issues a ticket to the driver, then raises the barrier to allow the car to enter.

This is shown on the UML diagram below. The diagram is incomplete.



(i) Give the correct name for this type of UML diagram. [1 mark]

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(ii) Add arrows and labels to the diagram opposite so that it shows the process described. (Do NOT add extra features which are not in the description.) [3 marks]

TURN OVER FOR NEXT QUESTION

(d) A council provides a number of public libraries. Information about library staff is to be stored. All staff work at just one library and are paid an annual salary. Their names and contact details must be stored. For each librarian, their qualifications must be stored. One senior librarian is in charge of each library: for this responsibility, they are paid an extra fee. Cleaning staff also work at each library: each cleaner works only on certain days of the week, so the days need to be stored.

Draw a UML class diagram to show the information about library staff. You should include all the information given. [8 marks]

7 (a) Discuss the use of functions, procedures and stepwise refinement in developing programs.

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

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(b) (i) State the type of data structure which is used to handle procedure calling and parameter passing. [1 mark]

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(ii) Explain the term parameter. [3 marks]

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8 (a) The table shows statements about types of computer language.
In each row, tick the box(es) to show for which type(s) of language the statement is correct.
[6 marks]

	Machine code	Assembly language	High level language
Uses mnemonics			
Uses only binary (or hexadecimal) code			
May use relative addresses			
May use local variables			
Needs translation before the program can be executed			
May be translated into intermediate code			

(b) Describe immediate addressing. [2 marks]

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(c) Explain how and why the index register (IR) is used. [3 marks]

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9 (a) Draw an entity-relationship (E-R) diagram to show the following:

A to B is a one-one relationship
B to C is a one-many relationship
A to D is a many-one relationship [4 marks]

(b) (i) State the meaning of the term primary key. [1 mark]

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(ii) Explain why a foreign key is also a primary key, but a primary key need not be a foreign key. [4 marks]

(c) Structured Query Language (SQL) is used with databases.
In a supermarket, the following SQL may be used.

```
SELECT StockNo, Quantity, Price
FROM Stock
WHERE Quantity < 100
ORDER BY Price DESC
```

From this

(i) State the name of ONE attribute. [1 mark]

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(ii) State the name of ONE table. [1 mark]

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(iii) Describe the purpose of the code. [3 marks]

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(d) SQL is also used to create an employee table in the database.
A simplified version of part of this is shown below, with line numbers added.

```
Line 1      CREATE TABLE Employee
Line 2          ( StaffId CHAR(6),
Line 3            Surname VARCHAR(15),
Line 4            Forename VARCHAR(15),
Line 5            DepartmentId CHAR(5),
Line 6            PRIMARY KEY StaffId,
Line 7            FOREIGN KEY DepartmentId
                  REFERENCES Department)
```

(i) Explain the difference between CHAR and VARCHAR data types in lines 2 and 3. [2 marks]

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(ii) Explain lines 5 and 7. [3 marks]

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(e) Give TWO reasons why views of data are made available to users of a database. [2 marks]

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2. _____

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END OF QUESTION PAPER

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