OXFORD CAMBRIDGE AND RSA EXAMINATIONS

A2 GCE

F453/01

COMPUTING

Advanced Computing Theory

TUESDAY 23 JUNE 2015: Morning

DURATION: 2 hours
plus your additional time allowance

MODIFIED ENLARGED 24pt

Candidate forename		Candidate surname	

Centre number						Candidate number				

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:
None

OTHER MATERIALS REQUIRED:
None

READ INSTRUCTIONS OVERLEAF

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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. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

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).

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.

'Quality of Written Communication' will be assessed in this paper.

Any blank pages are indicated.

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Answer ALL questions

1 (a) A typical desktop PC (personal computer) operating system includes a file allocation table (FAT).

Explain the purpose of the FAT and how it is used.

[6]

(b) When a PC is switched on, a file is used to provide some of the information needed.

Give the correct name of this file and state what information it provides.

_____

_____

_____

_____ [2]

(c) Interrupts may be used in a computer system.

(i) State the meaning of the term interrupt.

_____

_____ [1]

(ii) Describe how a data structure is used during the servicing of an interrupt.

_____

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_____ [4]

2 (a) An assembler may be used to produce machine code from assembly language.

Describe machine code and assembly language, making clear the differences between them, and describe the tasks done by an assembler.

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

(b) **Describe what happens during syntax analysis, when code is compiled.**

[5]

3 (a) Von Neumann and array processor are different types of computer architecture.

One feature of Von Neumann architecture is that instructions are executed in a linear sequence.

(i) Give THREE other features.

1 _____

_____

2 _____

_____

3 _____

_____

[3]

(ii) Describe what is meant by array processor architecture.

_____

_____

_____

_____ [2]

(iii) Give ONE advantage and ONE disadvantage, other than cost, of using Von Neumann compared with array processor architectures.

Advantage _____

_____

Disadvantage _____

_____

[2]

(b) Processors use special registers.

(i) Explain why special registers are needed in addition to primary memory.

_____

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_____ [2]

(ii) **One register holds the address of the next instruction to be processed.**

Explain TWO reasons why the value held may change.

_____

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_____ **[4]**

4 (a) A real binary number may be represented in normalised floating point binary notation using 5 bits for the mantissa followed by 3 bits for the exponent, both in two's complement binary.

The following binary numbers are in the format described.

Calculate their denary values.

Show all working.

(i) 01100011

[3]

(ii) 10100111

[3]

(b) Write the denary number +3.5 as a normalised binary number in the format described in (a).

[3]

(c) Using only 6 bits, the normalised binary numbers X and Y are in different formats.

X = 010111
Y = 011101

X and Y are the maximum possible values for each of their formats.

(i) State the number of bits in the mantissa for X.

_____ [1]

(ii) State the number of bits in the exponent for Y.

_____ [1]

(iii) Explain the trade-off between accuracy and range when representing numbers, using the denary values of X and Y in your answer.

_____

_____

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_____

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_____

_____ [4]

5 (a) **Describe an algorithm to insert one data item into a queue data structure.**

[4]

(b) (i) **Describe how an insertion sort is performed.**

[3]

(ii) **Demonstrate an insertion sort to place the following numbers into DESCENDING numerical order.**

12 7 4 5 26

[4]

(iii) **State ONE DISADVANTAGE of an insertion sort compared with a quick sort.**

[1]

6 (a) (i) A high-level language states what is required but not how to do it. The statements do not have to be in a specific order.

Identify the type of language described.

_____

_____ [1]

(ii) State ONE typical use for this type of language and give ONE reason for your choice.

_____

_____

_____

_____ [2]

(b) **Some high-level languages are object-oriented.**

Describe THREE features of an object-oriented language.

1 _____

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2 _____

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_____

3 _____

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_____

[6]

7 (a) Variables are used in programming.

(i) Describe the use of local variables.

_____

_____

_____

_____

_____

_____

_____ [4]

(ii) State TWO features of global variables that distinguish them from local variables.

1 _____

_____

2 _____

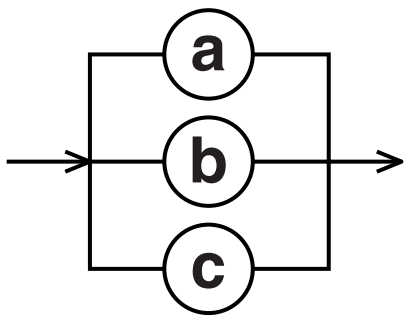
_____

[2]

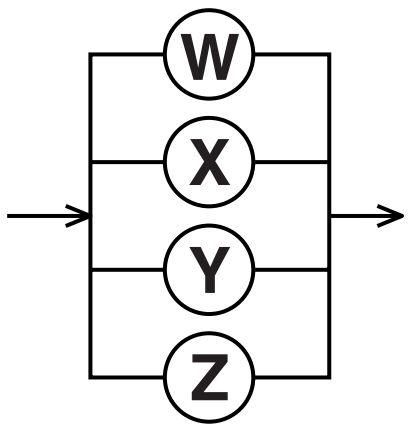
(b) Staff in a company use passwords.

The definition of a password is shown on the syntax diagrams.

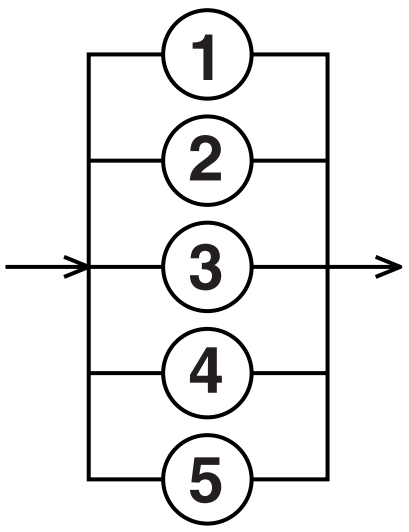
lower:



upper:



digit:



password:

(i) For each expression, give ONE reason why it is NOT a valid password according to the definition.

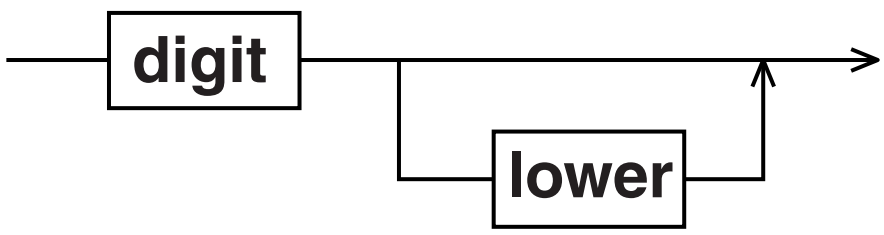
W234w

X2bc

[2]

A definition of new_password uses the term list.

list:



new_password:

(ii) Explain whether Z3a is a valid new_password or not.

_____

_____

_____

_____ [2]

8 (a) **Computer architectures use registers including the accumulator.**

Describe TWO ways in which the accumulator is used.

1 _____

_____

_____

_____

2

_____

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_____

_____

[4]

(b) Low-level languages have features which include opcodes and mnemonics.

(i) Explain the term opcode.

_____

_____

_____

_____ **[2]**

(ii) Explain the term mnemonics, giving an example.

_____

_____

_____

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_____

_____ **[3]**

9 A company sells garden furniture. It has decided to create a relational database. A first, incomplete database design includes two tables PRODUCT and ORDER.

PRODUCT (ProductId, ProductType, Size, Price,…)
ORDER (OrderId, OrderDate, ProductId,…)

For example, the product which has ProductId 12345 is a large bench which has a price of £150.

(a) State ONE additional piece of data which should be included in PRODUCT and give ONE reason why it is needed.

_____

_____

_____

_____ **[2]**

(b) You should use only the data given above.

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

_____

_____

_____

_____ **[2]**

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

_____

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_____ **[4]**

(c) **A CUSTOMER table is added. An entity-relationship (E-R) diagram is shown.**

Explain why this design would be inefficient for customers.

_____

_____

_____

_____ **[2]**

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

```
SELECT Surname, Title, PhoneNo
FROM CUSTOMER
WHERE Town = "Coventry"
ORDER BY Surname
```

Describe the purpose of this code and give ONE situation in which it may be used.

[5]

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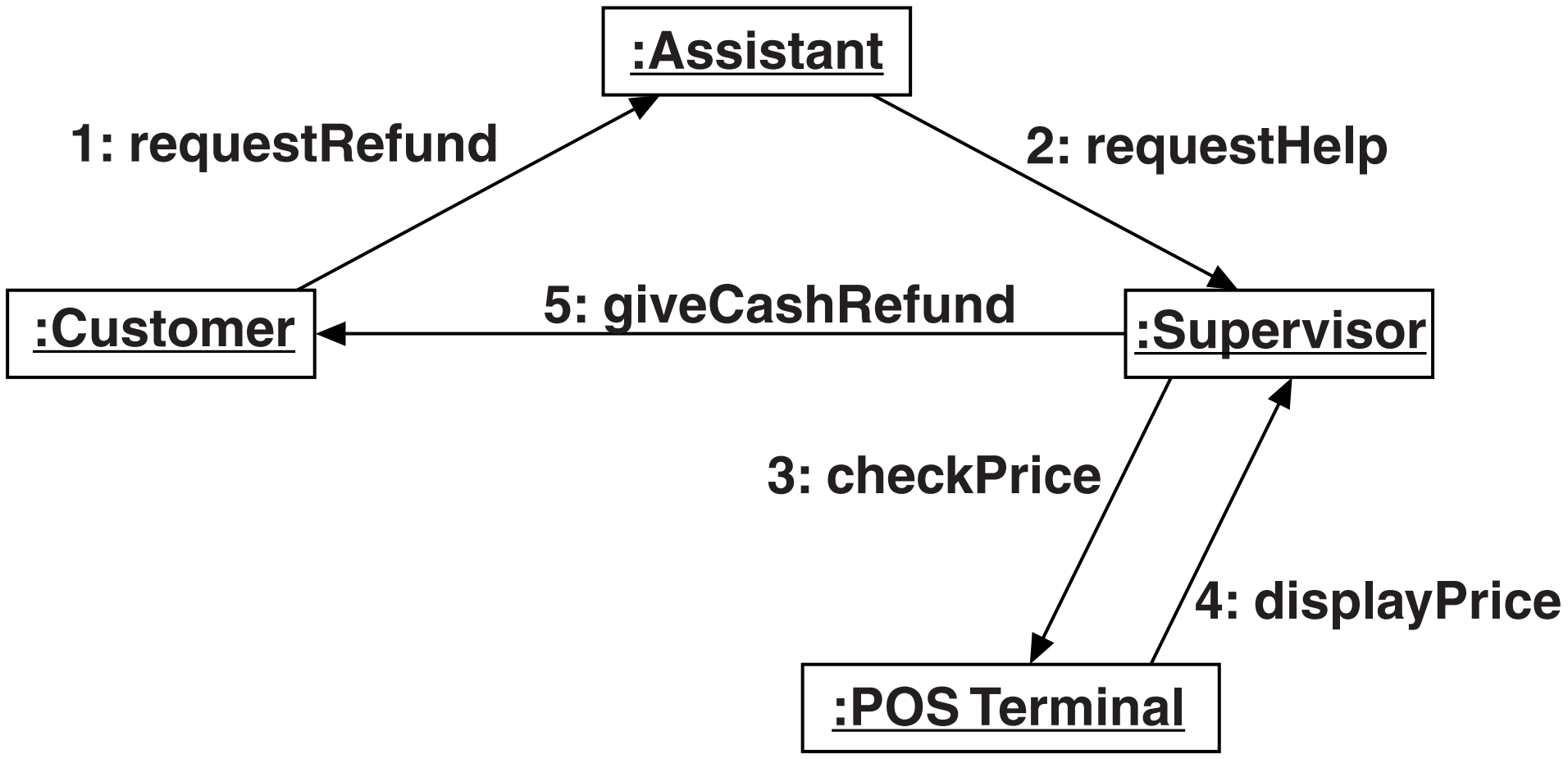
10 (a) A Unified Modelling Language (UML) diagram is used to show the process when a customer returns a faulty item to a shop.



(i) Describe the process shown in the diagram.

[3]

(ii) State TWO additional tasks that should be shown on the diagram.

1 _____

_____

2 _____

_____

[2]

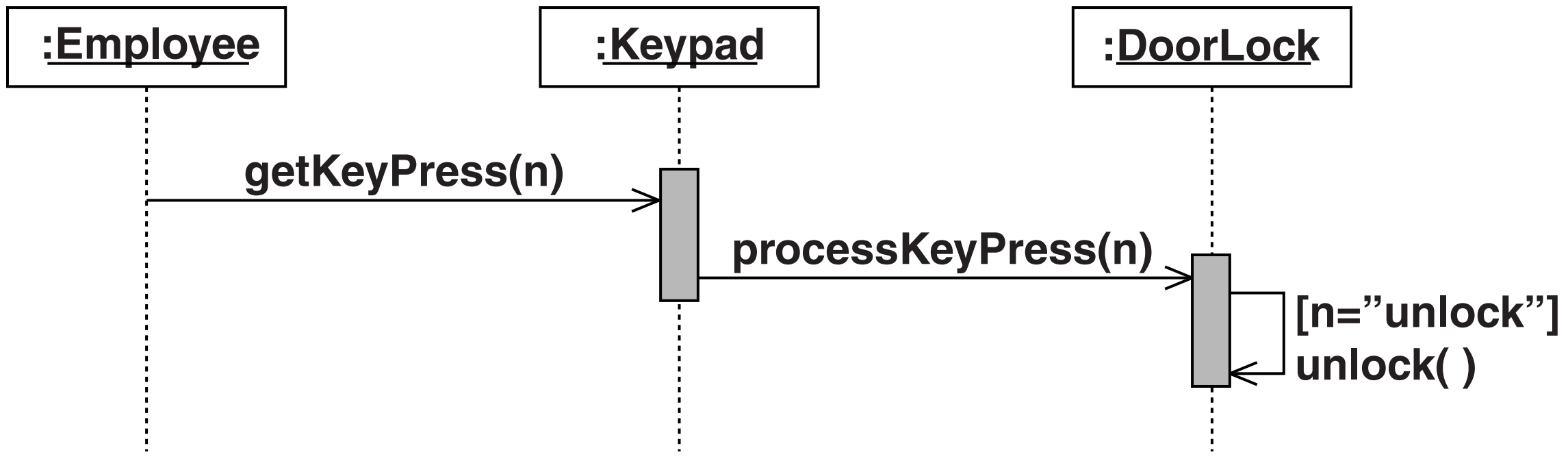
(b) The staff area of the shop has extra security. To enter this area, an employee must type a code on a keypad to unlock the door. This is shown on the sequence diagram opposite.

(i) Explain the rectangle labelled <u>:DoorLock</u>

[2]

(ii) Describe the purpose of the lifelines in this type of diagram.

[4]


:Employee
:Keypad
:DoorLock
getKeyPress(n)
processKeyPress(n)
[n=”unlock”]
unlock( )