Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				
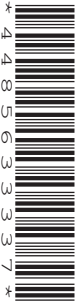
COMPUTING **9691/33**

Paper 3 **May/June 2015**

2 hours

Candidates answer on the Question Paper.

No additional materials are required.

No calculators allowed.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
No marks will be awarded for using brand names of software packages or hardware.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **20** printed pages.

Cambridge
International Examinations

[Turn over

1 A monthly magazine reviews new music releases.

Each music release has a title and a genre. The genre codes are as follows:

- J – Jazz
- P – Pop
- C – Classical

The magazine employs a number of people as reviewers. Reviewers are located all over the world. A reviewer is identified by a unique three-digit code.

A relational database is to store data for reviews which appear in the magazine.

The data stored for each review are:

- music title

- music genre

- release date

- month and year when the review appeared

The following table `REVIEWER` was a first attempt at the database design.

Table: `REVIEWER`

ReviewerID	Location	Title	Genre	ReleaseDate	ReviewDate
510	London	Hits 36	P	12/01/2015	01-15
		Cindy pop	P	26/03/2015	03-15
		Way out	P	11/06/2015	07-15
808	New York	Popular Bach	C	12/01/2015	02-15
		Ultimate Cole	J	31/01/2015	02-15
756	Dhaka	The Messiah	C	11/11/2014	11-14
		Hot Miles	J	02/02/2015	03-15
		Pine points	J	11/04/2015	05-15
		Kylie	P	11/04/2015	05-15

(a) (i) State why the table is not in First Normal Form (1NF).

....

....[1]

(ii) Comment on your answer by referring to the data in the table.

....

....[1]

(b) The design is changed so that there are two tables:

```
REVIEWER(ReviewerID, Location)

REVIEW(Title, Genre, ReleaseDate, ReviewDate, ReviewerID)
```

The primary keys are not shown.

(i) Using the data given in the original table, show the data now stored in table `REVIEWER`.

Table: `REVIEWER`

ReviewerID	Location

[1]

(ii) Using the data given in the original table, show **three** rows now stored in table `REVIEW`. The `ReviewerID` should be different for each row in the table.

Table: `REVIEW`

Title	Genre	ReleaseDate	ReviewDate	ReviewerID

[2]

(iii) Using the data given in the original table, how many rows would be in table `REVIEW`?

.... [1]

(iv) State the degree of relationship between `REVIEW` and `REVIEWER`.

....[1]

(v) Explain how the relationship in **part(b)(iv)** is implemented.

....

....

....[2]

[Turn over

(c) Each title is reviewed once only. The database designer decides to also store the reviewer's name.

A reviewer is paid a set fee for each review completed. The fee paid is determined by the music genre:

Genre	Fee($)
J	150
P	100
C	200

The following revised design for `REVIEW` is suggested:

```
REVIEW(Title, ReviewerID, ReviewerName, Genre, Fee,
                                    ReleaseDate, ReviewDate)
```

(i) State the primary key for this table.

....[1]

(ii) Explain why the `REVIEW` table is not in Third Normal Form (3NF).

....

....

....

....[2]

(iii) Currently the design is as follows:

```
REVIEWER(ReviewerID, Location)

   REVIEW(Title, ReviewerID, ReviewerName, Genre, Fee
                                    ReleaseDate, ReviewDate)
```

Re-design the solution to solve the issue in **part (c)(ii)**. Show all primary keys.

....

....

....

....[5]

Question 2 begins on page 6.

2 (a) Backus-Naur Form (BNF) is used to define programming language syntax.

State **one** other method used to define programming language syntax.

....[

(b) A firm sells a variety of products. Each product type has a single character code:

- W – White goods, such as a washing machine
- C – Computing
- B – Books
- H – Household

All products are stocked at one of two warehouses which are coded:

- N – New Delhi
- M – Mumbai

The following BNF rules define all possible product codes.

Rule number

```
1            <digit> ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
2      <producttype> ::= B | C | H | W
3         <location> ::= M | N
4      <digitstring> ::= <digit><digit><digit>
5      <productcode> ::= <producttype><digitstring><location>
```

(i) A BNF rule may be recursive.

What is meant by a recursive rule?

....

....[1]

(ii) For each statement below, state whether it is TRUE or FALSE.

Statement	TRUE or FALSE
None of the given rules are recursive	
Rule 4 is recursive	
Rule 5 is recursive	

[1]

(c) Circle whether or not each of the following sequences of characters is a valid pr
Show how you arrived at your answer by listing, in order, the rules used.

(i) `D175N`   Valid / Invalid (*circle*)

Rules ....

....

....

....

....

....

....[2]

(ii) `W058M`   Valid / Invalid (*circle*)

Rules ....

....

....

....

....

....

....

....[2]

(iii) `C86N`   Valid / Invalid (*circle*)

Rules ....

....

....

....

....

....

....[2]

[Turn over

3 **(a)** An IT company works on two types of project; software projects and the installa̶̶̶̶̶̶̶̶̶̶ area networks.

Software projects are either bespoke software for a particular client or off-the-shelf softw̶̶̶̶

Projects have recorded:
• project ID
• start date
• project leader

Off-the-shelf software projects have recorded:
• title
• current state of beta testing
  ○ N – not started
  ○ O – ongoing
  ○ C – completed
• anticipated retail price
• sales forecast for first year of sales (units)

Bespoke software projects have recorded:
• customer name
• agreed cost
• agreed delivery date

Software projects have recorded:
• programming language used
• current state of alpha testing
  ○ coded using the same three codes as for beta testing

Networking projects have recorded:
• client name
• agreed cost

This scenario is to be implemented using object-oriented programming.

Complete the class diagram using the classes:

Bespoke, Network, OffTheShelf, Project, Software.

Show properties only for the given data.

Project
ProjectID : STRING

[8]

[Turn over
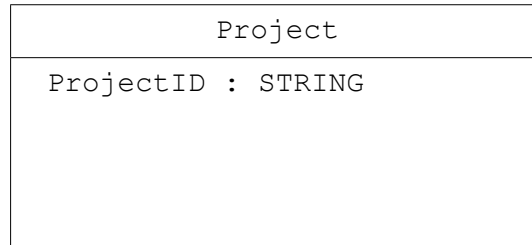
(b) Terminology for object-oriented programming and design includes the following t

Define the following terms:

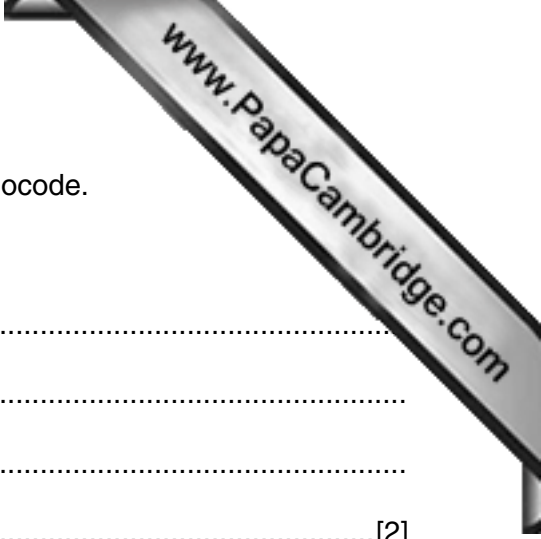**(i)** Class ....

....

....[1]

(ii) Inheritance ....

....

....[1]

(c) Part of the pseudocode for the object-oriented programming is shown below.

```
CLASS Project

    PRIVATE ProjectID : STRING

      <statements>

    PROCEDURE set_ProjectID()

      <statements>

    ENDPROCEDURE

    PROCEDURE get_ProjectID()

      <statements>

    ENDPROCEDURE

ENDCLASS


CLASS Network INHERITS Project

    <statements>

ENDCLASS


// Main program…

DECLARE ThisNetworkProject : Network

<statements>
```

Explain the following terms, with reference to the given pseudocode.

(i) Instance

....

....

....

....[2]

(ii) Method

....

....

....

....[2]

(iii) Encapsulation

....

....

....

....

....

....[3]

[Turn over

4 (a) Describe the operation of a stack data structure.

....

....[

A stack data structure is used to control the adding and removal of animal names.

The stack is implemented using the following data structure and variables.

Identifier	Data type	Description
Animal	ARRAY[0 : 99] OF STRING	Stores the animal names.
Index	INTEGER	Index pointer for the Animal array
StackPointer	INTEGER	Array index position of the item at the top of the stack. Value –1 indicates the stack is empty.
NewAnimal	STRING	Name of the new animal to be added to the Animal array.

(b) Complete the pseudocode procedure below to initialise the stack.

```
StackPointer ──▶ –1        Animal
                      0 │    " "    │
                      1 │    " "    │
                      2 │    " "    │
                      :
                      :
                     99 │    " "    │
```
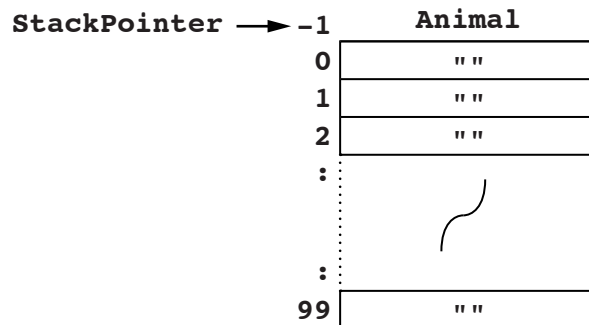
```
PROCEDURE InitialiseStack

    FOR Index ← 0 to 99

        Animal[.....................................................................................................] ← " "

    ENDFOR

    StackPointer ← .........................................................................................................

ENDPROCEDURE
```
[2]

(c) The diagram shows the state of the stack after the following operations:

- three values were added – BEAR, PANDA and CAMEL (in that order)
- a value was removed from the stack
- a new value APE was added

Animal

0	BEAR
1	PANDA
2	~~CAMEL~~ APE
3	" "
4	" "
5	" "
99	" "
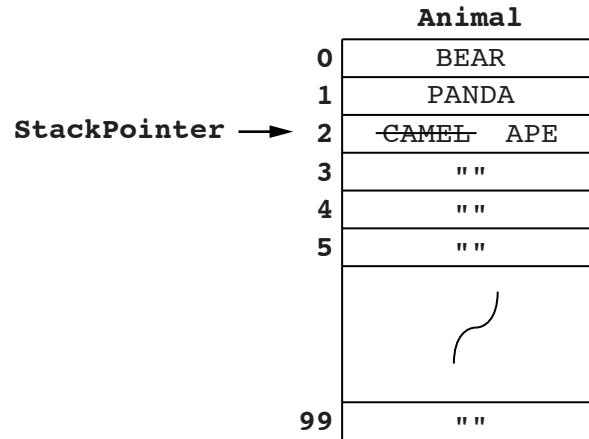
StackPointer → 2

 (i) State the current value of:

Animal[3]   ....

StackPointer - 1   ....   [2]

(ii) Adding a value to the stack is done with a procedure Push.

Shown below is the incomplete pseudocode for procedure Push.

Using the variables given, fill in the missing pseudocode.

```
PROCEDURE Push

   IF ..............................................................................................................................

     THEN

       OUTPUT "REFUSED – stack is full"

     ELSE

       INPUT ..................................................................................................

       StackPointer ← ..............................................................................

       ................................................................................... ← NewAnimal

   ENDIF

   ENDPROCEDURE                                                                                       [4]
```

[Turn over
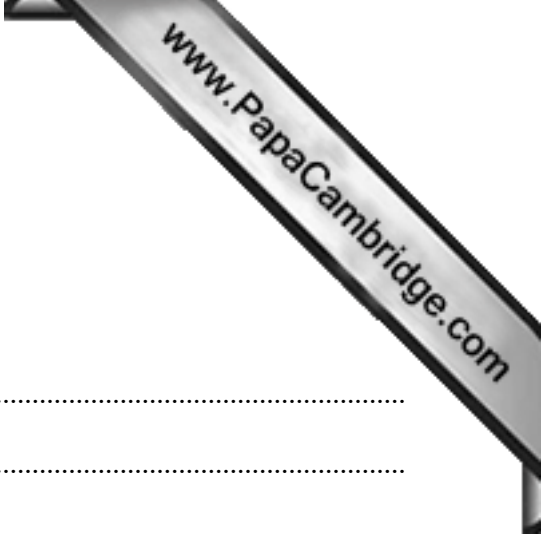
(d) Removal of a value is implemented with a procedure `Pop`.

Write pseudocode for the procedure `Pop`.

`PROCEDURE Pop`

....

....

....

....

....

....

....

`ENDPROCEDURE`

[4]

5 A computer system stores integers in a single byte using two's complement representation.

(a) State the denary integer represented by the following two bytes.

Give the hexadecimal representation of each integer.

(i)

1	1	1	0	1	0	0	1

Denary ....

Hexadecimal .... [2]

(ii)

0	1	1	0	1	0	1	1

Denary ....

Hexadecimal .... [2]

(iii) State the largest positive denary integer which can be represented.

....[1]

(iv) Why do computer scientists often write binary numbers in hexadecimal?

....

....[1]
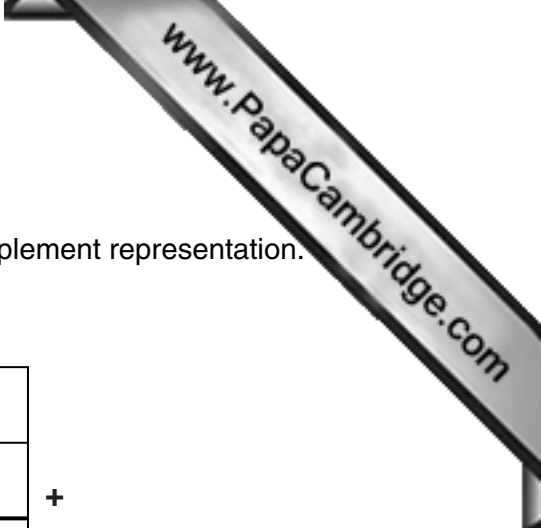
(b) The integers `99` and `29` are to be added.

Write the binary values for `99` and `29` below, using two's complement representation.

Show the binary addition calculation and the result.

99									
29									**+**

Comment on the result.

....

....[3]

(c) Integers can be represented in Binary Coded Decimal (BCD).

   (i) State what denary number is represented by this 2-byte BCD number.

0	0	0	1	0	1	0	1	0	1	1	1	1	0	0	0

   Denary ....   [1]

   (ii) A second BCD 2-byte number has been copied incorrectly.

1	0	0	1	1	1	0	1	0	1	0	1	0	0	0	0

   Without converting the whole pattern, how can you identify that this cannot be a valid BCD representation?

   ....

   ....

   ....[1]

[Turn over
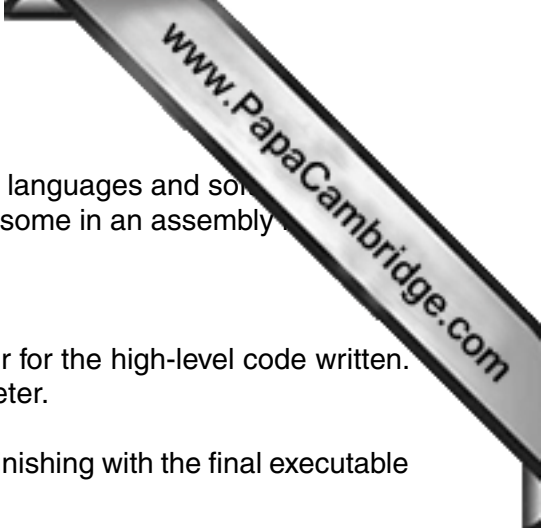
6 A team of programmers has developed software using a variety of languages and so[...]
Some of the code was written in the XYZ high-level language and some in an assembly [...]

The programmers have also made use of program libraries.

The programmers had available both a compiler and an interpreter for the high-level code written.
Some of the early error detection was carried out using an interpreter.

The diagram opposite shows the complete development life cycle finishing with the final executable code.

(a) State the type of diagram shown.

....[1]

(b) Use the following list to identify the labels 1 to 7 on the diagram opposite. Two of the items on the list will not be used.

- Assembler
- Compiler
- Code execution
- File allocation table (FAT)
- Linker
- Machine code
- On-screen error report
- Program library code
- Text editor

1 ....

2 ....

3 ....

4 ....

5 ....

6 ....

7 ....

[7]

XYZ program code

1

Source code

Interpreter

2

Assembly language code

XYZ program code

1

4

1

3

Error report

Error report

Intermediate code

Intermediate code

6

5

Object code

Loader

7

[Turn over
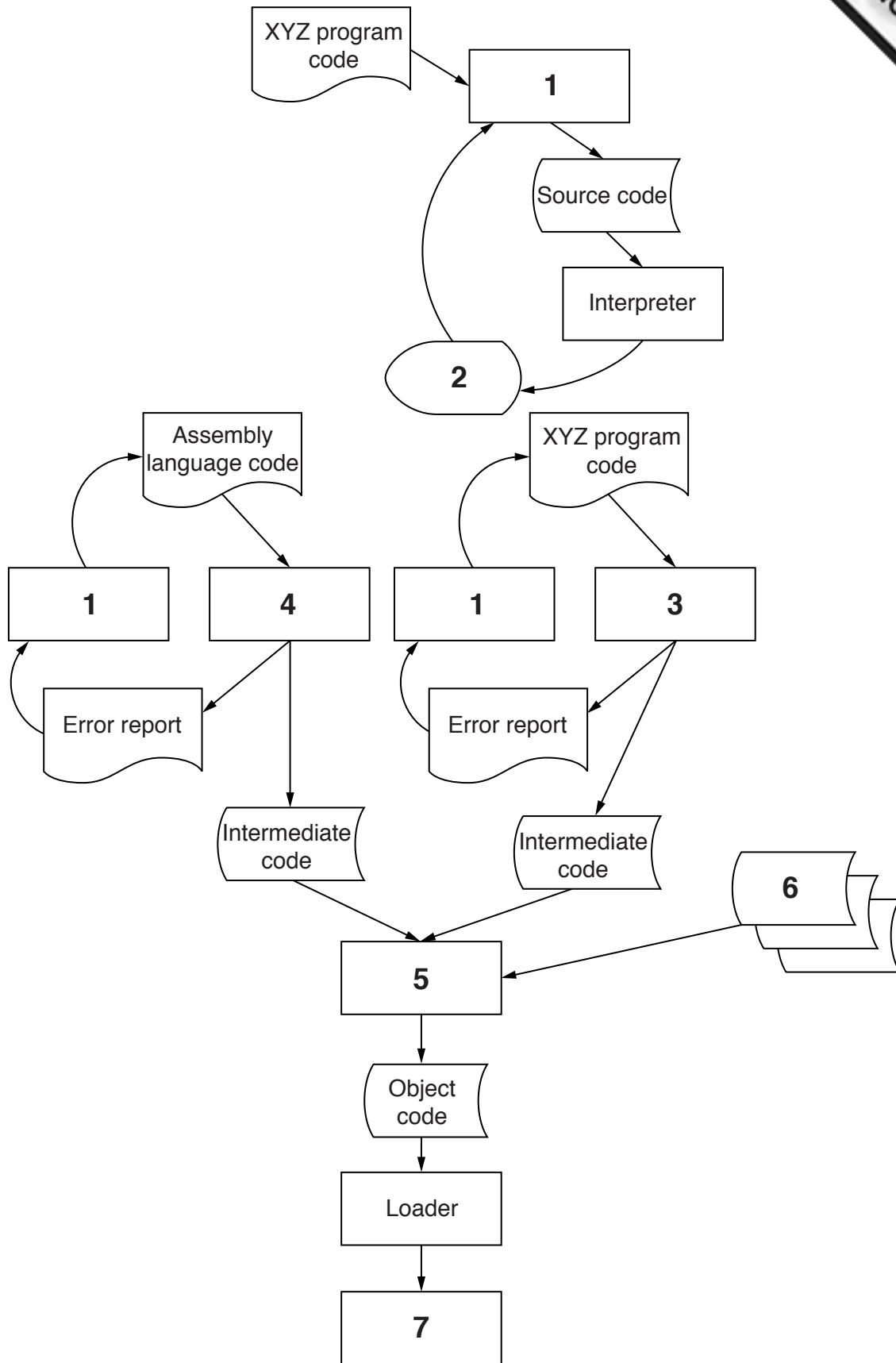
7 A small building company employs three staff in its office. They each work at a ~~separate~~ computer and each member of staff deals with a specific operation of the business:

- Computer A – Ordering of materials

- Computer B – Recording enquiries about jobs and producing quotations

- Computer C – Managing the accounts

At present, only Computer A has access to the Internet. Computer C has a laser printer attached.

The company is considering the introduction of a Local Area Network (LAN).

(a) The network is to have a bus topology.

Consider what additional hardware will be needed. This is to include a fourth computer which acts as a print server.

Sketch the layout of the LAN. Clearly label all items of hardware.

[5]

(b) The setting up of the LAN will require the purchase of additional software.

An essential item of software is a network operating system.

State **three** tasks performed by the network operating system.

1 ....

....

2 ....

....

3 ....

....
[3]

(c) The manager has suggested that once the LAN is operational, the company should introduce an intranet.

Describe what is meant by an intranet.

....

....

....[2]

[Turn over
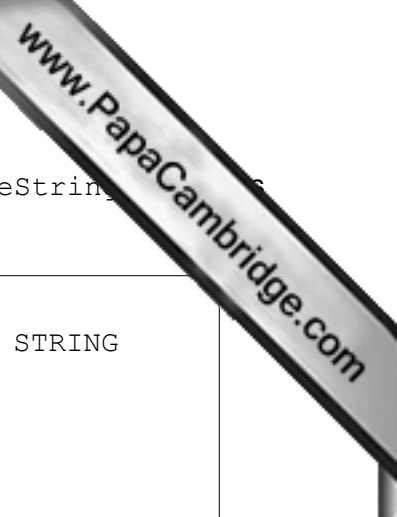
8 A high-level programming language has the following built-in function ChangeString as follows:

```
ChangeString(ThisString1 : STRING, ThisString2 : STRING)
                                                RETURNS STRING
```
will return the string value:
```
                ThisString2<Space>LEFT(ThisString1, 1)
```

For example:
```
ChangeString("Ben", "Pollard") will return "Pollard B"
```

If the function call is not properly formed an error is generated.

(i) State the function name and parameters for the above function.

Function name ....

Parameters ....

....[2]

State the value returned from the following function calls:

(ii) `ChangeString("Jim", "Ali")`

....[1]

(iii) `LENGTH(ChangeString("","Atzmon")`

....[1]

(iv) `ChangeString("81823", "JONES")`

....[1]