OXFORDAQA

INTERNATIONAL QUALIFICATIONS

INTERNATIONAL AS
COMPUTER SCIENCE

Unit 1 Programming

Specimen paper   07:00 GMT   Time allowed: 2 hours

Materials
For this paper you must have access to:
*   a computer
*   a printer
*   appropriate software
*   the Electronic Answer Document.

Information
*   The marks for questions are shown in brackets.
*   The maximum mark for this paper is 75.
*   You must print and collate this document immediately after the exam time ends.
*   The question paper is divided into **two** sections.
*   You may use a bilingual dictionary.
*   You must **not** use an English dictionary.
*   You may use a calculator.

Instructions
*   Type the information required on the front of your **Electronic Answer Document**.
*   Answer **all** questions.
*   Enter your answers for **Section A** into the **Electronic Answer Document**.
*   Include the evidence required for your answers to **Section B** in your **Electronic Answer Document**
*   Your programmed solutions to questions must use **C#**, **Python** or **VB.Net**..
*   Before the start of the examination make sure your **centre number**, **candidate name** and **candidate number** are shown clearly in the footer of every page (also at the top of the front cover) of your **Electronic Answer Document**.

Advice
You are advised to allocate time to each section as follows:
Section A – 20 minutes; **Section B** – 100 minutes.

At the end of the examination
Tie together all your printed **Electronic Answer Document** pages and hand them to the Invigilator.

Warning
It may not be possible to issue a result for this paper if your details are not on every page of your **Electronic Answer Document**.

Section A

You are advised to spend **20 minutes** on this section which is worth **15 marks**.

Type your answers to **Section A** in your Electronic Answer Document.

You **must save** this document at regular intervals.

| 0 | 1 | The incomplete structure chart in **Figure 1** shows the structure of a computer program used at a shop checkout. The program calculates the total cost of a customer's shopping.
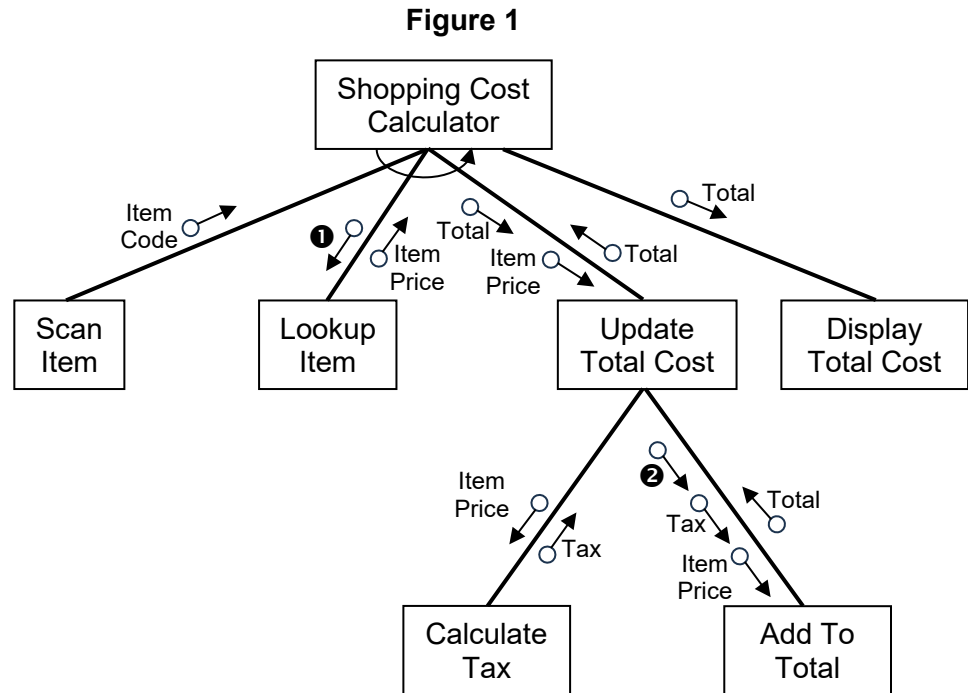
Figure 1

The labels on two of the arrows have been replaced by the symbols ❶ and ❷.

| 0 | 1 |.| 1 | State the label that should replace the symbol ❶ in **Figure 1**.

[1 mark]

| 0 | 1 |.| 2 | State the label that should replace the symbol ❷ in **Figure 1**.

[1 mark]

| 0 | 1 |.| 3 | State what the curved arrow below the top box means in **Figure 1**.

[1 mark]

| 0 | 2 | State **two** examples of work that you would expect to undertake during the analysis stage of software development.

[2 marks]

0 3 **Figure 2** shows pseudocode for an algorithm

Figure 2

```
numstr ← '10111'
result ← 0
val ← 1
position ← LEN(numstr) - 1
REPEAT
   IF numstr[position] = '1' THEN
      result ← result + val
   ENDIF
   val ← val × 2
   position ← position – 1
UNTIL position = -1
OUTPUT result
```

0 3 . 1 Complete the unshaded cells in **Table 1** to show the result of tracing the algorithm shown in **Figure 2**.

You may not need to use all of the rows in the table.

Table 1

numstr	result	val	position
10111	0	1	4
	1	2	3
	3	4	2
	7	8	1
	7	16	0
	23	32	-1

Copy the contents of the unshaded cells in **Table 1** into the table in your Electronic Answer Document.

[4 marks]

0 3 . 2 State the purpose of the algorithm in **Figure 2**.

[1 mark]

0 4 Describe the process that should be followed to add an item to a circular queue implemented as a static data structure using a one-dimensional array.

Your method should deal appropriately with any issues which could arise.

[5 marks]

Turn over ►

Section B

You are advised to spend **100 minutes** on this section which is worth **60 marks**.

Enter your answers in your Electronic Answer Document.

Ensure that the code and test evidence entered into your Electronic Answer Document are big enough to allow the examiner to read them.

You **must save** this document and your programs at regular intervals.

0 5 Students are awarded a level after they complete a test.

The level is based on the percentage score that the student achieved, using the criteria in **Table 2**.

Table 2

Percentage score	Level
80 to 100	Distinction
60 to 79	Merit
40 to 59	Pass
0 to 39	Fail

Task 1

Write a program that asks the user to enter a student's percentage score and then displays the level to award to the student, based on the criteria in **Table 2**.

Task 2

Add a check to your program so that if the user enters a percentage score below 0 or above 100 the message `Invalid percentage` is displayed and the user is asked to enter a new score. This should repeat until the user enters a score in the range 0 to 100.

Task 3

Add a check to your program so that if the user enters some text into the program instead of a number the message `Not a number` is displayed and the user is asked to enter a new score. This should repeat until the user enters a score that is a number.

Test

Test your program by entering the following four values.

- 84
- 60
- 120
- Hippo

You will need to run your program more than once to perform the tests.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

| 0 | 5 | . | 1 |

Your PROGRAM SOURCE CODE for your entire program.

[8 marks]

| 0 | 5 | . | 2 |

The output produced when you carry out the **four** tests.

This must include the values entered and the output displayed.

[1 mark]

Turn over for the next question

Turn over ►

0 6 A school makes identification codes for its students using their names and a random number.

An identification code for a student consists of:

- the first two letters of the student's forename, followed by
- the first and last letters of the student's surname, followed by
- a random three-digit number.

For example, a student who had the forename ARIN and the surname PATEL could be given the identification code ARPL396. The letters AR and PL are taken from the student's forename and surname and the number 396 is generated randomly.

Write a program that asks a student to enter their forename and surname and then generates an identification code for the student using the method described above.

When the program ends the identification code should be displayed on screen and stored in a variable named `idcode`

You may assume that the entered forename and surname are always in capital letters and are at least two characters long.

Test

Test your program by entering the following values for a forename and surname:

- Forename: DYLAN
- Surname: WINSER

Evidence that you need to provide
Include the following in your Electronic Answer Document.

0 6 . 1 Your PROGRAM SOURCE CODE for your entire program.

[8 marks]

0 6 . 2 The output produced when you carry out the test.

This must include the values entered and the output displayed.

[1 mark]

Turn over for the next question

Turn over ▶

0 7 A translator program lets a user type in a word in English and displays the Spanish word that has the same meaning.

Table 3 shows seven English words and the Spanish words with the same meaning.

Table 3

English word	Spanish equivalent word
apple	manzana
cat	gato
food	alimento
moon	luna
paint	pintar
school	escuela
water	agua

Task 1

Create suitable data structure(s) to store the English words and their Spanish equivalent words, as shown in **Table 3**.

Task 2

Write code that lets the user enter an English word.

Your program should then use the **binary search** algorithm to search your data structure(s) and display the equivalent Spanish word.

If the word entered by the user is not in **Table 3** then the message `Word not known` should be displayed.

If you use a method other than binary search to find the equivalent Spanish word you will be able to achieve some but not all of the marks for the question.

You must write your own code to perform the binary search, you must not use a built-in or library function to do this.

You may assume that the entered English word is always in lower case.

Programming Language Specific Advice

If you are using **Python** or **VB.Net** you can use the $>$ and $<$ operators to compare two strings.

If you are using **C#** you can use the `CompareTo` method to compare two strings. It returns:
- -1 if the first string is less than the second
- 0 if the first string is equal to the second
- 1 if the first string is greater than the second.

Test

Test your program by searching for the Spanish equivalent words for the following English words:

- moon
- cat
- paint
- ball

You will need to run your program more than once to perform the tests.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

0 7 . 1   Your PROGRAM SOURCE CODE for your entire program.

[11 marks]

0 7 . 2   The output produced when you carry out the **four** tests.

This must include the values entered and the output displayed for each of the **four** words.

[1 mark]

Turn over for the next question

Turn over ▶

0 8 The least-frequent number in a list of numbers is the number that appears the fewest times. For example, in the list:

7, 6, 5, 3, 7, 5, 6, 6

3 is the least-frequent number as it only appears once and the other numbers all appear more than once.

Some lists have more than one least-frequent number. For example, in the list:

1, 4, 8, 2, 4, 2, 1, 4, 4, 8, 1

8 and 2 are both least-frequent numbers as they both appear twice whilst 1 appears three times and 4 appears four times.

Task

Write a program to find and display the least-frequent number in a list together with how many times the least-frequent number appears in the list.

The program should ask the user how many numbers are in the list and then get the user to type in that many numbers.

The program should then display the least-frequent number in the list and how many times it appears.

If there is more than one least-frequent number in the list then the program should display the message `More than one least-frequent number` instead of displaying the numbers.

You may assume that the list will only contain single-digit numbers, ie the numbers 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9

Test

Test your program using the following two lists:

- the six-item list: 5, 3, 4, 5, 4, 5

- the seven-item list: 8, 2, 2, 7, 8, 7, 8

You may enter the lists as individual values into your program.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

0 8 . 1 Your PROGRAM SOURCE CODE for your entire program.

[12 marks]

0 8 . 2 The output produced when you carry out the **two** tests.

This must include the values entered and the output displayed.

[1 mark]

Turn over for the next question

Turn over ▶

0 9 Encryption is the process of converting plaintext into ciphertext so that it cannot be understood without knowing the key and method used to encrypt it.

Decryption is the process of converting ciphertext back into plaintext so that it can be understood.

The Caesar cipher encrypts messages by shifting letters along the alphabet by a number of positions specified by the key. For example, if the key is 4 then letters are shifted four positions along the alphabet.

Table 4 shows how each letter is encrypted and decrypted using the Caesar cipher with a key of 4.

Table 4

Plaintext	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Ciphertext	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D

- Using a key of 4 the word CAT would be encrypted to the ciphertext GEX.
- Using a key of 4 the ciphertext XSC would be decrypted to TOY.

In this question **some marks will be awarded for structuring your program code into appropriate subroutines with parameters and return values, where appropriate.**

Task 1

Write a program that can encrypt and decrypt messages using the Caesar cipher.

The program should display a menu with four options:

- Input key
- Encrypt message
- Decrypt message
- Exit

After the user has selected and used a menu option, the menu should be redisplayed so that they can choose another option.

When the user selects the **Input key** option the program should ask the user to enter the key that will be used for encrypting and decrypting. The key will be a number between 1 and 25.

When the user selects the **Encrypt message** option the program should ask the user to enter a message to encrypt (the plaintext) and should then display the encrypted message (the ciphertext).

When the user selects the **Decrypt message** option the program should ask the user to enter a message to decrypt (the ciphertext) and should then display the decrypted message (the plaintext).

One method that could be used to encrypt and decrypt messages is to convert the characters in the message into their character codes, but you may use any method that you like to encrypt and decrypt. The character codes of the capital letters are shown in **Table 5** to help you.

Table 5

Letter	A	B	C	D	E	F	G	H	I	J	K	L	M
Character code	65	66	67	68	69	70	71	72	73	74	75	76	77

Letter	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Character code	78	79	80	81	82	83	84	85	86	87	88	89	90

You may assume that all messages consist only of capital letters and that the user will always enter a key value that is a whole number in the range 1 to 25.

Task 2

The Caesar cipher can be cracked easily, which means that encrypted messages can be read without knowing the key.

As there are only 25 useful keys, one way to read a message encrypted using the Caesar cipher is to take the encrypted message and decrypt it using each of the possible 25 keys (the numbers 1 to 25). One of the 25 decryptions of the ciphertext will be the correct plaintext.

Add an additional option to your menu that can be used to crack a message encrypted using the Caesar cipher. When the option is selected the user should be asked to enter the encrypted message. The program should then display all 25 possible decryptions of the message.

Test

Test your program by:

- Encrypting the message PLUM using a key of 4, which should output the ciphertext TPYQ
- Decrypting the ciphertext UDLUXJ using a key of 6, which should output the plaintext OXFORD
- Cracking the ciphertext WIGJONYL by displaying all 25 possible decryptions of it

Evidence that you need to provide
Include the following in your Electronic Answer Document.

0 9 . 1 Your PROGRAM SOURCE CODE for your entire program.

[15 marks]

0 9 . 2 The output produced when you carry out the **three** tests.

This must include the values entered and the output displayed.

[2 marks]

END OF QUESTIONS