0 1 Write a program that gets **two** words from the user and then displays a message saying if the first word can be created using the letters from the second word or not.

For example:

- The word EAT can be formed from the word ATE as the first word uses one E, one A and one T and the second word also contains one of each of these letters.
- The word EAT can be formed from the word HEART as the second word contains one E, one A and one T which are the letters needed to form the first word.
- The word TO can be formed from the word POSITION as the second word contains one T and (at least) one O which are the letters needed to form the first word.
- The word MEET cannot be formed from the word MEAT as the second word only contains one E and two Es are needed to form the first word.

You may assume that the user will only enter words that consist of upper case letters.

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

0 1 . 1 Your PROGRAM SOURCE CODE.

[12 marks]

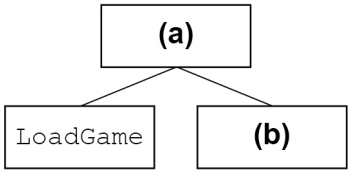
0 1 . 2 SCREEN CAPTURE(S) showing the result of testing the program by entering:

- the word NINE followed by the word ELEPHANTINE.
- the word NINE followed by the word ELEPHANT.

[1 mark]

0 2 **Figure 7** shows an incomplete hierarchy chart for part of the Skeleton Program.

Figure 7



0 2 . 1 Explain the difference between a local variable and a global variable.

[1 mark]

0 2 . 2 State **one** reason why it is considered to be good practice to use local variables.

[1 mark]

0 3 Write a program that asks the user how many numeric digits they would like to enter and then gets the user to enter that number of numeric digits.

The program should calculate and display the number of times the most frequently entered numeric digit was input.

> **Example**
>
> If the user says they are going to enter four digits and then enters the digits 3, 4, 5 and 3, the program should display the value 2 as the most frequently entered digit was 3 and that digit was entered twice.

If more than one numeric digit had the same frequency and was the most frequently entered then instead of displaying the frequency, a message saying "`Data was multimodal`" should be displayed.

A numeric digit is 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9

You may assume that the number that the user enters to state how many numeric digits there will be and the numeric digits entered by the user are all valid.

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

0 3 . 1 Your PROGRAM SOURCE CODE.

[12 marks]

0 3 . 2 SCREEN CAPTURE(S) showing the result of testing the program by entering:

- the number 6 then the numeric digits 0, 1, 2, 1, 2 and 1
- the number 5 then the numeric digits 0, 1, 2, 2 and 1

[1 mark]

Figure 3 (repeated)

```
SUBROUTINE Traversal(StartNode)
  Current ← StartNode
  Pos ← 0
  Stack[Pos] ← Current
  WHILE Pos ≠ -1
    Current ← Stack[Pos]
    Pos ← Pos - 1
    OUTPUT Data[Current]
    IF Dir2[Current] ≠ -1 THEN
      Pos ← Pos + 1
      Stack[Pos] ← Dir2[Current]
    ENDIF
    IF Dir1[Current] ≠ -1 THEN
      Pos ← Pos + 1
      Stack[Pos] ← Dir1[Current]
    ENDIF
  ENDWHILE
ENDSUBROUTINE
```

0 4 . 1 The subroutine shown in **Figure 3** could have been written so that it used recursion instead of iteration.

Explain what is meant by a recursive subroutine.

[1 mark]

0 4 . 2 Explain what is meant by a base case for a recursive subroutine.

[1 mark]

0 4 . 3 If the subroutine shown in **Figure 3** had been written using recursion, a stack frame would have been stored each time a recursive subroutine call was made.

State **two** components of a stack frame.

[2 marks]

0 5 A Harshad number is a positive integer which is exactly divisible by the sum of its digits. The first twelve Harshad numbers are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 and 18

- 36 is a Harshad number. The digits of 36 are 3 and 6; the sum of these digits is 9 as 3 + 6 = 9 and 36 is exactly divisible by 9 (36 ÷ 9 = 4)
- 300 is a Harshad number. The digits of 300 are 3, 0 and 0; the sum of these digits is 3 as 3 + 0 + 0 = 3 and 300 is exactly divisible by 3 (300 ÷ 3 = 100)
- 15 is not a Harshad number. The digits of 15 are 1 and 5; the sum of these digits is 6 as 1 + 5 = 6 and 15 is not exactly divisible by 6

Write a program that asks the user to enter a number, *n*, and will then calculate and display the *n*th Harshad number.

Example

If the user enters the number 12 then the program should calculate and display the twelfth Harshad number. The twelfth Harshad number is 18

You may assume that the number that the user enters will be a positive integer.

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

0 5 . 1 Your PROGRAM SOURCE CODE.

[12 marks]

0 5 . 2 SCREEN CAPTURE(S) showing the result of testing the program by entering the number `600`

[1 mark]

0 6 **Figure 2** shows a logic puzzle.

Figure 2

Which one of these six statements is correct?

Statement 1: All of the statements below are correct.

Statement 2: None of the statements below are correct.

Statement 3: All of the statements above are correct.

Statement 4: Exactly one of the statements above is correct.

Statement 5: None of the statements above are correct.

Statement 6: None of the statements above are correct.

0 6 . 1 Explain why Statement 1 is not correct.

[1 mark]

0 6 . 2 Which one of the six statements in **Figure 2** is correct?

[1 mark]

0 6 . 3 For **two** statements other than Statement 1 and your answer to Question **06.2**, explain why those statements are not correct.

[2 marks]

Figure 3 shows a subroutine represented using pseudo-code. The subroutine makes use of an array `Visited` and an array `ConnectedNodes` that stores a graph represented as an adjacency list.

Figure 3

```
FUNCTION G(V, P)
  Visited[V] ← True
  FOR EACH N IN ConnectedNodes[V]
    IF Visited[N] = False THEN
      IF G(N, V) = True THEN
        RETURN True
      ENDIF
    ELSE IF N ≠ P THEN
      RETURN True
    ENDIF
  ENDFOR
  RETURN False
ENDFUNCTION
```

0 7 . 1 The subroutine `G` uses recursion.

Explain what is meant by a recursive subroutine.

[1 mark]

0 8 Write a program that asks the user to enter a string. It should then change the order of the vowels in the string and display the result.

If there are *n* vowels in the string, the 1st vowel in the string should swap with the *n*th vowel in the string, the 2nd vowel in the string should swap with the (*n-1*)th vowel in the string, and so on.

The letters `a`, `e`, `i`, `o` and `u` are the only vowels.

Examples

If the user enters the string `horse` then the program should display the string `herso`.

If the user enters the string `goose` then the program should display the string `geoso`.

If the user enters the string `pinkfairyarmadillo` then the program should display the string `ponkfiaryarmidalli`.

If the user enters the string `nakedmolerat` then the program should display the string `nakedmolerat`.

If the user enters the string `lynx` then the program should display the string `lynx`.

If the user enters the string `pig` then the program should display the string `pig`.

You may assume the string that the user enters will only contain lowercase letters.

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

0 8 . 1 Your PROGRAM SOURCE CODE.

[12 marks]

0 8 . 2 SCREEN CAPTURE(S) showing the results of three tests of the program by entering the strings `persepolis`, `darius` and `xerxes`.

[1 mark]

0 9 This question is about the `CardCollection` class.

The `CardCollection` class uses a list to store the cards.

0 9 . 1 A hash table can be used to implement a dictionary data structure.

Explain why a hash table is a suitable choice.

[1 mark]

1 0 **Figure 1** shows a logic puzzle.

Figure 1

The following five coloured shapes are placed on a table.

Image of coloured shapes not reproduced here due to third party copyright restrictions.

Tabitha secretly chooses one of the coloured shapes and:

- tells Walter the colour of the shape she has chosen (pink, yellow or blue)
- tells Lionel the type of shape she has chosen (triangle, circle or square).

Lionel and Walter both know what coloured shapes are on the table.

Lionel knows that Walter has been told the colour chosen by Tabitha.
Walter knows that Lionel has been told the type of shape chosen by Tabitha.
They do not know what the other has been told.

Tabitha first asks Walter and Lionel if they know which coloured shape she has chosen. They both answer at the same time and say "No".

Tabitha then asks them again if they know which coloured shape she has chosen. They both answer at the same time and say "No" again.

Tabitha asks them a third time if they know which coloured shape she has chosen and they both answer at the same time and say "Yes".

1 0 . 1 After they have both replied to Tabitha's **first** question, what does Lionel now know about Tabitha's choice because Walter said "No"?

[1 mark]

1 0 . 2 After they have both replied to Tabitha's **first** question, what does Walter now know about Tabitha's choice because Lionel said "No"?

[1 mark]

1 0 . 3 Which coloured shape had Tabitha chosen?

[1 mark]

1 1 Write a program that gets the user to enter a string. It should keep getting the user to enter a string until they enter a valid string. Each time they enter a string an appropriate message should be displayed telling them whether the string they entered is valid or not.

For a string to be valid:

- it must be between five and seven characters in length (inclusive)
- it must consist only of uppercase letters
- it must contain only unique characters (ie no character appears in the string more than once)
- the sum of the ASCII codes of the characters in the string must be between 420 and 600 (inclusive).

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

1 1 . 1 Your PROGRAM SOURCE CODE

[12 marks]

1 1 . 2 SCREEN CAPTURE(S) showing the results of testing the program by entering the strings `BOIL`, `BRAisE`, `ROAST`, `BLANCH` and `PRESSURECOOK`. You will need to execute your program more than once to test all of the strings.

[1 mark]

1 2 State **three** advantages of using subroutines.

For each advantage, you must explain how the advantage is achieved.

[3 marks]

1 3 Write a program that gets the user to enter an integer. It should keep doing this until they enter a value greater than 0.

The program should then tell the user if they have entered a perfectly bouncy number, a bouncy number or a number that is not bouncy.

A **bouncy number** is a number that is not an increasing number and not a decreasing number.

An **increasing number** is one where each digit is greater than or equal to the previous digit in the number.

A **decreasing number** is one where each digit is less than or equal to the previous digit in the number.

A **perfectly bouncy number** is a bouncy number in which the number of digits that are followed by a larger digit is equal to the number of digits that are followed by a smaller digit.

Examples

- 13578 is not a bouncy number because it is an increasing number.
- 973 is not a bouncy number because it is a decreasing number.
- 98657 is a bouncy number.
- 1111 is not a bouncy number because it is both an increasing number and a decreasing number.
- 13421 is a perfectly bouncy number as exactly two digits are followed by a larger digit and there are also exactly two digits followed by a smaller digit.
- 1829361 is a perfectly bouncy number as exactly three digits are followed by a larger digit and there are also exactly three digits followed by a smaller digit.
- 13333331 is a perfectly bouncy number as there is exactly one digit followed by a larger digit and also exactly one digit followed by a smaller digit.

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

13.1 Your PROGRAM SOURCE CODE

[12 marks]

13.2 SCREEN CAPTURE(S) showing the results of testing the program by entering the integers:

- −3
- 14982
- 1234

You will need to execute your program more than once to test all of the integers.

[1 mark]

1 4 This question is about the `Puzzle` class.

The `DisplayPuzzle` method uses concatenation.

1 4 . 1 Explain what is meant by concatenation.

[1 mark]