AQA

Please write clearly in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________
I declare this is my own work.

GCSE
COMPUTER SCIENCE

Paper 1 Computational thinking and programming skills – Python

Wednesday 15 May 2024 Afternoon Time allowed: 2 hours

Materials
- There are no additional materials required for this paper.
- You must **not** use a calculator.

Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Questions that require a coded solution must be answered in Python.
- You should assume that all indexing in code starts at 0 unless stated otherwise.

Information
The total number of marks available for this paper is 90.

For Examiner's Use	
Question	Mark
1	
2–3	
4–5	
6–7	
8–9	
10–11	
12	
13–14	
15	
TOTAL	

Advice

For the multiple-choice questions, completely fill in the lozenge alongside the appropriate answer.

CORRECT METHOD ● WRONG METHODS ⊗ ⊙ ≋ ✓

If you want to change your answer you must cross out your original answer as shown. ☒

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. ⊗

IB/G/Jun24/G4005/E11

Answer **all** questions.

0 1 **Figure 1** shows an algorithm, represented using pseudo-code.

The algorithm assigns different values to two variables, then asks the user to input a letter.

Figure 1

```
film ← "Godzilla vs. Kong"
year ← 2021
OUTPUT "Please guess a letter"
letter ← USERINPUT
```

0 1 . 1 Which pseudo-code statement assigns the length of the string `film` to a variable called `value`?

Shade **one** lozenge.

[1 mark]

A `film ← LEN(value)` ○

B `film ← film + value` ○

C `value ← film` ○

D `value ← LEN(film)` ○

0 1 . 2 The `POSITION` subroutine returns the position of the first occurrence of a character in a string.

For example:

- `POSITION("Godzilla vs. Kong", "o")` would return `1`
- `POSITION("Godzilla vs. Kong", "z")` would return `3`

`letter` and `film` are variables used in the algorithm in **Figure 1**.

Complete the pseudo-code statement to find the position of the first occurrence of the contents of `letter` in `film` and store this position in the variable `location`

You **must** use the `POSITION` subroutine in your answer.

[1 mark]

`location ←` ______________________________

____

0 1 . 3 Which of the following would be the most suitable data type for the variable `year`?

Shade **one** lozenge.

[1 mark]

A Boolean ○

B character ○

C integer ○

D real ○

0 1 . 4 Describe what is meant by an assignment statement in a program.

[1 mark]

Question 1 continues on the next page

0 1 . 5 Write a Python program that:

- gets the user to enter the name of a film
- displays `You entered` followed by the name of the film entered by the user.

The output from the program **must** be on one line.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code accurately.

[2 marks]

6

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

0 2 **Figure 2** shows an algorithm, represented using pseudo-code.

- Line numbers are included but are not part of the algorithm.

Figure 2

```
1     num ← USERINPUT
2     IF NOT(num > 1) OR num > 20 THEN
3        OUTPUT "False"
4     ELSEIF num > 1 AND num < 15 THEN
5        OUTPUT "Almost"
6     ELSEIF num MOD 5 = 0 THEN
7        OUTPUT "True"
8     ELSE
9        OUTPUT "Unknown"
10    ENDIF
```

The modulus operator is used to calculate the remainder after dividing one integer by another.

For example:

- `14 MOD 3` evaluates to `2`
- `24 MOD 5` evaluates to `4`

0 2 . 1 Where is a relational operator **first** used in the algorithm in **Figure 2**?

Shade **one** lozenge.

[1 mark]

A Line number 1 ○

B Line number 2 ○

C Line number 3 ○

D Line number 6 ○

0 2 . 2 In the algorithm in **Figure 2**, what will be the output when the user input is `5`?

Shade **one** lozenge.

[1 mark]

A `Almost` ○

B `False` ○

C `True` ○

D `Unknown` ○

0 2 . 3 Which value input by the user would result in `True` being output by the algorithm in **Figure 2**?

Shade **one** lozenge.

[1 mark]

A `-1` ○

B `10` ○

C `20` ○

D `21` ○

0 2 . 4 Rewrite **line 2** from the algorithm in **Figure 2 without** using the `NOT` operator.

The algorithm must still have the same functionality.

[1 mark]

0 2 . 5 A user inputs a value into the algorithm in **Figure 2**.

State **one** value that the user could input that would result in an output of `Unknown`

[1 mark]

0 3 **Figure 3** shows an incomplete Python program for a number guessing game.

- Line numbers are included but are not part of the program.

Figure 3

```
1      import random
2
3      print("Enter a number")
4      userNumber = int(input())
5      while userNumber < 1 or userNumber > 100:
6         print("Invalid number")
7         userNumber = int(input())
8      print("Valid number entered")
9      if randomNumber == userNumber:
10        print("Number guessed correctly")
```

0 3 . 1 The program should generate a random number between 1 and 100 (including 1 and 100). This will be the number the user has to guess.

Write the Python code that should be used on **line 2** in **Figure 3** to:
- generate a random number between 1 and 100 inclusive
- assign this number to the appropriate variable from the program.

You **must** use `random.randrange(a, b)` in your Python code.

`random.randrange(a, b)` generates a random integer in the range `a` to `b` starting at `a` but finishing one before `b`

[2 marks]

0 3 . 2 Complete the test plan in **Table 1** to test the validation of `userNumber` in the program in **Figure 3**.

[2 marks]

Table 1

Test number	**Test type**	**Test data**	**Expected result**
1	Erroneous	`150`	
2	Boundary		
3	Normal		`Valid number entered`

0 3 . 3 In an earlier version of the program in **Figure 3**, **line 5** contained one syntax error and one logic error:

```
whil userNumber < 1 or userNumber >= 100:
```

Complete the table to describe the errors in the program on **line 5**.

[2 marks]

Error type	**Description**
Syntax error	
Logic error	

11

Turn over ►

0 4 . 1 Define the term **abstraction**.

[1 mark]

0 4 . 2 State the name for the process of breaking a problem down into sub-problems.

[1 mark]

0 5 **Figure 4** shows an algorithm, represented using pseudo-code.

The algorithm calculates the total cost of hiring a hotel for a wedding.

Figure 4

```
numberOfGuests ← USERINPUT
numberOfRooms ← USERINPUT
charge ← 25
IF numberOfGuests > 50 THEN
   totalCost ← numberOfGuests * 2
ELSE
   IF numberOfGuests ≥ 25 THEN
      totalCost ← numberOfGuests * 4
   ELSE
      totalCost ← numberOfGuests * 5
   ENDIF
ENDIF
totalCost ← totalCost + (numberOfRooms * 100)
IF totalCost < 1400 THEN
   totalCost ← totalCost + charge
ENDIF
OUTPUT totalCost
```

Complete the table below using the algorithm in **Figure 4**.

[3 marks]

Input value for `numberOfGuests`	**Input value for** `numberOfRooms`	**Output**
50	30	
20	10	
500	5	

5

Turn over ►

0 6 A university is writing a program to calculate a student's total mark for three essays.

If any essays are handed in late, the total mark is reduced.

Write a Python program to calculate the total mark.

You should assume there are three integer variables called `e1`, `e2` and `e3` which have already been given values to represent the marks of the three essays.

The program should:

- get the user to enter the number of essays handed in late and store the number in a variable
- calculate the total mark for the three essays
    - if only one essay is handed in late, the total mark is reduced by 10
    - if more than one essay is handed in late, the total mark should be halved
    - the total mark should **not** be less than 0
- output the total mark.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code.

[7 marks]

Turn over for the next question

0 7 A shop owner wants to create stock codes for each type of sweet they sell.

Figure 5 shows some of the sweets.

Figure 5

sweetID	**sweetName**	**brand**
S1	WINE GUMS	MAYNARDS
S2	COLA CUBES	BERRYMANS
S3	STARBURST	WRIGLEY

A stock code is made up of the:
- `sweetID`
- first letter and the second letter in `sweetName`
- first letter of the `brand`

For example:
- the stock code for `WINE GUMS` would be `S1WIM`
- the stock code for `STARBURST` would be `S3STW`

Write a Python program to create the stock code for a sweet.

The program should:
- get the user to enter the `sweetID`, `sweetName` and `brand`
- create the stock code
- assign the stock code to a variable called `code`

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code.

[4 marks]

11

Turn over for the next question

0 8 **Figure 6** shows an algorithm, represented using pseudo-code.

Figure 6

```
days ← [10, 15, 4]
sales ← [20, 33, 12]
weeks ← [0, 0, 0]
FOR i ← 0 TO 2
   daysTotal ← days[i] + sales[i]
   weeks[i] ← daysTotal DIV 7
ENDFOR
weeksTotal ← weeks[0] + weeks[1] + weeks[2]
OUTPUT weeksTotal
```

The `DIV` operator is used for integer division.

Complete the trace table for the algorithm in **Figure 6**.

Part of the table has already been filled in.

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

[6 marks]

`i`	**`daysTotal`**	**`weeks`**			**`weeksTotal`**
		`[0]`	**`[1]`**	**`[2]`**	
		0	0	0	

0 9 . 1 Which of the following best describes a **data structure**?

Shade **one** lozenge.

[1 mark]

A A number with a fractional part ○

B A value such as a whole number ○

C All of the data used and stored within a program ○

D An organised collection of values ○

Question 9 continues on the next page

0 9 . 2 **Figure 7** shows an **incomplete** algorithm, represented using pseudo-code.

The algorithm is used to store and manage books using records.

The algorithm should do the following:

- create a record definition called `Book` with the fields `bookName`, `author` and `price`
- create a variable for each book using the record definition.

Complete **Figure 7** by filling in the gaps using the items in **Table 2**.

- You may need to use some of the items in **Table 2** more than once.
- You will **not** need to use all the items in **Table 2**.

[3 marks]

Table 2

`1`	`2`	`author`
`B1`	`B2`	`Book`
`bookName`	`i`	`Real`
`OUTPUT`	`String`	`Boolean`

Figure 7

```
RECORD ______________

   bookName : String

   ______________ : String

   price : ______________

ENDRECORD

B1 ← Book("The Book Thief", "M Zusak", 9.99)

B2 ← ______________ ("Divergent", "V Roth", 6.55)
```

0 9 . 3 Write an algorithm using pseudo-code to display the name of the most expensive book.

The algorithm should:

- compare the price of `B1` and the price of `B2`
- output the book name of the most expensive book
- output `Neither` if the books are the same price.

The algorithm should work for any values stored in `B1` and `B2`

[3 marks]

13

Turn over for the next question

1 0 **Figure 8** shows a Python program.

Figure 8

```
def First(p1, p2, p3):
   v1 = p2 + p3
   print(Second(v1, p1))

def Second(p1, p2):
   v1 = p1 + p2
   if v1 > 12:
      v1 = v1 + Third(p1)
   return v1

def Third(p1):
   if p1 > 3:
      return 2
   else:
      return 0
```

1 0 . 1 State what will be displayed by the `print` statement when the subroutine `First` is called with the values `3`, `4` and `4` for the parameters `p1`, `p2` and `p3`

[1 mark]

____

____

1 0 . 2 State what will be displayed by the `print` statement when the subroutine `First` is called with the values `3`, `4` and `8` for the parameters `p1`, `p2` and `p3`

[1 mark]

____

____

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

1 1 A program is to be written to authenticate a username and password entered by the user.

Figure 9 shows the only two pairs of valid usernames and passwords.

Figure 9

Username	**Password**
`Yusuf5`	`33kk`
`Mary80`	`af5r`

Write a Python program to authenticate a username and password.

The program should:
- get the user to enter a username
- get the user to enter a password
- display the message `Access denied` if the username and password pair entered is not valid
- display the message `Access granted` if the username and password pair entered is valid
- repeat until a valid username and password pair is entered.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code accurately.

[7 marks]

Do not write outside the box

9

Turn over ►

1 2 A program is being written to solve a sliding puzzle.

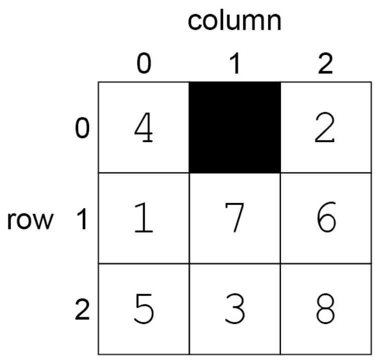
- The sliding puzzle uses a 3 x 3 board.
- The board contains eight tiles and one blank space.
- Each tile is numbered from 1 to 8
- On each turn, a tile can only move one position up, down, left, or right.
- A tile can only be moved into the blank space if it is next to the blank space.
- The puzzle is solved when the tiles are in the correct final positions.

Figure 10 shows an example of how the tiles might be arranged on the board at the start of the game with the blank space in the position (0, 1).

Figure 11 shows the correct final positions for the tiles when the puzzle is solved.

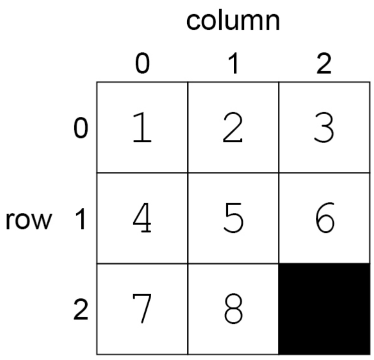
The blank space (shown in black) is represented in the program as number `0`

Figure 10



row \ column	0	1	2
0	4	■	2
1	1	7	6
2	5	3	8

Figure 11



row \ column	0	1	2
0	1	2	3
1	4	5	6
2	7	8	■

Table 3 describes the purpose of three subroutines the program uses.

Table 3

Subroutine	**Purpose**
`getTile(row, column)`	Returns the number of the tile on the board in the position `(row, column)` For example: • `getTile(1, 0)` will return the value `5` if it is used on the board in **Figure 12** • `getTile(1, 2)` will return the value `0` if it is used on the board in **Figure 12**.
`move(row, column)`	Moves the tile in position `(row, column)` to the blank space, if the blank space is next to that tile. If the position `(row, column)` is not next to the blank space, no move will be made. For example: • `move(0, 2)` would change the board shown in **Figure 12** to the board shown in **Figure 13** • `move(2, 0)` would not make a move if used on the board shown in **Figure 12**.
`displayBoard()`	Displays the board showing the current position of each tile.

Figure 12

	column 0	1	2
0	1	7	4
row 1	5	8	■
2	6	2	3

Figure 13

	column 0	1	2
0	1	7	■
row 1	5	8	4
2	6	2	3

Question 12 continues on the next page

1 2 . 1 The Python program shown in **Figure 14** uses the subroutines in **Table 3**, on page 25.

The program is used with the board shown in **Figure 15**.

Figure 14

```
if getTile(1, 0) == 0:
   move(2, 0)
if getTile(2, 0) == 0:
   move(2, 1)
displayBoard()
```

Figure 15

column

	0	1	2
0	1	8	3
row 1	■	7	5
2	4	2	6

Complete the board to show the new positions of the tiles after the program in **Figure 14** is run.

[2 marks]

column

	0	1	2
0			
row 1			
2			

Figure 16 shows part of a Python program that uses the `getTile` subroutine from **Table 3**, on page 25.

The program is used with the board shown in **Figure 17**.

Figure 16

```
for i in range(3):
   for j in range(3):
      if getTile(i, j) == 0:
         ref1 = i
         ref2 = j
```

Figure 17

			column	
		0	1	2
	0	4	7	6
row	1	3	8	1
	2	■	5	2

12.2 Which **two** of the following statements about the program in **Figure 16** are **true** when it is used with the board in **Figure 17**?

Shade **two** lozenges.

[2 marks]

A Nested iteration is used. ○

B The final value of `ref1` will be `0` ○

C The number of comparisons made between `getTile(i, j)` and `0` will be nine. ○

D The outer loop, `for i in range(3)`, will execute nine times. ○

E The values of `i` and `j` do not change when the program is executed. ○

Question 12 continues on the next page

Figure 16 and **Figure 17** are repeated below.

Figure 16

```
for i in range(3):
   for j in range(3):
      if getTile(i, j) == 0:
         ref1 = i
         ref2 = j
```

Figure 17

		column		
		0	1	2
	0	4	7	6
row	1	3	8	1
	2	■	5	2

1 2 . 3 Explain the purpose of the **first** iteration structure in the program in **Figure 16**.

[1 mark]

1 2 . 4 Explain the purpose of the **second** iteration structure in the program in **Figure 16**.

[1 mark]

1 2 . 5 State the purpose of the program in **Figure 16**.

[1 mark]

Question 12 continues on the next page

Turn over ►

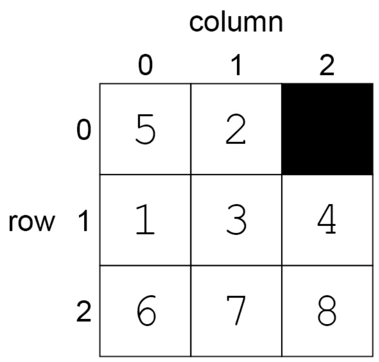
1 2 . 6 **Table 4** shows a description of the `getTile` subroutine previously described in more detail in **Table 3**, on page 25.

Table 4

Subroutine	**Purpose**
`getTile(row, column)`	Returns the number of the tile on the board in the position `(row, column)`

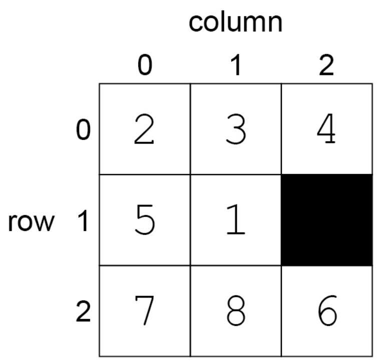
Figure 18 and **Figure 19** show example boards.

Figure 18



		column 0	1	2
	0	5	2	■
row	1	1	3	4
	2	6	7	8

Figure 19



		column 0	1	2
	0	2	3	4
row	1	5	1	■
	2	7	8	6

Write a Python program to:

- check that in the first row:
  - the second tile number is one more than the first tile number
  - the third tile number is one more than the second tile number
- display `Yes` when the row meets both conditions above
- display `No` when the row does not meet both conditions above.

For example:

- for the board in **Figure 18**, the program would display `No`
- for the board in **Figure 19**, the program would display `Yes`

You **must** use the `getTile` subroutine in your Python code.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code accurately.

[4 marks]

Question 12 continues on the next page

1 2 . 7 **Table 5** describes the purpose of another two subroutines the program uses.

Table 5

Subroutine	**Purpose**
`solved()`	Returns `True` if the puzzle has been solved. Otherwise returns `False`
`checkSpace(row, column)`	Returns `True` if there is a blank space next to the tile on the board in the position `(row, column)` Otherwise returns `False`

Table 6 shows a description of the `move` subroutine previously described in more detail in **Table 3**, on page 25.

Table 6

Subroutine	**Purpose**
`move(row, column)`	Moves the tile in position `(row, column)` to the blank space, if the blank space is next to that tile. If the position `(row, column)` is not next to the blank space, no move will be made.

Write a Python program to help the user solve the puzzle.

The program should:
- get the user to enter the row number of a tile to move
- get the user to enter the column number of a tile to move
- check if the tile in the position entered is next to the blank space
  - if it is, move that tile to the position of the blank space
  - if it is not, output `Invalid move`
- repeat these steps until the puzzle is solved.

You **must** use the subroutines in **Table 5** and **Table 6**.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid opposite contains vertical lines to help you indent your code accurately.

[6 marks]

17

1 3 Explain how the linear search algorithm works.

[3 marks]

1 4 . 1 State **one** property of local variables that is **not** true for all variables.

[1 mark]

1 4 . 2 Using Python, write a subroutine to help a museum review the number of visitors in a month.

The subroutine must:
- have the identifier `countDays`
- have the number of days a museum was open in the last month as a parameter
- get the user to enter the number of visitors to the museum for each of those days
- count how many of those days the museum had more than 200 visitors
- return the count.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code.

[6 marks]

10

1 5 A programmer is writing a game.

The game uses a row of cells represented as a list. **Figure 20** shows an example.

Figure 20

0	1	2	3	4	5	6	7
			X			X	

Figure 21 describes how the game is to be played.

Figure 21

- The player starts at position `0` in a row of cells.
- The aim of the game is for the player to reach the end of the row.
- At each turn the player must enter either `1` or `2`
  - if the player enters `1`, the player's position increases by 1
  - if the player enters `2`, the player's position increases by 2
- If the player's position goes beyond the end of the row or contains an `X`:
  - the message `Bad move` is displayed
  - the player goes back to position `0`
- These steps are repeated until the player reaches the end of the row.
- If the player reaches the end of the row the game is finished.

For example, using the list in **Figure 20**:

- the player starts in position `0`

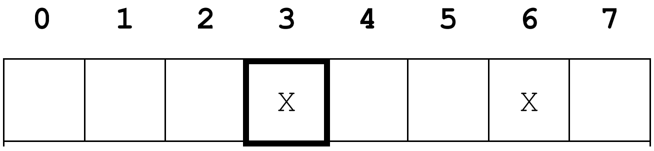
0	1	2	3	4	5	6	7
			X			X	

- if the player enters a `1`, then they move to position `1`

0	1	2	3	4	5	6	7
			X			X	

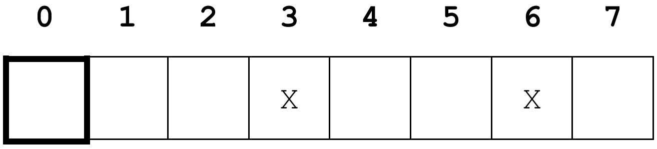
Question 15 continues on the next page

- if the player then enters a `2`, `Bad Move` is displayed as position `3` contains an `X`

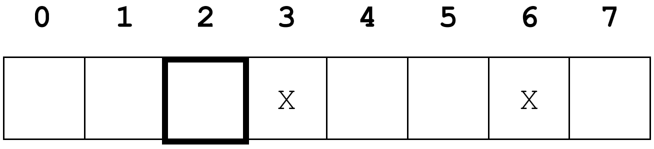


`Bad move`

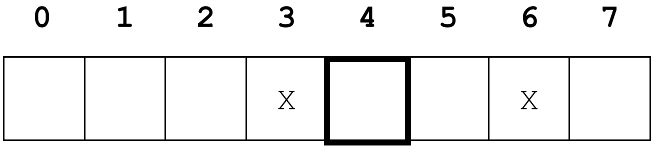
- the player then goes back to position `0`



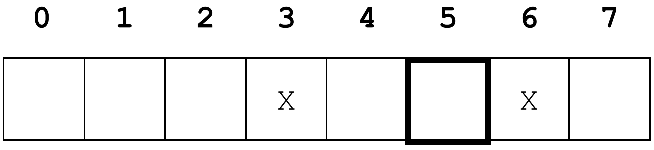
- if the player then enters a `2`, they move to position `2`



- if the player then enters a `2`, they move to position `4`



- if the player then enters a `1`, they move to position `5`



- if the player then enters a `2`, the game finishes.

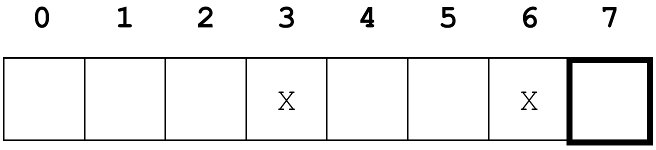


Figure 22 shows part of a Python program that will be used for the game.

Figure 22

```
pos = 0
lastPos = len(row) - 1
while pos < lastPos:
```

`pos` is a variable that contains the player's current position.

Extend the program from **Figure 22** so that the game works as described in **Figure 21**, on page 37.

When writing your program you should assume:

- there is a list called `row`
- the number of `X` characters in `row` can vary
- the position of the `X` characters in `row` can vary
- the `X` characters have already been added to the list called `row`
- the `row` list can be of any length.

You **should** use indentation as appropriate, meaningful variable name(s) and Python syntax in your answer.

The answer grid below contains vertical lines to help you indent your code.

[8 marks]

```
pos = 0
lastPos = len(row) - 1
while pos < lastPos:
```

8

END OF QUESTIONS

There are no questions printed on this page

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

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