

Please write clearly in block capitals.

Centre number

Candidate number

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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.

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

Information

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

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.



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

Turn over ►



Turn over for the next question

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0 5

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]

Turn over ►



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:

```
while 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	

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 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]



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

Turn over ►



09.2

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)



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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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

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

Figure 11

		column		
		0	1	2
row	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
<code>getTile(row, column)</code>	Returns the number of the tile on the board in the position <code>(row, column)</code> For example: <ul style="list-style-type: none"> • <code>getTile(1, 0)</code> will return the value 5 if it is used on the board in Figure 12 • <code>getTile(1, 2)</code> will return the value 0 if it is used on the board in Figure 12.
<code>move(row, column)</code>	Moves the tile in position <code>(row, column)</code> to the blank space, if the blank space is next to that tile. If the position <code>(row, column)</code> is not next to the blank space, no move will be made. For example: <ul style="list-style-type: none"> • <code>move(0, 2)</code> would change the board shown in Figure 12 to the board shown in Figure 13 • <code>move(2, 0)</code> would not make a move if used on the board shown in Figure 12.
<code>displayBoard()</code>	Displays the board showing the current position of each tile.

Figure 12

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

Figure 13

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

Question 12 continues on the next page

Turn over ►



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

1 2 . 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

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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
row	0	4	7	6
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

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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
<code>getTile(row, column)</code>	Returns the number of the tile on the board in the position <code>(row, column)</code>

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

Figure 18

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

Figure 19

		column		
		0	1	2
row	0	2	3	4
	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]

1 2 . 7

Table 5 describes the purpose of another two subroutines the program uses.

Table 5

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

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

Table 6

Subroutine	Purpose
<code>move(row, column)</code>	Moves the tile in position <code>(row, column)</code> to the blank space, if the blank space is next to that tile. If the position <code>(row, column)</code> 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]

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

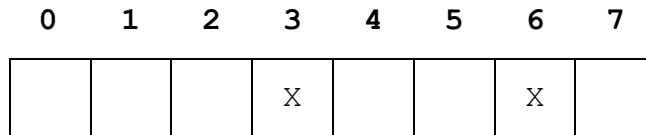


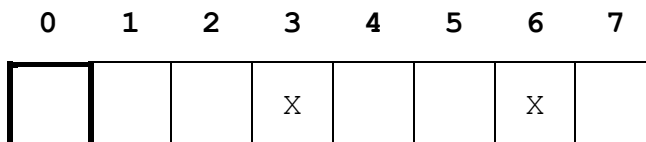
Figure 21 describes how the game is to be played.

Figure 21

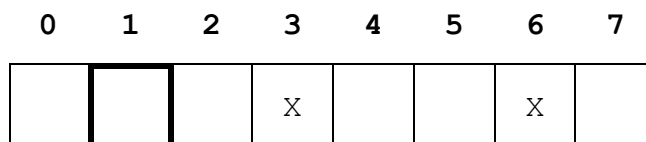
- The player starts at position 0 in a row of cells.
- The aim of the game is for the player to reach the end of the row.
- At each turn the player must enter either 1 or 2
 - if the player enters 1, the player's position increases by 1
 - if the player enters 2, the player's position increases by 2
- 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



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

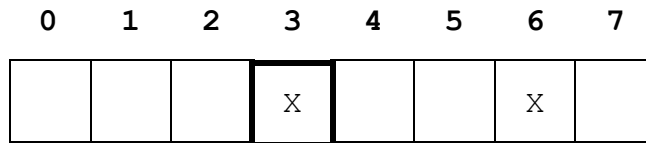


Question 15 continues on the next page

Turn over ►

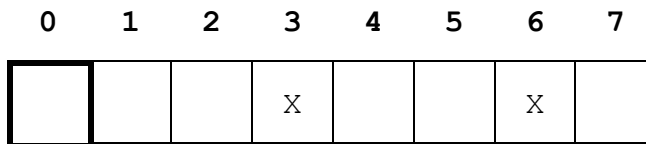


- if the player then enters a 2, Bad Move is displayed as position 3 contains an X

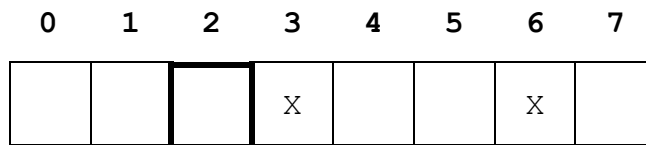


Bad move

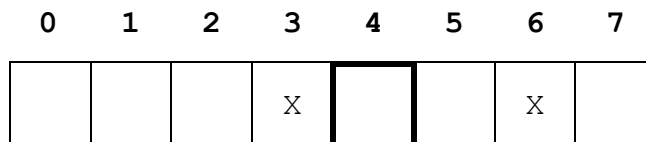
- the player then goes back to position 0



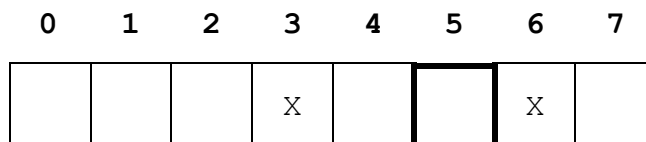
- if the player then enters a 2, they move to position 2



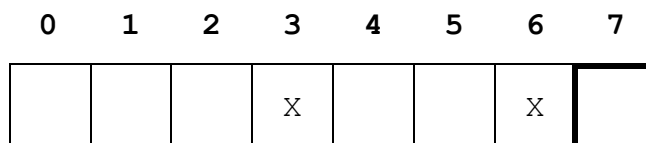
- if the player then enters a 2, they move to position 4



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



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



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