B 5 1

Pre-Leaving Certificate Examination, 2023

Computer Science

Sections A & B

Ordinary Level

Time: 1 hour, 30 minutes

210 marks

Name:
School:
Address:
Class:
Teacher:

Instructions

There are **three** sections in this examination. Section A and B appear in this booklet. Section C is in a separate booklet that will be provided for the computer-based element.

Section A	Short Answer Questions	Attempt any nine questions All questions carry equal marks	45 marks
Section B	Long Questions	Attempt any two questions All questions carry equal marks	78 marks
Section C	Programming	Answer all question parts	87 marks

Calculators may **not** be used during this section.

The superintendent will give you a copy of page 78 (Logic gates) of the *Formulae and Tables* booklet on request. You are not allowed to bring your own copy into the examination.

Write your answers for Section A and Section B in the spaces provided in this booklet. There is space for extra work at the end of the booklet. Label any such extra work clearly with the question number and part.

Section A Short Answer Questions 45 marks

Answer any **nine** of the twelve questions.

Question 1

Two types of primary memory are RAM and ROM.

(a) Give **one** difference between RAM and ROM:

(b) Give an example of a device that could be used as Secondary Memory in a computer.

Question 2

Program tracing is an important aspect of coding; it allows the programmer/user to track the values of variables throughout the code. A piece of Python code is shown below. Examine the code and answer the questions that follow.

```
1   x = 5
2   y = 4
3   y = x - 2
4   x = y + 3
5   print("The value of x is: ",x)
6   print("The value of y is: ",y)
```

(a) What will the final value of the variable x be when the code is run?

(b) What will the final value of the variable y be when the code is run?

Question 3

The decimal (or Base 10) number system is the number system most used by humans today. Computers use another number system, such as the binary number system (Base 2).

(a) Convert the following binary number to its decimal equivalent. Please show all your workings.

10110010_2

(b) Convert the following decimal number to its binary equivalent.

99_{10}

Question 4

Sorting and Searching are two key algorithm types in Computer Science. Perform a Simple Sort on the data array below, starting with the smallest number. An empty array has been provided. Indicate at each step of the algorithm which number you have selected as the new minimum from the original array.

Original array:

3	5	1	2	4

New minimum:

New minimum:

New minimum:

New minimum:

New minimum:

Question 5

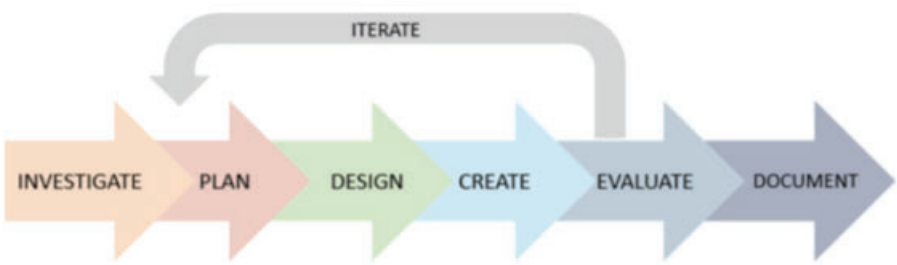
Binary Digits (commonly known as “Bits”) can have a value of either 1 or 0. Answer the questions below:

(a) How many bits are in a byte?

(b) Which is a bigger file, a 1 Megabyte file or a 1 Gigabyte file?

(c) There are 1000 metres in 1 kilometre and 1000 grams in a kilogram. Why are there 1024 bytes in a kilobyte and not 1000 kilobytes?

Question 6



The diagram above identifies some of the main stages of a software development design process. Describe briefly what happens at the following stages of the design process:

(a) Create stage

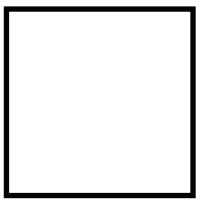
(b) Evaluate stage

Question 7

Turtle graphics are ways of creating simple pictures in a Python program. Give it the command `turtle.forward(50)`, and it moves 50 pixels in the direction it is facing, drawing a line as it moves. The turtle starts facing to the right (→).

Give it the command `turtle.left(90)`, and it rotates in-place 90 degrees to the left. Code and the resulting shape for a square is shown below:

```
import turtle
turtle.forward (50)
turtle.left (90)
turtle.forward (50)
turtle.left (90)
turtle.forward (50)
turtle.left (90)
turtle.forward (50)
turtle.left (90)
```

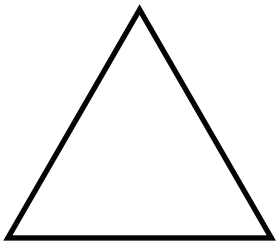


Match the following blocks of code with the correct shape made.

Code A

```
import turtle
turtle.forward (100)
turtle.left (72)
turtle.forward (100)
turtle.left (72)
turtle.forward (100)
turtle.left (72)
turtle.forward (100)
turtle.left (72)
```

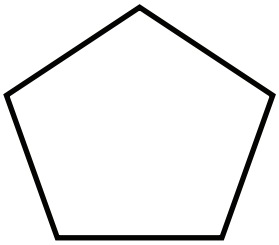
Triangle



Code B

```
import turtle
turtle.forward (100)
turtle.left (90)
turtle.forward (50)
turtle.left (90)
turtle.forward (100)
turtle.left (90)
turtle.forward (50)
turtle.left (90)
```

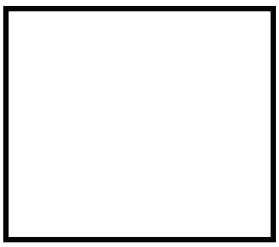
Pentagon



Code C

```
import turtle
turtle.forward (100)
turtle.left (120)
turtle.forward (100)
turtle.left (120)
turtle.forward (100)
turtle.left (120)
```

Rectangle



Code	Shape
	Pentagon
	Rectangle
	Triangle

Question 8

The image below shows a man in a self-driving car. Self-driving cars are an example of machine learning and artificial intelligence.

(a) Suggest **one** issue with the technology associated with self-driving cars presently.

(b) Identify **two** other examples of machine learning and artificial intelligence and briefly explain how they are involved in improving society.

1.
2.

Question 9

The American Standard Code for Information Interchange (ASCII) was a common method of encoding used in the sending and receiving of messages. It was invented in 1981 and could encode 127 different characters using the binary number system. The ASCII standard character table is shown below.

ASCII	Hex	Symbol	ASCII	Hex	Symbol	ASCII	Hex	Symbol	ASCII	Hex	Symbol
0	0	NUL	16	10	DLE	32	20	(space)	48	30	0
1	1	SOH	17	11	DC1	33	21	!	49	31	1
2	2	STX	18	12	DC2	34	22	"	50	32	2
3	3	ETX	19	13	DC3	35	23	#	51	33	3
4	4	EOT	20	14	DC4	36	24	$	52	34	4
5	5	ENQ	21	15	NAK	37	25	%	53	35	5
6	6	ACK	22	16	SYN	38	26	&	54	36	6
7	7	BEL	23	17	ETB	39	27	'	55	37	7
8	8	BS	24	18	CAN	40	28	(	56	38	8
9	9	TAB	25	19	EM	41	29	)	57	39	9
10	A	LF	26	1A	SUB	42	2A	*	58	3A	:
11	B	VT	27	1B	ESC	43	2B	+	59	3B	;
12	C	FF	28	1C	FS	44	2C	,	60	3C	<
13	D	CR	29	1D	GS	45	2D	-	61	3D	=
14	E	SO	30	1E	RS	46	2E	.	62	3E	>
15	F	SI	31	1F	US	47	2F	/	63	3F	?

ASCII	Hex	Symbol	ASCII	Hex	Symbol	ASCII	Hex	Symbol	ASCII	Hex	Symbol
64	40	@	80	50	P	96	60	`	112	70	p
65	41	A	81	51	Q	97	61	a	113	71	q
66	42	B	82	52	R	98	62	b	114	72	r
67	43	C	83	53	S	99	63	c	115	73	s
68	44	D	84	54	T	100	64	d	116	74	t
69	45	E	85	55	U	101	65	e	117	75	u
70	46	F	86	56	V	102	66	f	118	76	v
71	47	G	87	57	W	103	67	g	119	77	w
72	48	H	88	58	X	104	68	h	120	78	x
73	49	I	89	59	Y	105	69	i	121	79	y
74	4A	J	90	5A	Z	106	6A	j	122	7A	z
75	4B	K	91	5B	[	107	6B	k	123	7B	{
76	4C	L	92	5C	\	108	6C	l	124	7C	|
77	4D	M	93	5D	]	109	6D	m	125	7D	}
78	4E	N	94	5E	^	110	6E	n	126	7E	~
79	4F	O	95	5F	_	111	6F	o	127	7F	

(a) Suggest **one** limitation of the ASCII system when sending information internationally in 1981.

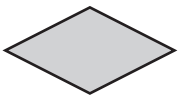
(b) What character encoding format was developed to overcome the limitation you identified in part (a)? Explain how this newer method of character encoding overcame this limitation.

Question 10

Flowcharts can be useful when showing the functionality of a piece of hardware or software. For example, when using a microcontroller (such as a BBC Micro: Bit, Raspberry Pi or Arduino) you can use a flowchart to describe how it can be used to build a home heating system.

Using the flowchart symbols below, sketch a flowchart in the space provided that will describe the following home heating system:

- The temperature is detected by the thermometer of the Embedded System.
- If the temperature is greater than 21 degrees Celsius, turn off the boiler.
- If the temperature is less than 16 degrees Celsius, turn on the boiler.
- This process should keep on going forever.

Symbol	Name	Function
	Start/End	An oval represents a start or end point.
	Arrows	A line is a connector that shows relationships between the representative shapes.
	Input/Output	A parallelogram represents input or output.
	Process	A rectangle represents a process.
	Decision	A diamond indicates a decision.

Question 11

Computing technologies (both hardware and software) need to be produced for people with a disability. Examine the image below and answer the questions that follow.

(a) Identify **one** way in which the above keyboard is adapted for people with special needs.

(b) Voice-controlled person assistants such as Apple's Siri or Google's Google Assistant are common on handheld devices. Suggest **one** way in which this software could be used to help someone with special needs use the device.

Question 12

The image below shows a person playing a computer game. The computer game uses both the Random-Access Memory (RAM) and the Read-Only Memory (ROM) of the computer.

(a) While the user is playing the computer game, is the game using Random-Access Memory or Read-Only Memory to display the graphics and generate the sound? Give a reason for your answer.

(b) When the user saves the game before turning the computer off, is the user using Random-Access Memory or Read-Only Memory to save the game? Give a reason for your answer.

Section B Long Questions 78 marks

Answer any two of three questions.

Question 13

(a) Minesweeper is a game where mines are hidden in a grid of squares. Safe squares have numbers telling you how many mines touch the square.
Minesweeper is a popular game that you can use computational thinking to solve.
The rules of minesweeper are as follows:

- A square with a number cannot contain a mine.
- Each number describes the number of mines touching that square (with either a side or a corner touching). These mines can touch vertically, horizontally or diagonally.
- No square contains more than one mine.

An example of a completed Minesweeper problem would be:

1	**2**	
1		**2**
1	**1**	**1**

1	**2**	**Mine**
1	**Mine**	**2**
1	**1**	**1**

Find exactly **five** mines in the grid below.

0		**3**	
2		**4**	

(b) The river-crossing problem is a famous computational thinking problem.
Imagine you are a farmer and you have bought three things in a market: a wolf, a cabbage and a sheep.
On your way home, you must cross a river using a boat. The issue is that the boat can only carry you plus one item you bought at a time.
You cannot leave the sheep and the wolf alone together as the wolf will eat the sheep.
You cannot leave the sheep and the cabbage alone as the sheep will eat the cabbage.

Write down the steps you must take in order to successfully bring all three items across the river intact.

(c) There are four aspects of computational thinking: Pattern Recognition, Algorithms, Abstraction and Decomposition. In your opinion, which one of the four aspects of computational thinking would be most suited to solve the river-crossing problem?

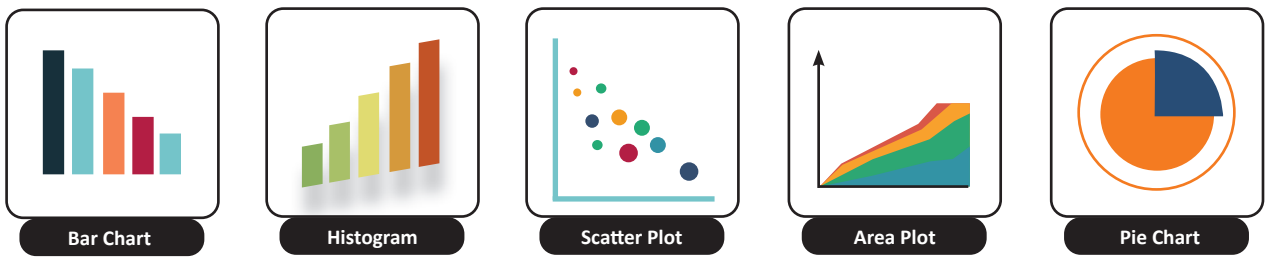
Question 14

(a) Numerical analysis can be used to summarise a large collection of data. Match each type of numerical analysis with the description of it by filling in the table below. The first one has been completed for you.

Type of numerical analysis	Description
Mean	**D**
Median	
Mode	
Range	

Description
A: The middle value of a sorted dataset
B: The value or values that occur(s) most frequently in a dataset
C: The largest value minus the smallest value
D: The average of a dataset

(b) Data visualisation is an important aspect of data analysis. It allows for quick and easy interpretation of data collected. There are several different types of graphs that can be generated using code to display data as shown in the image below:

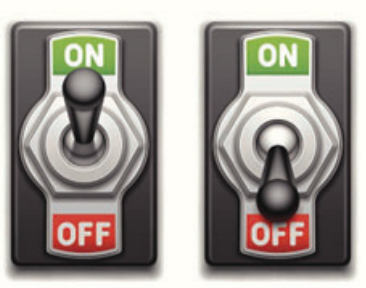


Using the data examples given below, match that example with an appropriate type of graph. You can only use each type of graph once in your answer.

Data example	Type of graph
Exam results of a student	
Temperature recorded over several hours	
Monthly expenditure of a household budget	
The ages of a group of people	

Question 15

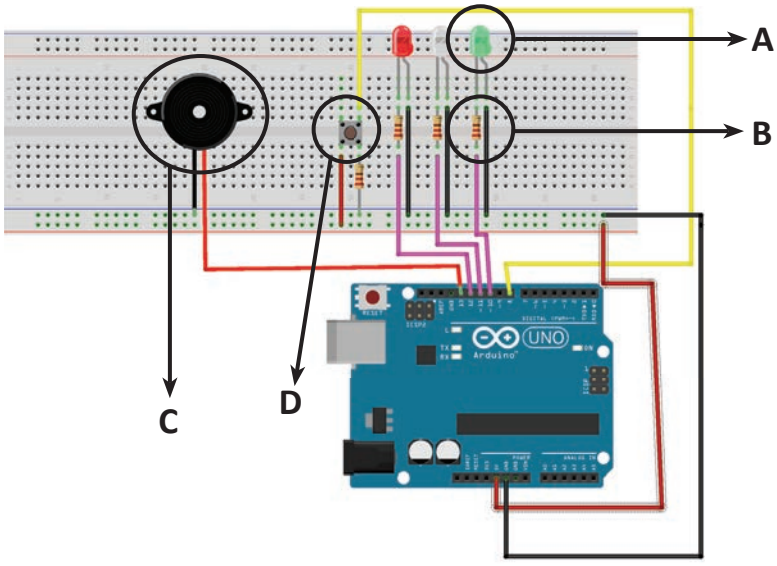
(a) The basis of the binary system in early computers was physical switches that were either ON or OFF:



Combinations of these switches were used to program these early computers.
Give **two** reasons why it is important that data storage and transmission use the binary system in computers.

1.
2.

(b) The diagram below shows an Arduino Embedded System connected to various electronic components. Examine the diagram and answer the questions that follow.



(i) Identify the component labeled **A**.

(ii) Identify the component labeled **B**.

(iii) Component **C** is a buzzer. Is this an example of an analogue output or digital output? Explain your answer.

(iv) Component **D** is a button. Is this an example of digital input or analogue input? Explain your answer.

(c) Important building blocks of computers and electronic circuitry are Logic Gates. There are three main types of Logic Gates: AND Gates, OR Gates and NOT Gates.
The AND and OR Gates have two inputs (A and B) and one output (C). The NOT Gate has one input and one output. The output of each gate depends on the input(s) given.

(i) Complete the Truth Tables for each type of gate given below.

AND Gate Truth Table

A	B	C
0	0	
0	1	
1	0	
1	1	

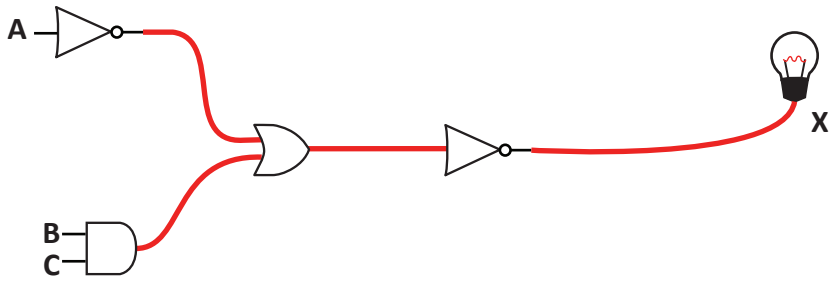
OR Gate Truth Table

A	B	C
0	0	
0	1	
1	0	
1	1	

NOT Gate Truth Table

A	C
1	
0	

(ii) The diagram below shows some Logic Gates connected. The three initial inputs are **A, B** and **C**. The final output is **X**.



Given the following combinations of inputs, give the outputs of **X**.

A	B	C	**X**
1	0	0	
1	1	1	

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B 5 1

Acknowledgements

Q6: Source: SEC LCCS Sample Paper

Q8: Source: https://www.rte.ie/brainstorm/2020/0804/1157190-self-driving-cars-autonomous-cars-sensors-social-acceptability-safety/

Q9: Source: https://ascii.cl/

Q11: Source: https://www.popscreen.com/prod/MTI2MzczOTc2/New-Dell-USB-White-105-Keys-UK-Keyboard-SK8115-HK216-eBay

Q12: Source: https://media.baamboozle.com/uploads/images/106719/1617349921_122432.jpeg

Q13: resources from Flaticon.com

Q15a: Source: https://www.genengnews.com/wp-content/uploads/2019/04/GettyImages-482384339.jpg

Q15b: Source: https://www.instructables.com/Simple-Music-Player-With-Buzzer/

B 5 2

Pre-Leaving Certificate Examination, 2023

Computer Science

Section C

Ordinary Level

Time: 1 hour

210 marks

Instructions

There is one section in this paper.

Section C	Programming	One question Answer all question parts	87 marks

Answer all parts of the question on your digital device.

Calculators may be used during this section of the examination.

The *Formulae and Table*s booklet cannot be used for this section of the examination.

Ensure that you save your work regularly and when you complete each question part.

Save your files using the naming structure described at the beginning of each question part.

If you are unable to get some code to work correctly, you can comment out the code so that you can proceed. The code that has been commented out will be reviewed by the examiner.

Rough work pages are provided at the end of this booklet. Please note that this work will **not** be reviewed by an examiner.

At the end of the examination it is your responsibilty to ensure that you have saved all of your files onto your external media.

Section C Programming 87 marks

Answer all question parts.

Question 16

(a) Computer programs can be used to make simple tools. One such tool is a calculator.
Open the program called **Question16_A.py** from your device.
Enter your name in the space provided on **line 2**.

The program asks the user if they wish to add or subtract. If the user enters "a" then the program will add the numbers and if "s" is entered by the user, it will subtract the first number from the second. It prints the results of the calculations to the screen.

```
#Question 16(a)
#Write your name here:
option = input("Would you like to (a)dd or (s)ubtract?")
num1 = int(input("Please enter your first number: "))
num2 = int(input("Please enter your second number: "))
if option == "a":
     print (num1 + num2)
if option == "s":
     print (num1 - num2)
```

When the program is run the output may now look as follows:

```
Would you like to (a)dd or (s)ubtract? a
Please enter your first number: 12
Please enter your second number: 7
19
```

```
Would you like to (a)dd or (s)ubtract? s
Please enter your first number: 12
Please enter your second number: 7
5
```

Modify the program to do the following:

(i) Increase the number of operations the calculator can perform by including a multiplication and division option.

When the program is run the output may now look as follows:

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? m
Please enter your first number: 12
Please enter your second number: 7
84
```

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? d
Please enter your first number: 12
Please enter your second number: 7
1.7142857142857142
```

(ii) At present, the program can only take in integers. Modify the program so the user will be able to enter floating-point numbers.

When the program is run the output may now look as follows:

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? m
Please enter your first number: 5.5
Please enter your second number: 6.2
34.1
```

(iii) The outputs are not very informative as the program is written currently. Modify the program so that the outputs will be more informative as shown below:

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? a
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 + 6.1 = 11.6
```

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? s
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 - 6.1 = -0.5999999999999996
```

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? m
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 x 6.1 = 33.55
```

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? d
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 / 6.1 = 0.9016393442622951
```

(iv) In the above output, some of the decimal places are quite long and unnecessary. Modify the code so that all answers will be rounded to 2 decimal places.

When the program is run the output may now look as follows:

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? s
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 - 6.1 = -0.6
```

```
Would you like to (a)dd, (s)ubtract, (m)ultiply or (d)ivide? d
Please enter your first number: 5.5
Please enter your second number: 6.1
5.5 / 6.1 = 0.9
```

Save and close your file before moving on to the next part.

(b) Computer programs can also be used to make games. In this program, the user will play a simple word-guessing game with the computer.
Open the program called **Question16_B.py** from your device.
Enter your name in the space provided on **line 2**.

The program contains a list of words. The program will extract a random word from the list and store it in a variable called "`random_word`".

```
#Question 16(b)
#Write your name here:
import random
words = ["cat", "mat", "can", "man", "pool","tool", "mule","pat","tan", "rule"]
print("The list of words is: ", words)
random_word = words (random.randint(0,len(words)-1)]
```

Modify the program to do the following:

(i) Print the length of the variable `random_word.`

When the program is run the output may now look as follows:

```
The length of the word is: 3
```

(ii) Print the first character in the `random_word variable.`

When the program is run the output may now look as follows:

```
The length of the word is: 3
The first letter in the word is: C
```

(iii) Allow the user to make a guess at what the word is. This should be stored in an appropriately labelled variable.

When the program is run the output may now look as follows:

```
The length of the word is: 3
The first letter in the word is: C
Please guess what the word is:
```

(iv) If the user guesses correctly, display an appropriate message. If the user guesses incorrectly, display an appropriate message and allow the user to make 2 more guesses at the word. If the user guesses correctly at any point, an appropriate message should be displayed. If the user does not guess the correct word after 3 guesses, an appropriate message should be displayed and the user should be told what the word was. Hint: a loop may be useful

When the program is run, it may look as follows:

```
The list of words is: ['cat', 'mat', 'can', 'man', 'pool', 'tool', 'mule', 'pat',
'tan', 'rule']
The length of the word is: 4
The first letter in the word is: p
Please guess what the word is: mat
You guessed incorrectly, try again
Please guess what the word is: pat
You guessed incorrectly, try again
Please guess what the word is: man
You guessed incorrectly, try again
The word was: pool
```

```
The list of words is: ['cat', 'mat', 'can', 'man', 'pool', 'tool', 'mule', 'pat',
'tan', 'rule']
The length of the word is: 3
The first letter in the word is: m
Please guess what the word is: man
You guessed incorrectly, try again
Please guess what the word is: mat
Well done!
The word was: mat
```

```
The list of words is: ['cat', 'mat', 'can', 'man', 'pool', 'tool', 'mule', 'pat',
'tan', 'rule']
The length of the word is: 4
The first letter in the word is: t
Please guess what the word is: tool
Well done!
The word was: tool
```

This is the end of the examination.

Space for rough work.

This page will not be reviewed by an examiner.

Space for rough work.

This page will not be reviewed by an examiner.