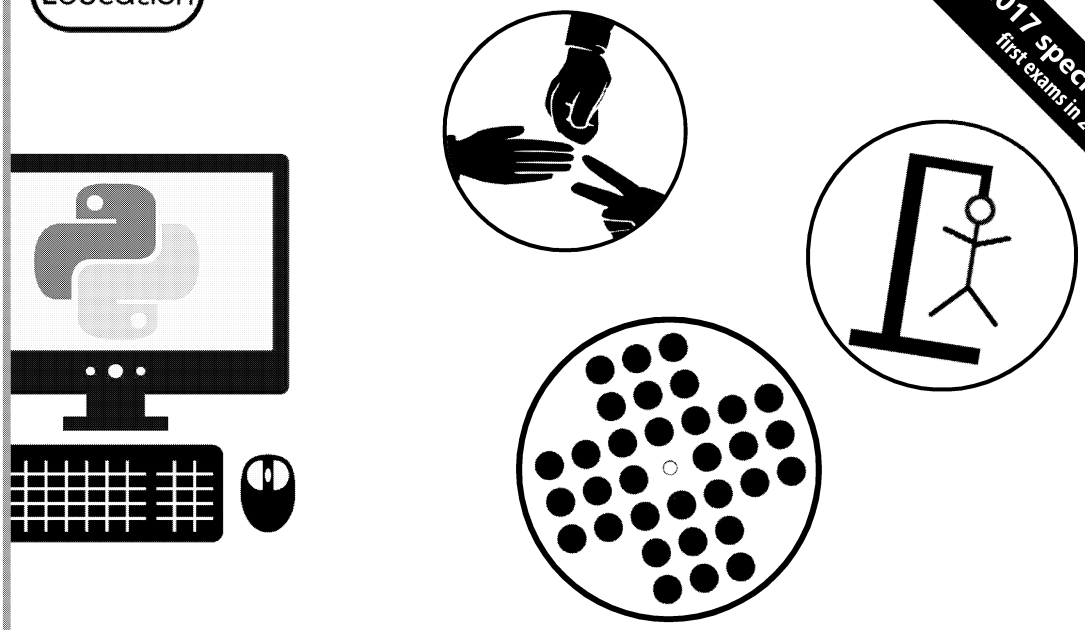
Zig Zag Education

Computer Science GCSE | WJEC | 3500QS

2017 specification
first exams in 2019



Python Exercises

for WJEC GCSE Computer Science (2017 spec)

Download support files from
zzed.uk/productsupport

zigzageducation.co.uk

POD 9837

Contents

Thank You

for choosing ZigZag Educa

We ♥ your feedback – let us k
using the feedback sheet on the
➥ ***£10 ZigZag Voucher for deta***

For m... resources go to **zzed.uk/**
... you can preview *every page* befo

ZigZag is a large community of over 6000 teachers & educ
Review new titles or publish your own work

Fancy being involved?

Then register at...

publishmenow.co.uk

The Professional Publi... ing Community

Alternative... m... ew resource ideas directly t...
...**menow@zigzageducation.co.uk**

ZigZag Education
Unit 3, Greenway Business Centre
Doncaster Road
Bristol
BS10 5PY

0117 950 3199
Real Person

0117 95...
Fa...

Teacher Feedback Opportunity

£10 ZigZag Voucher for detailed & complete revie
Use for problems/areas for improvement/positive fe

Resource ID & name	9837 Python Exercises: WJEC GCSE Computer Science	Your Name	
School Name		Position	

Overall, what did you think about this resou

I particularly like this resource because...

How does it help you or your students?

It is better than some other resources because...

What might you say to a colleague in a neighbouring sch p rsuade them to use

How well does tch your specification (& which specification is this)?

Other comments, suggestions for improvements, errors found (please give page num

***Resources* I would like published:**

***Resources* I might write, *or hav* rit for consideration for publication:**

Fax: **0117 959 1695**
Email: **feedback@ZigZagEducation.co.uk**
Post: **ZigZag Education, Unit 3, Greenway Business Centre, Doncaster Road, Bri**

Terms and Conditions of Use

Terms and Conditions

Please note that the **Terms and Conditions** of this resource include poi

> **"You acknowledge that you rely on your own skill and j**
> **determining the suitability of the [illegible]ls for any particu**

"We do not warrant: that any of the [illegible]s are suitable for any particular qualification), or the results that may be obtained from the use of any pu grades, or that [illegible] affiliated with any educational institution, or that a associa[illegible]h, sponsored by or endorsed by any educational institutio

Copyright Information

Every effort is made to ensure that the information provided in this publicatio no legal responsibility is accepted for any errors, omissions or misleading state policy to obtain permission for any copyright material in their publications. Th make suitable arrangements with any copyright holders whom it has not been

Students and teachers may not use any material or content contained herein a work without referencing/acknowledging the source of the material ("Plagiaris

Different teachers, Heads of Departments and Moderators have different pers and support to provide an individual or group for a given specification and wh specifications and modules require different levels of support or differing amo provided, or they prohibit information or support to be given to a student abo level work no support or information may be appropriate or a required feature

Where the teacher uses any of the material from this resource to support cour similar then the teacher must ensure that they are happy with the level of info pertaining to their personal point of view and to the constraints of the specific moderation or the process or delivery of the course. It is considered essential and or censor any parts of the contained material to suit their needs, the need of moderators and the needs of the individual or group concerned. As such, t parts of the material, if any, to provide to students and which parts to use as b themselves.

In this matter they should also determine the nature of information or support consideration the medium and style of support. So specifically, they should de provide verbally, if any, and which, if any, to provide in written format. Similarl inappropriate but the information or support itself is appropriate then the mat achieve this end. For example, if any of the contained material appears to ove result in a downgrading of the student's project, then the teacher should remo avoid this unless it is the teacher's intention to do this to achieve a certain leve

In summary, it is intended that these materials be used appropriately and at th that the teacher take into consideration the ability of the individual or group. to assess the suitability of coursework/project publications and to decide whic students.

ZigZag Education is not affiliated with Pearson, Edexcel, OCR, AQA, WJEC, Edu International Baccalaureate Organization or DFE in any way nor is this publicat with, sponsored by or endorsed by these institutions unless explicitly stated o publication.

Teacher's Introduction

This resource is designed to support the development of programming skills using Python. It contains 10 unique exercises, featuring a range of scenarios that develop the core programming principles.

These include using arrays, iteration, selection, sequence, string manipulation, mathematical and logical operations – all requirements of the WJEC GCSE (2017) Computer Science specification (a specification map is provided on page 2, showing how the relevant specification content is covered across the exercises).

Each exercise contains a combinations of questions and tasks, and consists of two sections – A and B.

The purpose of **Section A** is to test knowledge of the existing code, and to fix any errors that might be present. The skill of debugging is incredibly important in programming as programmers rarely tend to write whole programs by themselves.

Section B provides students with the opportunity to develop the functionality; these should take slightly longer to complete and will help students when they start addressing the NEA element of the course.

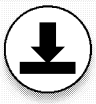
Along with the worksheets, there are Python [v3.5] programs that should be changed as the questions have been answered. Working Python files are provided for every worksheet, along with written answers. *Note that credit should also be given for any valid responses that are not explicitly included in this resource.*

The following icons are used to indicate the nature of the task, along with the number of marks available.

	A written response is required (using the answer lines provided)
	An amendment to the electronic skeleton program is required

In addition, the following additional resources are provided to assist students:

- *Python Quick Help Sheet* – provides an overview of the most commonly used Python (3.5) commands, along with examples. It is recommended that students also refer to the official Python documentation at: **https://docs.python.org/**
- *Python Common Error Guide* – describes and gives examples of a number of common pitfalls, along with the corrected code. A useful reference for students, particularly when attempting to debug their code.



The following resources are provided as a download via the ZigZag Education Support Files system, which can be accessed via zzed.uk/productsupport

- Skeleton Python script that students need to modify for each exercise
- Exemplar Python script (with all of modifications made) for each exercise

WJEC Specification Map

	Exercise 1 Number Game	Exercise 2 Rock, Paper, Scissors	Exercise 3 Turtle Drawing	Exercise 4 Monty Hall Problem	Exercise 5 Caesar Cipher	E C
2.1 – Problem [illegible]g						
Problem solving	✓	✓	✓	✓	✓	
2.2 – Algorithms and Programming Constructs						
Algorithms	✓	✓	✓	✓	✓	
Programming constructs	✓	✓	✓	✓	✓	
Variables	✓	✓		✓	✓	
Identifiers	✓	✓		✓	✓	
String handling	✓			✓	✓	
Mathematical operations				✓	✓	
Logical operations	✓	✓				
Searching						
Testing and ev[illegible]uation	✓	✓	✓	✓	✓	
2.4 – Data Structures and Data Types						
Implementing data structures				✓	✓	
Implementing data types	✓			✓		
Variables and constants	✓	✓		✓	✓	
2.5 – Security and Authentication						
Security techniques						

Exercise 1 – Number Game

This is a simple game whereby one person (the computer in this case) thinks of a nu between 1 and 100. The other person then has to guess what the number is.

If they guess incorrectly they are given clues about whether their guess is too high o low and they have to guess again until they get it right. The idea is to guess the nu correctly in as few guesses as possible.

A program designed to play the game is show[illegible] and provided electronically).

Study the code and try to unders[illegible] what is happening in the program, before atte

```
1     im[illegible]
2
3     def guess():
4     num = input("Please enter your guess")
5     return num
6
7     print("Welcome to the number guessing game")
8     print("The objective is to guess the number I'm thinki
9     print("I will give you clues after your first guess.")
10    secretNumber = random.randint(1,100)
11    print("I have thought of a number from 1-100")
12    numGuessed=guess()
13    if numGuessed < secretNumber:
14        print("Guess is too low, guess higher!")
15    else:
16        print("Guess is too high, guess lower!")
```

Section A

A 1

The program do[illegible] properly and you should get a syntax error Identify [illegible] of the problem and fix the program.

.....

Program updated ☐

A 2

When the program asks the user to enter their guess, it is not formatt Modify the program so that it presents a more suitable layout/prompt

Program updated ☐

A 3

The welcome message does not stand out – it is merged into the requ first guess and the instructions.

Modify the welcome message so that it appears underlined to separat of the text, and then leave a blank line after the instructions before the enter their first guess.

Program updated ☐

A 4

Current[illegible] program will generate a type error when you run it – this [illegible] that is being entered is actually stored as a string. On co[illegible]vert writing such as "23" to integers such as 23. This is so that t to treat it as a number. For example, "23" + "23" is actually "2323" on 23 + 23 is 46. This is why the computer needs to know whether it is a

Find the error in your program and fix it.

Program updated ☐

A 5

The program only allows the user to have one guess before stopping. T

Modify the program that it keeps asking the user to enter a guess unti

Hint: You will need to use a new variable that is initialised before the ne

Program updated ☐

A 6

The program will not perform correctly when the user guesses the nu
Investigate what happens and describe it, then fix the program electro

.....

.....

Program updated ☐

Section B

B 1

Develop the program further so that the game prints out the numb
the user took to get the correct answer.

Program updated ☐

B 2

It is important to add validation to programs to prevent errors fro
user input.

Modify the program to:

- only allow the user to enter numbers from 1–100
- print out an error message when they enter an invalid num
- ask them to try again.

Program updated ☐

B 3

Currently, if a user enters anything other than an integer, the progr

Fix this issue in your program using a TRY...EXCEPT.

Remember that the guess function should not exit/return until a va

Program updated ☐

Exercise 2 – Rock, Paper, Scissors

Rock, paper, scissors is a game played by two people in order to decide on the outcome something, much like tossing a coin. Both players tap their fist three times and then m either a rock (clenched fist), paper (open, flat hand) or scissors (two fingers open like scissors and the others clenched). The following rules are then used to decide who wins

- *Rock beats scissors (because it smashes them).*
- *Paper beats rock (because it wraps it).*
- *Scissors beats paper (because sc's ... paper).*
- *If both players show the same symbol then it's a draw.*

A program designed to play the game is shown below (and provided electronically). Study the code and try to understand what is happening in the program, before atte

```
1     def printRules()
2         print("The computer will think of either rock, pap
3         print("You will enter r for rock, p for paper or s
4         print("The computer will reveal it's choice and th
5        print()
6
7     def playGame():
8         choice=input("Enter r for rock, p for paper or s f
9         computerChoice=random.randint(0,2) # 0=rock, 1=pap
10
11        if computerChoice = 0:
12            print("The computer chose: Rock")
13        elif computerChoice == 1:
14            print("The computer chose: Paper"
15        else:
16            print("The computer chose: Scissors")
17
18        if choice == r:
19            if compute... == 0:
20                ...(It's a draw)
21            ...mputerChoice == 1:
22                print("Computer Wins!")
23        else:
24                print("Player Wins!")
25
26    print("Welcome to the Rock, Paper, Scissors Game")
27    print("========================================")
28    printRules
29    playGame()
```

There are a number of syntax errors in the code, which will need to be fixed before

A **syntax error** means that we have not followed the rules of the programming lan have given is slightly wrong (e.g. a missing bracket or quotation mark).

Section A

A 1 The first error is on line 1 which de...s t... unction printRules(). Identify the issue and fix t... pr...m accordingly.

.....

...m u...ated ☐

A 2 There is a second syntax error within the printRules() function. Identify the issue and fix the program accordingly.

.....

Program updated ☐

A 3

In Python, we use = to assign a value to a variable but we use == to c
value of one variable to another (or against a specified value).

Find a place where an incorrect number of = has been used and fix th
accordingly. State the line number below.

.....

Program updated ☐

A 4

There is another syntax er[illegible] on [illegible] 14. Identify the issue and fix the p

.....

[illegible] updated ☐

A 5

There is a problem on line 18. Identify the issue and fix the program a

.....

Program updated ☐

A 6

There is another syntax error on line 20. Identify the issue and fix the pr

.....

Program updated ☐

A 7

There is one final syntax error on line 28. Identify the issue and fix the p

.....

Program updated ☐

A 8

The program is now givi[illegible] error, random not defined.
Describe the issu[illegible] and fix the program accordingly.

.....

[illegible] updated ☐

A 9

There is now a logic error in the program. Test it by playing the game
the options to see what happens. Identify the issue and fix the progra

.....

Program updated ☐

Section B

B 1

The player can currently enter something other than r, p or s. If th
should be robust and ask them to re-enter their choice. Develop t
implementing this validation rule.

Program updated ☐

B 2

The user should [illegible] allowed to enter an uppercase R, P or S, not jus
Develop [illegible] program further to implement this additional function

[illegible] updated ☐

B 3

The program currently only plays the game once. Modify the prog
user if they would like to play again instead of just pressing enter t

Program updated ☐

Exercise 3 – Turtle Drawing

One of the first robots invented for drawing was the turtle – a simple robot with a ch of pens that drives around the floor and either has a pen touching the paper underne it (using different colours), or has the pen raised so that it can move to a new locatio start the next part of the drawing (or the next drawing).

To create turtle drawings, Python's turtle package is used. The package is called 'turt as it allows you to control a 'virtual turtle' that draws lines where the turtle has move

*This is an example of an **external lib**... Some basic commands have been given b*

Command	Description
`turtle.forward(x)`	Move x pixels in the direction the turtle is pointing.
`turtle.left(x)`	Turns the turtle left x degrees.
`turtle.right(x)`	Turns the turtle right x degrees.
`turtle.color(x)`	Sets the colour using a value represented using hexadecimal.
`Turtle.penup()`	Puts the pen up which means that the turtle can be moved without creating a line.
`Turtle.pendown()`	Puts the pen down which means that the turtle will draw a line when it moves.
`turtle.heading()`	Returns the direction in which the turtle is heading (in degrees). If the turtle is heading east, it's heading is 0.
`turtle.setheading(x)`	Sets the direction in which the turtle is facing.
`turtle.speed(x)`	Allows the speed of the turtle to be changed (1 = slow, 10 = fast).

A basic program that draws a square has been given below.

Study the code and try to understand what is happening in the program, before atte

```
1     import turtle
2
3     BLUE="#0000ff"
4     PINK="#ff00ff"
5     GREEN="#00ff00"
6
7     def drawSquare(size, colour):
8         turtle.color(colour)
9         for i in range(4):
10            turtle.forward(size)
11            turtle.right(90)
12
13    turtle.speed(5)
14    turtle.setheading(0)
15    turtle.pendown()
16    drawSquare(100, BLUE)
17    turtle.penup()
18    turtle.forward(5)
19    turtle.right(90)
20    turtle.forward(5)
21    drawSquare(80, PINK)
22
23    turtle.exitonclick()
```

Section A

A 1 The program draws a blue square and then the turtle attempts to draw a
no square appears. Identify the issue and fix the program so that the pin

.....

Program updated ☐

A 2 After the bug described above has been fixed, you notice that the pin
in the wrong place – it should be inside the blue square.

By looking at the direction of the turtle, identify the issue and fix the pr

.....

Program updated ☐

A 3 Modify the program to make the colour of the inside square green ins
You should only change one line.

Program updated ☐

A 4 The colour codes on lines 3–5 are in hexadecimal. Modify the progra
new constant storing the hex colour for RED (look it up if you need to)
the colour of the outside square to RED.

Program updated ☐

A 5 The position of the inside square is not even. Modify the program so t
square is positioned evenly inside the outside square.

Program updated ☐

Section B

B 1 Programmers cannot be expected to know how every function of ever
they need to be able to look up the documentation to fill any gap

By looking up the documentation for the turtle module, modify the pr
command that will make turtle invisible after the image has been draw
command used below.

https://docs.python.org/3.5/library/turtle.html

.....

Program updated ☐

B 2 Other shapes can be drawn easily using the turtle. What isn't quite so
drawing a shape without taking the pen off the paper, or drawing the
twice. One example that can be achieved is shown on the right.

Create a function called drawHouse() that draws this shape using turtle.

*You can start at any point you like. You will need to use Pythagoras' th
the lines to draw – a length of 100 is recommended for the main house.*

Program updated ☐

B 3 Write another draw function to replicate the star shown on the right.
Use a loop to create the shape. Attempt to colour in the star using the
commands.

Program updated ☐

Exercise 4 – The Monty Hall Problem

Consider the following scenario:

You are on a TV game show, and have the choice of three doors to open. One of the doors has a brand-new car behind it – the other two have old goats behind them.

Once you have picked a door, the game show host opens one of the two doors that you did not pick, to show you a goat. He then offers you the choice to switch your choice to the remaining door.

Should you switch your choice? Does it make any difference to how likely you are to win the car? If you do not switch you have a 1/3 chance of winning the car, and if you do switch, the odds double and th

You will be writing a simulation of the Monty Hall Problem. A basic program is shown electronically.

Study the code and try to understand what is happening in the program, before attempting

```
1     door = ["goat","goat","car"]
2
3     choice = input("Door 1, 2 or 3? ")
4     otherDoor = 0
5     goatDoor = 0
6
7     if choice == 1:
8         if door[1] == "goat":
9             otherDoor = 3
10            goatDoor = 2
11        elif door[2] == "goat":
12            otherDoor = 2
13            goatDoor = 3
14    elif choice == 2:
15        if door[0] == "goat":
16            otherDoor = 3
17            goatDoor = 1
18        elif door[2] == "goat":
19            otherDoor = 1
20            goatDoor = 3
21    elif choice == 3:
22        if door[0] == "goat":
23            otherDoor = 2
24            goatDoor = 1
25        elif door[1] == "goat":
26            otherDoor = 1
27            goatDoor = 2
28
29    switch = input("There is a goat behind door " + goatDo
30                   " switch to door " + otherDoor + "? (y/
31
32    if switch == "y":
33        choice = otherDoor
34
35    if door[choice-1] == "car":
36        print("You won a car!")
37    else:
38        print("You won a goat!")
```

Section A

A 1 Describe the purpose of the '\' symbol used on line 29.

.....

A 2 After making a choice, the program crashes unexpectedly.

Describe the reason for this, and fix the program accordingly.

.....

.....

Program updated ☐

A 3 The program does not recognise a user's choice, even if it is valid.

Describe the reason for this, and fix the program accordingly.

.....

.....

Program updated ☐

A 4 Currently, the prize is always behind the same door.

Fix this electronically by using random.shuffle().

Program updated ☐

A 5 On line 35, the selection statement refers to **`choice-1`**.

Why does it refer to this instead of simply **`choice`**?

.....

Section B

These tasks are to enable you to build a simulation or computer model for the Monty H will run automatically without need for you to intervene in each situation. It will al set different variables such as how many times to play the game or whether you wish t that you can automatically run the model for thousands of games and see what h

B 1 To observe the effect of switching doors, it would be useful to be able games. Modify the program so that 10 games are played before the p

Name the type of programming construct used to achieve this below.

.....

Program updated ☐

B 2 In a simulation, you should not need to manually enter your choice. In randomness to pick for us.

Change the program so that instead of asking for an input, it automatical

Program updated ☐

B 3 Create a subroutine monty_hall containing the code that you have written subroutine should take in two parameters – the first should indicate th that should be changed, and the second should indicate whether you sh choose randomly or not.

Run it 1,000 times with switching, and 1,000 times without switching. the number of times that you won the car, and how many times you w

Program updated ☐

Exercise 5 – Caesar Cipher

Life in Ancient Rome was very different to how we live in the present day. In 44 BC, t computers, no cars, and if you wanted to send a message to your friend who lived in you either had to deliver it yourself or pay someone to deliver it for you.

*The problem that Julius Caesar had, during the sending of messages, was that milita being stolen or read during delivery. To combat this issue, he devised one of the very of **encryption**. In this method, each letter is shifted along by a fixed amount to turn into ciphertext. If the secret key is 2, then A → C, B → D, ..., Y → A and Z → B.*

Encryption: The act of scrambling a message in a way that only the intended recip

A program used to perform a basic Caesar cipher is shown below (and is provide

Study the code and try to understand what is happening in the program, before atte

```
1       def letter_to_number(letter):
2        letters = "abcdefghjiklmnopqrstuvwxyz"
3        # Find the number corresponding to the given lette
4        # In this case a = 0, b = 1, c = 2, ..., z = 25.
5        number = letters.index(letter)
6        return number
7
8       def number_to_letter(index):
9        letters = "abcdefghijklmnopqrstuvwxyz
10       # Finds the letter corresponding to the given numb
11       # In this case 0 = a, 1 = b, 2 = c, ..., 25 = z.
12       return letters[index]
13
14      def shift(letter):
15       n = letter_to_number(letter
16       return number_to_let      (n + 13) % 26 )
17
18      def rot13(
19       ciphe
20       l      ter in string:
21       ertext += shift(letter)
22       return ciphertext
23
24
25      plaintext = "i love computing!"
26
27      ciphertext = rot13(plaintext)
28      print(ciphertext)
```

Section A

A 1 What is the value that each letter has been shifted by in this program?

.....

A 2 Initially, the program does not run correctly.

Identify the cause of the error (including naming the type of the error) and fix the program accordingly.

.....

Program updated ☐

A 3 A table has been provided that will let you manually decode the given

0	1	2	3	4	5	6	7	8
a	b	c	d	e	f	g	h	i
13	14	15	16	17	18	19	20	21
n	o	p	q	r	s	t	u	v

The output from the program is '**w ybir pbzchgwat!**'.

Checking the message using the table above, you can deduce that there is an error electronically, and write the line that it occurred on below.

.....

Program updated ☐

A 4 To encrypt another message, you have to change the program's source code. Ideally, the program should ask the user to input a string to be encrypted.

State below how you would ask the user for input in Python. Update your program electronically to reflect this.

.....

Program updated ☐

A 5 When a string is passed that contains uppercase letters, the program crashes. Correct your program electronically to allow the user to input uppercase letters without the program failing. State the function that you used.

.....

Program updated ☐

Section B

B 1 ROT13 is a special case of the Caesar cipher, as to decrypt a previously encrypted message you simply run the function rot13() on it again. If the shift value is different from the one used in ROT13, to decrypt a message you need to shift the letters in the other direction (a negative amount).

Create a new function, encrypt(), that takes a string and a 'shift value' and shifts the letters by the given shift value.

You will need to change the function shift(). You will also need to change

Below, write the encryption of the phrase 'hello world!' with a 'shift value' of 3.

.....

Program updated ☐

TRIVIA (Attention all Mathematicians!!)

The Python command % is often referred to in pseudo code as MOD. MOD returns after integer division has occurred. The function **10 MOD 5** will return 0 but **11 MOD**

Although the function **–9%3** returns 0 as expected, **–10%3** returns 2 whereas **10%3** retu
The function **–5%20** does not return –5 or 5, as you might expect. What does **–5%20**

Why do you think that is (mathematically)?

Hint: Computers cannot do division (or mul[illegible]ion), they use repeated addition.

B 2

d crypt a message, you need to shift the letters in the opposite
nction decrypt() that takes in a string and a 'shift value', that shift
opposite direction.

Using your function, decrypt the string "drsc sc k combod wocckq
encrypted by shifting the letters 10 spaces forwards.

.....

Program updated ☐

B 3

If a user needs to encrypt a lot of text, it is more sensible to read it
Changing lines 25–27, load the text file "plaintext.txt" into your pro
using a "shift value" of 13.

Program updated ☐

Exercise 6 – Check Digits

At many stages of communication between hardware devices there is a chance tha
misunderstood. Check digits are especially useful, as they can tell us if there has b

One use of check digits is on ISBN numbers, used for book identification. Each ne
code. The thirteenth digit is reserved for a check digit that verifies that the ISBN i

To calculate the check digit of a 12-digit unique book i[illegible] the following arith

Split the unique identifier:	9 7 8 [illegible] 7 9 0
Multiply every other number by 3:	9 [illegible] 4 21 1 3 1 21 9 0
Add all of the numbers:	9+21+8+3+4+21+1+3+1+21+9+0 = 101
Perform division modulo 10:	101 MOD 10 = 1
Subtract the result from 10:	10 – 1 = 9 ← This is the check digit.

NOTE: if the sum modulo 10 = 0, the check digit is 0.

This particular ISBN is written in the following way: 978-1-47-111790-9

The first number, 978, indicates that the 13-digit code is used for identifying a book. T
different document types; for instance, the number 979 is used for sheet music, which

The second number, 1 (after the dash), indicates the book is from an 'English-speak
codes depending on the country – the first few have been listed below.

0	English-speaking area	2	French-speaking area	4	Japan
1	English-speaking area	3	German-speaking area	5	(former) USS

The third and fourth numbers identify the publisher, the book, and the edition of the b
check digit used for error checking. *An ISBN checking program has been given below (*

```
1     def ISBNcheck(ISBN):
2
3         # Split the ISBN into the unique ID and the check
4         unique_id = []
5         for i in range(len(ISBN)-1):
6             unique_id.append(int(ISBN[i]))
7         actual_check_digit = ISBN[-1:]
8
9         # Multiply the second, fourth, sixth, ... elements
10        times_three=[]
11        for x in range(len(unique_id)):
12            if x%2 == 0:
13                times_three.append(unique_id[x]*3)
14            else:
15                times_three.append(unique_id[x])
16
17        # Calculate the sum of the numbers
18        sum_new_digits = 0
19        for x in range(0,len(times_three)):
20            sum_new_digits += times_three[x]
21
22        # Take the sum mod 10, and subtract from 10
23        sum_mod_10 = sum_new_digits % 10
24        if sum_mod_10 == 0:
25            sum_mod_10 = 10
26        check_digit = 10 - sum_mod_10
27
28        # Check if the calculated check digit is equal t
29        if check_digit == actual_check_digit:
30            return "valid."
31        else:
32            return "invalid."
33
34    choice = input("Enter the ISBN number: ")
35    print("ISBNcheck() returns " + ISBNcheck(choice))
```

SECTION A

A 1

The code on line 7 takes the last character of the array and assigns it t
digit. There is a problem with the data types on this line which will m
ISBN will return invalid.

Fix the error electronically, and write the line that it occurred on belo

.....

Program updated ☐

A 2

T ing gram on the (valid) ISBN 9781471117909, you'll see t
no work correctly. The error is in the iteraction statement that s

Explain below why the error is happening, and fix your program electr

.....

.....

Program updated ☐

A 3

Finding the value of sum_new_digits on lines 11–13 can actually be w
instead of three, using an inbuilt function.

Change lines 11–13 so the sum of the array is calculated in one line.
State below the name of the inbuilt function that you have used.

.....

Program updated ☐

A 4

In this pro m user can enter a 13-digit number and check that t
is rect. Add length validation to your program to only conti
d a 13-digit number.

Program updated ☐

A 5

The program currently exits immediately before you can see the outp

Describe how this could be prevented, and implement this change to

.....

.....

Program updated ☐

SECTION B

B 1

Instead e g a 13-digit number, the user should enter a pro
rm -x-x-x-x, where, excluding the dashes, there are still thir
ur program to reflect this – a message should show if the ISBN i

Hint: The functions .split() and "".join() will be useful.

Program updated ☐

B 2

Explain why returning "True" and "False" is better than returning "V
Change your program electronically to do this.

.....

.....

Program updated ☐

B 3

The second number in the ISBN (after the first dash) denotes either
book, or the country from which the publisher originates.

If the ISBN is valid, your program should print out the country that

To do this, write a function called getCountry(), that converts the se
The first six codes have been given below (you can assume that any
countries).

0	**English**
1	**English**
2	**French**
3	**German**
4	**Japan**
5	**(former) USSR**

Program updated ☐

Exercise 7 – Hangman

Hangman is a popular pencil and paper game where one player has to guess the wo other, one letter at a time. If the guessing player guesses incorrectly, a stick figure be is drawn one line at a time. The game is over after a certain number of guesses.

The origins of Hangman are fairly unknown, with a guess that it was first played duri Victorian era, as hanging was one of the more popular me[illegible] of execution at the t game needed to be created about it is a mystery, however.

To play this game on a computer, we can treat the words as ***strings***.

String: A data type that can be seen as a list of characters.

A program [illegible] forms functions needed to play hangman is shown below (and is p

Study the code and try to understand what is happening in the program, before atte

```
1    print("Welcome to Hangman!\n")
2
3    word = list("computing")
4    guessed_word = list("_________")
5    lives = 10
6    wordGuessed = False
7
8    while lives>=1 and not wordGuessed:
9
10       print(" ".join(guessed_word))
11
12       user_guess = input( "Guess a letter/word! (" + str(
13                           " lives remaining)\n")
14
15       # Check if letter is in the word
16       letter_in_word = False
17       for i in range(len(word)):
18           if user_guess == word[i]:
19               guessed_word[i] = user_guess
20               letter_in_word = True
21
22       if letter_in_word == False:
23           lives -= 1
24
25       if guessed_word = word:
26           print(" ".join(guessed_word))
27           print("You have guessed the word correctly!")
28           wordGuessed=True
29       elif lives > 1:
30           print("You failed to guess the word correctly :
```

Section A

A 1 Initially, when the program is run, an error immediately occurs. Explain the error below, and fix it electronically.

.....

.....

A 2 Explain the purpose of the characters "\n" and "\" in lines 12–13.

.....

.....

A 3

The program tells you that you have lost after your first guess, this is c
Fix your program electronically and state the line(s) that you have cha

.....

.....

Program updated ☐

A 4

Describe why a guess of 'C' does not do anything, even though it is in
"computing". Fix your program on the computer.

.....

.....

Program updated ☐

A 5

Describe the purpose of the join() function on line 10 of the program.

.....

.....

SECTION B

B 1

The user should also be able to guess the whole word, as well as t
Remarkably, this added functionality only requires changing one li

By changing **one line** of your program, add functionality that com
word – if so, then the game should stop.

*Note: There is already code that does something similar to this – wh
include this extra requirement?*

Program updated ☐

B 2

So far, the Hangman game only uses one word – "COMPUTING". T
pretty boring – it would be much better if multiple words could be

In your electronic program, change lines 3 and 4 to read a random
provided text file, "words.txt".

Hint: You will also need to change the way that the underscore mask

Program updated ☐

B 3

Finally, it would be helpful if the user could see a list of all of the pr
have entered.

Add an array called 'guessed_letters' to your program, that stores t
successful. You will also need to print out this list for the user a

Program updated ☐

Exercise 8 – Peg Solitaire

Peg solitaire is a one-player game consisting of a board with 33 holes and 32 pegs. The aim is to remove pegs by jumping over them, in a similar fashion to draughts (or checkers).

For example, if in a line you had **abXc** *– with X representing a space – you could mo the leftmost peg into the space, removing the 'b' peg (maki* **ac***).*

You will be making an electronic version of t a but on a 4 × 4 board.

A basic Python peg solitaire game is sh below (and is provided electronically).

Study the code and t derstand what is happening in the program, before atte

```
1   def find(board,choice):
2       for i in range(1, len(board)):
3           for j in range(1, len(board[0])):
4               if choice == board[i][j]:
5                   return i, j
6
7   grid = [["a","X","c","d"],["e","f","g","h"],["i","j","k",
8
9   while True:
10      print(grid)
11      choice = input("Enter a letter: ")
12      direction = input("Enter a direction (u,d,l,r): ")
13
14      row, column = find(grid, choice)
15
16      if direction == "r":
17          if column + 2 < len(grid[0]):
18              if grid[row][column + 2] == "X":
19                  grid[row][column] = "X"
20                  grid[row][column + 1] = "X"
21                  grid[row][column + 2] = choice
22
23      if direction == "l":
24          if column - 2 >= 0:
25              if grid[row][column - 2] == "X":
26                  grid[row][column] = "X"
27                  grid[row][column - 1] = "X"
28                  grid[row][column - 2] = choice
29
30      if direction == "u":
31          if row - 2 >= 0:
32              if grid[row - 2][column] == "X":
33                  grid[row][column] = "X"
34                  grid[row - 1][column] = "X"
35                  grid[row - 2][column] = choice
36
37      if direction == "d":
38          if row + 2 < len(grid):
39              if grid[row + 2][column] == "X":
40                  grid[row][column] = "X"
41                  grid[row + 1][column] = "X"
42                  grid[row + 2][column] = choice
```

NOTE: *In th am, it will not close itself unless you have completed the tasks in program press Ctrl+C.*

SECTION A

A 1

The 'find' function cannot find letters on the first column or the first r
Explain below why this is the case. You should also fix the problem e

.....

.....

Program updated ☐

A 2

Instead of using 'X' for the blank spaces, it has been decided that a
should be used instead.

Describe why the current program is not particularly good if you need
space symbol frequently, and how the program could be improved.

Change your program appropriately, making the consideration that it mi

.....

.....

Program updated ☐

A 3

The program does not print the 2D array in a readable manner.

Write a function show() that takes the board as a parameter, and print

You should change line 10 so your function is actually used.

Program updated ☐

A 4

Add validation to your program to ensure that a choice is in the corre
For instance, entering "C" and "R" on the first turn does not move 'c' le

Program updated ☐

A 5

Having an IF statement inside an IF statement inside an IF statement i
good programming practice.

State below the proper name that we give to 'IF inside an IF inside an
and change your program so this practice is not used.

.....

Program updated ☐

SECTION B

B 1

When moving, e.g. the program assumes that the space next to i

Explain why this happens, and fix your program to only make a mo
e.g. is jumping over a different one.

.....

.....

Program updated ☐

B 2

It would be useful if the player could save their progress in the ga
word 'save' when asked for a letter, the program should save the st

You should save the board by storing the size and then the conte
number of rows onto the first line of the file and the number of co
Then write the contents of each space on a new line in a text file ca

You should also allow the user to load the game using the by input
should read the number of rows and columns and set the board siz
in the contents of the board

Program updated ☐

B 3

The board can be extended to include larger sizes. Currently, the g
into the program. Instead, it should be generated at the start of th

Given that the ord('a') = 97, extend your program to allow custom
You should set the space that would have the letter 'b' to be the en

The grid size should be set in the program – the user does not nee

Program updated ☐

B 4

The game has been won if there is one piece remaining.

Add a check to your program that tests if the game has been won.

Test that your function works by playing on a 4 × 1 grid.

Program updated ☐

Exercise 9 – Blackjack Hands

Blackjack is one of the more well-known card games, played all over the world by millions of people in their homes and in casinos. It is a fairly unique game, in that the dealer only has a slight edge over the player – and players can actually gain a slight advantage if they learn how to count cards (although this is frowned upon by gambling establishments!).

The given program automatically plays blackjack. It should repeatedly 'hit' (get a new card) and only 'stick' (stop hitting) when the sum of the cards is higher than 17 (J, Q and K are each worth 10 points, A is worth 1 or 11 points). The aim is to get as close to 21 as possible. However, if you go over you are 'bust' (you have lost).

A basic blackjack program is shown below (and is provided electronically).

Study the code and try to understand what is happening in the program, before atte

```
1     import random
2
3     def getValue(card):
4         try:
5             return int(card)
6         except:
7             if card == "J" or "Q" or "K":
8                 return 10
9             else:
10                return 11
11
12    print("Automatic Blackjack Player\n")
13
14    games = 0
15    gameOver=False
16
17    while not gameOver:
18
19        deck = ["A", "2", "3", "4", "5", "6", "7", "8", "9", "
20        random.shuffle(deck)
21
22        hand = []
23        score = 0
24
25        while score < 17 and len(deck) != 0:
26            card = deck.pop()
27            hand.append(card)
28            score = score + getValue(card)
29
30        if score == 21:
31            print("Blackjack!")
32            games += 1
33        if score < 21:
34            print("You have scored " + str(score))
35            games += 1
36        else:
37            print("Uh oh, you've gone bust!")
38            games += 1
39
40        print("Your cards were " + hand + "\n")
41
42        if len(deck) < 1:
43            gameOver=True
44
45    number_of_games = games
46    print("\nYou played " + str(number_of_games) + " games
```

SECTION A

A 1

Initially, the program can correctly add the values of a hand, but crash
print the hand.

Explain why, and fix the issue electronically.

.....

.....

Program updated ☐

A 2

ntly the program gets stuck in an infinite loop.

Explain why, and stop your electronic program from getting stuck in t

.....

.....

Program updated ☐

A 3

Explain the purpose of the code * 4 when creating the deck variab
why is it good practice to create the deck in this way?

.....

.....

.....

A 4

Th e i e y a logic error in the getValue() function – all picture c
10. dentify below where the error occurs in this function, and fi

.....

.....

Program updated ☐

A 5

If you hit Blackjack, a message appears stating that you have gone bu
State the line number where the error occurs, and fix your program e

.....

Program updated ☐

SECTION B

B 1

In addition to the number of games played, it would be useful to k
you hit Blackjack, how many times you scored higher than 17 (and
an times you went bust.

Change the variable games to a list. It should store [number of bla
number of busts] in that order.

The program should print out the percentage of the times that eac

Program updated ☐

B 2

In blackjack, the ace can either have the value 11, or the value 1. A
the program only sees it as the value 11.

Change your program so that instead of going over 21 by countin
it counts it as 1 instead, before continuing as normal.

Program updated ☐

B 3

In order to see how [illegible] game is in terms of the edge that the
to run the [illegible] much longer period of time and get the co
[illegible] is is called modelling.

ange the number of decks to 500 – don't print out each hand, ju
hands won with blackjacks, hands lost with blackjacks, hands won
hands lost with a total >= 17 and total busts.

Program updated ☐

Exercise 10 – Connect Four

Connect Four is a two player logic game in which players take it in turns to drop a coloured piece of plastic into a grid, until one player has four colours matched in a row, column or diagonal.

*To represent this grid on a computer, we can use **two-dimensional arrays**. Then, each value in the array can either be an 'R' or a 'B' depending on whether the tile in that space is red or black.*

Array: A data type that can hold many values of the same data type.

A program that performs the actions needed to play the game is shown below (and is p

Study the code and try to understand what is happening in the program, before atte

```
1    def draw(grid):
2        print("")
3        print("1 2 3 4 5") # Print column headers
4        print("| | | | |")
5        print(grid[0][0], grid[0][1], grid[0][2], grid[0][3],
6        print(grid[1][0], grid[1][1], grid[1][2], grid[1][3],
7        print(grid[2][0], grid[2][1], grid[2][2], grid[2][3],
8        print(grid[3][0], grid[3][1], grid[3][2], grid[3][3],
9
10   def add_piece(grid, column, row, player):
11       if player == 1:
12           piece = "B"
13       else:
14           piece = "R"
15       grid[row][column] = piece
16       return grid
17
18   #- MAIN PROGRAM ----------------------------
19
20   board = [[0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0
21   won = False
22
23   draw(board)
24
25   while not won == True:
26
27       player = 1
28
29       print("It is player " + str(player) + "'s go.")
30       c_choice = int(input("Enter the column number. "))
31       r_choice = int(input("Enter the row number. "))
32
33       board = add_piece(board, c_choice, r_choice, player
34
35       if player == 1:
36           player = 2
37       else:
38           player = 1
39
40       draw(board)
41
42   print("Player " + str(player) + " has won!")
```

***NOTE:** In this program, it will not close itself unless you have completed the tasks in program press Ctrl+C.*

SECTION A

A 1

The first error that you might notice is that the player does not chan
Describe below why this happens, and then fix your program electro

.....

.....

Program updated ☐

A 2

The c[illegible]d row selection also does not work correctly. Describ
s[illegible] work below, and fix the problem on your electronic copy o

.....

.....

Program updated ☐

A 3

Try entering a negative column, or a column greater than 5. Descri
what happens in the program when you try to enter a negative colu

.....

.....

Add validation to the program after lines 30 a[illegible]31 to ensure that t
valid. The program should repeatedly prompt the player to enter a

Program updated ☐

A 4

[illegible] currently overwrite other people's moves by choosing the s
[illegible]cribe below the action you should take to stop this from happen
your electronic program to reflect this. *If the space is not empty, a m
shown saying that the player has forfeited their turn.*

.....

.....

Program updated ☐

A 5

In the real game, you cannot put the game pieces anywhere – they e
on the bottom row, or on top of another existing piece.

Instead of asking for a row number, it m[illegible]re sense to only ask
place the piece in the lowest empty [illegible]e [illegible]e board. Change your
requires the user to enter [illegible]nd places a piece in the lowest fre

By modifying [illegible]piece() function, add verification to only allow
colun [illegible] least one empty space. If a move is invalid, you shou
[illegible]he next player take their turn.

Program updated ☐

SECTION B

B 1

The grid in Connect Four actually uses seven columns and six rows.

Change the draw() function to allow *any* sized grid to be drawn. *The should be calculated from the grid parameter.*

Test that it works by changing line 20 to:

```
board = [[0,0,0,0] [0,0,0,0],[0,0,0,0],[0,0,0,0],[0,0,0,0
```

You may assume that the number of rows or columns will not be grea

Program updated ☐

B 2

Change the program so that it asks the user to enter the size of the b and then initialises the board correctly.

Program updated ☐

B 3

Your program currently runs forever. Describe the reason for this.

.....

.....

To fix this, some checking needs to be put in place to determine whe game. Write a function check_winner() that checks whether there are *horizontally* or *vertically*.

Use this function directly after adding a piece to stop the program if (horizontally or vertically).

For two additional marks, extend this to check for upward diagonal w marks, extend this to check for downward diagonal winning lines.

Program updated ☐

Answers

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are one way of the many ways to pro

EXERCISE 1 – NUMBER GAME

A 1

Two marks (one for desc[illegible] issue, one for modifying the code as

Lines 4 and 5 are the code for the function guess() – they must be in that they belong to the function.

```
def guess():
    num = input("Please enter your guess")
    return num
```

A 2

One mark for modifying the code as described:

The problem is that the prompt doesn't provide a colon or a space b type their answer. This looks confusing, but can be fixed simply by ch

```
num = input("Please enter your guess: ")
```

A 3

Two marks for modifying the code as described:

Award marks for:

- adding a separator below the first one
- adding a blank line at the end

```
print("Welcome to the [illegible] guessing game")
print("========== [illegible] ==========")
print("Th[illegible]ive is to guess the number I'm t
[illegible]ill give you clues after your first gue
[illegible]()
```

A 4

One mark for modifying the code as described:

The change is on line 4 and involves using the int() function which co

```
num = int(input("Please enter your guess: "))
```

A 5

Three marks for modifying the code as described.

Award marks for:

- setting up the new variable outside the loop
- setting the loop condition correctly
- indenting the correct contents of the loop

```
numGuessed = 0
while numGuessed != [illegible]umber:
    numGuessed=[illegible]
    if [illegible] < secretNumber:
        [illegible]("Guess is too low, guess higher!")
    else:
        print("Guess is too high, guess lower!")
```

A 6

Three marks (one for describing the issue, two for modifying the code

Description: When the user guesses correctly it prints out that their g
program simply exits (which makes it almost look like a bug/error).

Award marks for:

- changing the 'else' to an 'elif' and providing the correct co
- adding the new else clause and printing out a suitable mes

```
numGuessed = 0
while numGuessed !=  etNumber:
  numGuess = gue s()
  if  ue sed < secretNumber:
    print("Guess is too low, guess higher!")
  elif numGuessed > secretNumber:
    print("Guess is too high, guess lower!")
  else:
    print("Congratulations, you guessed correctl
```

B 1

Three marks for modifying the code as described.

Award marks for:

- initialising the number of guesses outside the loop
- incrementing it in the correct place
- printing it out at the end in a suitably formatted message

```
numGuessed = 0
guesses = 0
while numGuessed != secretNumber:
  numGuessed=guess()
  guesses += 1
  if numGuessed  se  etNumber:
    pri  e  is too low, guess higher!")
  el  nGuessed > secretNumber:
    print("Guess is too high, guess lower!")
  else:
    print("Congratulations, you guessed correctly
```

B 2

*Two marks for modifying the code as described. Note that the solutio
possible.*

Award marks as follows:

- 1 mark if they have solved it without a while loop (i.e. it just
- 2 marks if they have solved it using a while loop with the co
- No marks should be given if the condition is incorrect

```
while num <1 or num >100:
  num = int(input("Your number must be in the ran
```

B	3

Three marks for modifying the code as described. Note that the solut
possible.

Award marks for:

- the exception being handled and the user asked to re-enter
- a working loop condition, meaning that it will carry on until
- the entire logic being correct, meaning that it will always re
  1–100 inclusive from the guess() fu n.

```
def guess():
   num = input("Please enter your guess: ")
   numEntered = False
   while not numEntered:
      try:
         num = int(num)
         while num <1 or num >100:
            num = int(input("Your number must be in the
            numEntered=True
      except:
         num = input("You must enter a number, try
   return num
```

A 1

Two marks (one for describing the issue, one for modifying the code a

There is a missing colon (:) at the end of the function definition. Line

```
def printRules():
```

A 2

Two marks (one for des[illegible] issue, one for modifying the code a

There is an er[illegible] indentation on line 5. The function should

```
def printRules():
    print("The computer will think of either rock,
    print("You will enter r for rock, p for paper
    print("The computer will reveal it's choice an
    print()
```

A 3

Two marks (one for describing the error, one for modifying the code a

The error is on line 11. The correct code should be:

```
if computerChoice == 0:
```

A 4

Two marks (one for describing the issue, one for modifying the code a

The closing bracket is missing. The code should be:

```
print("The computer chose: Paper")
```

A 5

Two marks (one for describing the issue, one for modifying the code a

The comparison mu[illegible] the string "r". By using just r, the prog variable call[illegible] will instead compare the value of the variable [illegible]

```
if choice == "r":
```

A 6

Two marks (one for describing the error, one for modifying the code a

The closing quotation mark is missing. The code should be:

```
print("It's a draw")
```

A 7

Two marks (one for describing the issue, one for modifying the code a

The opening and closing brackets are missing. These are needed be call a function (printRules); the code should be:

```
printRules()
```

A 8

Two marks (one for [illegible] the issue, one for modifying the code a

The libra[illegible] needs to be imported at the start of the program

```
import random
```

A 9

Three marks (one for describing the issue, two for modifying the code

The code needs to be changed so that when the player chooses sor
game decides who the winner is and prints out the result. The selecti
should now be:

```
if choice == "r":
   if computerChoice == 0:
      print("It's a draw")
   elif computerChoi[illegible] = 1:
      print("Co[illegible]Wins!")
   else:
      [illegible]("Player Wins!")
if choice == "p":
   if computerChoice == 0:
      print("Player Wins!")
   elif computerChoice == 1:
      print("It's a draw")
   else:
      print("Computer Wins!")
else:
   if computerChoice == 0:
      print("Computer Wins!")
   elif computerChoice == 1:
      print("Player Wins!")
   else:
      print("It's a draw")
```

B 1

Two marks for modifying the code as described:

Award marks for:

- ch[illegible] input and asking the user to re-enter
- [illegible]g it into an iterative statement. This change is made a

```
ile choice not in ["r","p","s"]:
   choice = input("You must enter r, p or s – try
```

B 2

Two marks for modifying the code as described:

Award one mark each for modifying lines 8 and 10 to convert the ch

```
choice = input("Enter r for rock, p for paper or
while choice not in ["r","p","s"]:
   choice=input("You must enter r, p or s – try a
```

B 3

Two marks for modifying the code as described:

There needs to be an iterative statement [illegible] keep checking if th
they have finished the game. Award one mark each for replacing lin
shown below.

```
playAg[illegible] = True
wh[illegible]playAgain:
   playGame()
   if input("Would you like to play again(y/n): "
      playAgain=False
```

A 1

Two marks (one for describing the issue, one for modifying the code a

There should be a new line added before line 21 to put the pen for t
the line.

```
turtle.pendown()
```

A 2

Two marks (one for describing the issue, one for modifying the code a

t[illegible]eds to turn left again to be facing in the correct directio
choices for this; the first is preferred. There are, of course, other
270 degrees. This change is made after line 20.

```
turtle.left(90)
```

or to set the heading of the turtle back to the same as it was at the s

```
turtle.setheading(0)
```

A 3

One mark for modifying the code as described:

This involves changing line 23 (it was originally line 21).

```
drawSquare(90, GREEN)
```

A 4

Two marks for modifying the code as des[illegible]

Award marks for:

- adding a new [illegible]sta[illegible]with the hex value for red

```
RE[illegible]"#FF0000"
```

- modifying the line to change the colour from blue to red

```
drawSquare(100, RED)
```

A 5

One mark for modifying the code as described:

There are two main ways this can be achieved

The first option (preferred) is to place the square more evenly inside
This involves modifying lines 18–20 as follows:

```
turtle.forward(10)
turtle.right(90)
turtle.forward(10)
```

The second option is to draw the squ[illegible]sl[illegible]tly larger. This is by m
(it was originally line 21).

```
drawSquare(9[illegible]GREEN)
```

B 1

Two marks (one for naming the command, one for modifying the cod

This can be done using **turtle.hideturtle()**.
This should be added just before the **turtle.exitonclick()** co

```
turtle.hideturtle()
```

B 2

Three marks for modifying the code as d[illegible]ed.

Award marks for:

- drawing the [illegible]hape
- achi[illegible] without taking the pen off the paper
- [illegible]ting the side lengths and angles correctly so that the

```
f drawHouse():
    turtle.left(90)
    turtle.forward(100)
    turtle.right(45)
    turtle.forward(70)
    turtle.right(90)
    turtle.forward(70)
    turtle.right(45)
    turtle.forward(100)
    turtle.right(135)
    turtle.forward(141)
    turtle.right(135)
    turtle.forward(100)
    turtle.right(135)
    turtle.forward(141)
    turtle.left(135)
    turtle.forward(100)

turtle.speed(5)
turtle.setheading(0)
turtle.pendown()
turtle.color(BLUE)

drawHouse()
```

B 3

Three marks for modifying the code as described:

Award marks for:

- drawing the correct shape
- using an appropriate loop the correct number of times
- using fill commands to add colour

The drawStar function might look as follows:

```
def drawStar():
    turtle.color('red', 'yellow')
    turtle.begin_fill()
    for [illegible]ange(36):
        turtle.forward(200)
        turtle.left(170)
    turtle.end_fill()
```

EXERCISE 4 - THE MONTY HALL PROBLEM

A 1

One mark for a valid description:

The '\' symbol allows a single line of code to be written over multiple
purposes.

A 2

Two marks (one for describing the issue, one for modifying the code as

The program crashes because you cannot concatenate a string with
following ma

```
switch = input("The is a goat behind door " + str
" switch to door " + str(otherDoor) + "?  (y/n)
```

A 3

Two marks (one for describing the issue, one for modifying the code as

The program does not work as input is read as a string, not an intege
converting the input to an integer.

```
choice = int(input("Door 1, 2 or 3?  "))
```

*Note: This means that the program will crash if something other than a
try catch clause should be used, but it can be assumed that the input wi*

A 4

One mark for modifying the code as described:

The random module must be imported before `random.shuffle()`

```
import random

door = ["goat", "goat", "car"]
random.shuffle(door)
```

A 5

One mark for a valid description:

Arrays (lists) in Python always start at 0; the –1 is to convert from the
data is stored.

B 1

Two marks (one mark identifying the construct, one for modifying the

This is easily done by wrapping everything in a FOR loop (construct

```
for games in range(10):
  door = ["goat", "goat", "car"]
  ...
```

B 2

One mark for modifying the code as described:

This can be done using the function `random.randint()`:

```
choice = random.randint(1,3)
```

B	3

Two marks for modifying the code as shown:

Only award one mark if the function is not called twice with 1,000 ga

```
import random

def montyHall(numGames,switch):

  won = 0
  lost = 0

  for ca  .  range(numGames):
...

  if switch:
     choice = otherDoor

  if door[choice-1] == "car":
    won += 1
  else:
    lost += 1

  print("You won", won, " cars and", lost, " goa

montyHall(1000,True)
montyHall(1000,False)
```

EXERCISE 5 - CAESAR CIPHER

A 1

One mark for the correct answer:

The shift value is **13**.

A 2

Three marks (one mark for describing the error, one mark for identifying the line, one mark for modifying the code as described):

There is a syntax error on line 3 – a missing quotation mark.

```
letters = "abcdefghijklmnopqrstuvwxyz"
```

A 3

One mark for correctly identifying line 2

One mark for correctly modifying the code

```
def letter_to_number(letter):
    letters = "abcdefghijklmnopqrstuvwxyz"
    # Find the number corresponding to the given le
    # In this case a = 0, b = 1, c = 2, ..., z = 25
    number = letters.index(letter)
    return number
```

A 4

One mark for correctly identifying `input` *function*

One mark for correct implementation of an 'input' function with an ap

```
plaintext = input("Enter a mess, : "")
```

A 5

One mark for correctly identifying `lower` *function*

One mark for `lower` *at the correct point in line 15*

```
def shift(letter):
    n = letter_to_number(letter.lower())
    return number_to_letter( (n + 13) % 26 )
```

B 1

One mark for correctly identifying `jgnnq yqtnf` *as the encrypted str*

Four marks for the new `encrypt` *function*

Award marks for:

- correct declaration of the function with two parameters
- creating and returning an appropriate variable for the encryp
- looping through each character in the string parameter
- appending the encrypted character to the encrypted string

```
def encrypt(string, offset):
    ciphertext = ""
    # Creates the cipher text one step at a time
    for letter in st
        cipher
    ret
```

Trivia

To do division, a computer will do repeated addition. In the case of 9%
and add 3 to it and compare with the result; it's less, so it adds 3 agai
more. This time the comparison shows that we have 9=3+3+3 so the
DIV 3 is 3, 9 MOD 3 is 0. Taking the same idea but using 10%3, you h
takes you over so 10=3+3+3+1 making 10 DIV 3 equal to 3, but 10 M

To solve the problem set using a negative number, you start with the n
divisor repeatedly to get the result. For example, –10%3 means startin
repeatedly, thus –7+3=–4; –4+3=–1; –1+3=2; therefore, –10 DIV 3 is 4 and –10 M

B 2

1 mark for decrypted string `this is a secret message`

Three marks for the new `decrypt` *function*

Award marks for:

- correct declaration of the function with two parameters
- variable declared and returned by the function
- call to 'encrypt' that uses the appropriate parameter, negate

```
def decrypt(string, offset):
    plaintext = encrypt(string,-offset)
    return plaintext
```

B 3

Three marks for the modified code

Award marks for:

- opening the text file in read (r) mode
- reading the file into the plaintext variable
- calling the encrypt method with the plaintext variable and a

```
file = open("plaintext.txt", 'r')
plaintext = file.read()
file.close()
ciphertext = encrypt(plaintext, 13)
```

EXERCISE 6 - CHECK DIGITS

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are <u>one</u> way of the <u>many</u> ways to pro

A 1

One mark for correctly identifying line 7
One mark for the modified version of that lin

```
actual_check_digit = int(ISBN[-1:])
```

A 2

Two marks for identifying that the code that should multiply the even
multiply the odd numbers by 3 instead (1).
One mark for either changing the value in the IF statement from 0 to
the contents of the IF part with the ELSE part

```
for x in range(len(unique_id)):
  if x%2 == 1:
    times_three.append(unique_id[x]*3)
  else:
    times_three.append(unique_id[x])
```

A 3

One mark for identifying the sum function
One mark for the correct code in place of lines 11-13

```
sum_new_digits = sum(times_three)
```

A 4

Three marks for the additional code after line

Award marks for:

- use of a loop
- correct detection of either 13 as valid or not(13) as invalid
- error message appears when invalid data is entered

```
choice = input("Enter the ISBN number: ")
while len(choice) != 13:
  choice = input("Error – you must have 13 characters
```

A 5

One mark for identifying the required input statement (other possibil
One mark for additional code after the output

```
input("Press enter to quit. ")
```

B 1

Three marks for the modified code after line 34

Award marks for:

- removal of dashes from input string
- IF statement checking for four dashes, '978' start and 13 no
- contents of IF and ELSE clauses correct as below

N.B. other solutions exist and should be given full credit if they wou

```
choice = input("Enter the ISBN number: ")

ISBN_split = choice.split("-")
ISBN_numbers = "".join(ISBN_split)

if choice.count("-") == 4 and ISBN_split[0] == "9
len(ISBN_numbers) == 13:
  print("ISBNcheck() returns " + ISBNcheck(ISBN_
else:
  print("Invalid ISBN!")
```

B 2

One mark for acknowledging that Booleans require less storage or are compare than strings One mark for acknowledging that using Boolea of working

Three marks for the modified code

Award marks for:

- modified return statements on lines 30 and 32
- use of an IF expression that acts on values returned from line
- output displayed correctly in IF and ELSE clauses

```
if check_digit != actual_check_digit:
    return True
else:
    return False
...
if ISBNcheck(ISBN_numbers) == True:
    print("ISBNcheck() returns True")
else:
    print("ISBNcheck() returns False")
```

B 3

Four marks for the new code

Award marks for:

- correct definition of function with a single parameter
- implementation of IF, ELIF, ELSE structure
- correct values returned in all cases
- call to getCountry function inside a print statement

N.B. other solutions exist and should be given full credit if they would

```
def getCountry(number):
    if number == "0" or number == "1":
        return "an English speaking country."
    elif number == "2":
        return "a French speaking country."
    elif number == "3":
        return "a Germany speaking country."
    elif number == "4":
        return "Japan."
    elif number == "5":
        return "the (former) USSR."

...
if choice.count("-") == 4 and ISBN_split[0] == "9
len(ISBN_numbers) == 13:
    if ISBNcheck(ISBN_numbers) == True:
        print("ISBNcheck() returns True")
        print("The book is from " + getCountry(count
    else:
        print("ISBNcheck() returns False")
else:
    print("Invalid ISBN!")
```

EXERCISE 7 - HANGMAN

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are <u>one</u> way of the <u>many</u> ways to pro

A 1

One mark for recognising that = is used instead of ==
One mark for modifying code on lines 18 and

```
if user_guess == word[:l: ...
```

```
if guessed_word == word: ...
```

A 2

mark: '\n' is the newline character. It can be used to simulate pre
mark: \ allows a line of code to be split across multiple lines in th

A 3

One mark for identifying line 29
One mark for the modified code for that line

```
elif lives < 1:
```

A 4

One mark: 'c' is not recognised as the same character as 'C'
One mark for including .lower in line 12

```
user_guess = input("Guess a letter/word!  (" + st
   " lives remaining)\n").lower()
```

Alternatively, the user could force all strings to be uppercase but then
followed through by changing the word list to

A 5

One mark: connects two str... ...er into a larger string
*One mark: inserts th... ...g after **every character** of the second s*

B 1

...ifying code on line 25 to the following effect
mark: if no additional lines are written, so line 25 is as below:

```
if guessed_word == word or list(user_guess) == wo
```

B 2

Seven marks for the modified code

Award marks for:

- importing random
- opening the file in read (r) more
- splitting the file contents with .split(",")
- reading the contents of the file into wordlist
- choosing a random word
- converting the random word to lower case
- creating the correct mask for the words with _ underscores

```
import random
...
file = open("wo... t...','r') # Open file
wordlist = file.read().split(",") # Split content
file.close() # Close file

randomWord = random.randint(1, len(wordlist) - 1)

word = list(wordlist[randomWord].lower()) # Don't
every word to lowercase

guessed_word = list("_"*len(word))
```

B	3

One mark: declaring an array alongside other variable declarations

```
guessed_letters = []
```

One mark: appending guesses to the new array
One mark: only appending for letters not in the word

```
if not letter_in_word:
    lives -= 1
    guessed_letters.append(user_guess)
```

One mark: modifying line 12 to include an output for the array's conte

```
user_guess = input("Incorrect letters/words: " +
    str(guessed_letters) + "\n" \
    "Guess a letter/word!  (" + str(lives) + \
    " lives remaining)\n").lower()
```

EXERCISE 8 – PEG SOLITAIRE

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are <u>one</u> way of the <u>many</u> ways to pro

A 1

One mark: arrays' elements in Python begin at 0 (not 1)
One mark: modifying find function to rem[illegible] values

```
def find(board,piece)
  for i in ra[illegible](len(board)):
    fo[illegible]nge(len(board[0])):
      [illegible] choice == board[i][j]:
        return i, j
```

A 2

One mark: this program makes use of many constant values/characte

One mark: a variable could be used to store a space

Two marks for modifying the code (below is a snippet, but all IF clause

Award marks for:

- declaring a variable that contains a space
- using that variable in lieu of "X"

```
SPACECHAR = " "

if direction == "r":
  if column + 2 < len(grid[0]):
    if grid[row][column + 2] [illegible]PACECHAR:
      grid[row][column] [illegible]PACECHAR
      grid[row][c[illegible] + 2] = SPACECHAR
      grid[[illegible]ow][[illegible]lumn + 2] = choice
...
```

A 3

[illegible] marks for new code

Award marks for:

- declaring the show procedure
- looping once per row
- outputting the row
- calling the procedure from line 10

```
def show(board):
  for row in board:
    print(row)
```

Equally acceptable alternative solution:

```
def show(board):
  for row in range(len[illegible]):
    for col in [illegible]ge(len(board[row])):
      [illegible]nt(board[row][col], end="")
    [illegible]nt()
```

A 4

One mark: use of .lower on lines 10 and 11

```
choice = input("Enter a letter: ").lower()
direction = input("Enter a direction (u,d,l,r): "
```

Alternatively, in every place at which a comparison is made between
to see if it matches the uppercase letter, e.g.:

```
if direction == "r" or di[illegible] == "R":
```

A 5

One mark: nes[illegible] statements

Two marks for modified code

Award marks for:

- use of Boolean operator 'and'
- code modified with no errors

```
if direction == "r" and column + 2 < len(grid[0]) a
== SPACECHAR:
   grid[row][column] = SPACECHAR
   grid[row][column + 1] = SPACECHAR
   grid[row][column + 2] = choice

if direction == "l" and column - 2 >= 0 and grid[
SPACECHAR:
   grid[row][column] = SPACECHAR
   grid[row][column - 1] = SPACECHAR
   grid[row][column - 2] = choice

if direction == "u" and r[illegible] - 2 >= 0 and grid[row
SPACECHAR:
   grid[row][column] = SPACECHAR
   g[illegible][row - 1][column] = SPACECHAR
   grid[row - 2][column] = choice

if direction == "d" and row + 2 < len(grid) and g
SPACECHAR:
   grid[row][column] = SPACECHAR
   grid[row + 1][column] = SPACECHAR
   grid[row + 2][column] = choice
```

B 1

One mark: there is no check that the adjacent square contains a space

Four marks for modified code

Award marks for:

- checking 'column+1' location for a move to the right
- checking 'column-1' location for a move to the left
- checking 'row+1' location for a move down
- checking 'row-1' location for a move up

Code below is the modifications for a move right:

```
if direction == "r" and column + 2 < len(grid[0]) a
   SPACECHAR and grid[row][column + 1] != SPACECHA
   grid[row][column] = SPACECHAR
   grid[row][column + 1] = SPACECHAR
   grid[row][column + 2] = choice
```

Alternatively, an additional IF statement can be used (if A5 has not b

B 2

Eleven marks for modified code

Award marks for:

- IF statement to check for 'save'
- opening the file in write (w) mode
- writing the number of rows and columns to the file first
- nested loop structure
- game state correctly written to file [illegible] character on a new
- ELIF statement to handle 'load'
- opening the file in [illegible] mode
- grid array initialised
- [illegible] loop structure
- grid properly populated
- code functions as normal for any game play moves

```
...
choice = input("Enter a letter: ").lower()
if choice == "save":
   file = open("game.txt",'w')
   file.write(str(rows)+"\n"+str(columns)+"\n")
   for row in grid:
      for item in row:
         file.write(item+"\n")
   file.close()
elif choice == "load":
   file = open("game.txt",'r')
   rows = int(file.readline().strip())
   columns = int(file.readline().strip())
   grid = []
   for row in range(rows):
      grid.append([])
      for column in range(columns):
         grid[row].append(file.readline().strip("\n
   file.close()
else:
   direction = input("Enter a direction (u,d,l,r)
   row, column = find(grid, choice)

...
```

B 3

Three *marks for modified code*

Award marks for:

- declaration and initialisation of variables as below
- use of 'chr' to get the character from the ASCII code
- incrementation of 'count'

```
# Creating the board array
rows = 6
columns = 4
grid = []
count = 97

for i in range(rows):
   grid.append([])
   for j in range(columns):
      if count != 98:
         grid[i].append(chr(count))
      else:
         grid[i].append(spaceChar)
      count += 1
```

B	4

Three marks for additional code

Award marks for:

- determining the number of empty spaces on the board
- comparing this with the number of available places minus 1
- terminating the main loop if these values match

N.B. other solutions exist and should be given full credit if they would

```
# Function to check if the game has been won.
def has_won(board):
   board_string = ""
   # Make a string of the whole board
   for row in board:
      for item in board:
         board_string += item

    # Count the total number of spaces, if it is
    # width times the height, then there is one c

   if board_string.count(spaceChar) == len(board)
      return True
   else:
      return False

# Main game loop
while not has_won(grid):
   show(grid)
   choice = input("Enter a letter: ").lower()
...
```

Another solution to this problem might be:

```
# Function to check if the game has been won.
def has_won(board):
   pegs = 0
   # Parse the board
   for row in board:
      for item in row:
         if item != SPACECHAR:
            pegs += 1
   if pegs == 1:
      return True
   else:
      return False

# Main game loop
...
```

EXERCISE 9 - BLACKJACK HANDS

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are <u>one</u> way of the <u>many</u> ways to pro

A 1

One mark: you cannot concatenate a string with an array OR the arra
One mark: correct use of str

```
print("Your cards wer" + str(hand)+ "\n")
```

A 2

One mark: the length of the deck array never reaches zero...
One mark: ...because it is re-populated at the beginning of each loop
*One mark: moving the code to populate and shuffle the deck to **befo***

```
...
deck = ["A", "2", "3", "4", "5", "6", "7", "8", "9",
random.shuffle(deck)

while not gameOver:

  hand = []
  score = 0
...
```

A 3

One mark: multiplying a list by an integer creates copies of each elem
One mark: manually creating copies of each element by repeating co

A 4

One mark: the IF statement on line seven is incorrect as it does not re
One mark: modified code

```
if card == "J" or card == "Q" or card == "K":
```

A 5

One mark: error exists in line 33
One mark: IF on line 33 replaced with ELIF

```
if score == 21:
  print("Blackjack!")
  games += 1
elif score < 21:
  print("You have scored " + str(score))
  games += 1
else:
  print("Uh oh, you have gone bust!")
  games += 1
```

B 1

Three marks for additional code

Award marks for:

- games is now a list rather than a variable
- elements within games are incremented within correct IF, E
- calculations correct to return percentages

```
games = [0,0,0] # First element is blackjacks, se
and third is bust.

...

if score == 21:
   print("Blackjack!")
   games[0] += 1
elif score < 21 and score > 17:
   print("You have scored " + str(score))
   games[1] += 1
else:
   print("Uh oh, you have gone bust!")
   games[2] += 1
...
number_of_games = sum(games)
print("\nOut of " + str(number_of_games) + " game
print("- hit Blackjack " + str(games[0]) + " time
str(100*games[0]/number_of_games) + "% of the ti
print("- scored (> 17) " + str(games[1]) + " time
str(100*games[1]/number_of_games) + "% of the ti
print("- went bust " + str(games[2]) + " times ("
str(100*games[2]/number_of_games) + "% of the ti
```

B 2

ee [illegible] for additional code

rd marks for:

- IF statement to determine both presence of ace **and** score a
- subtraction of 10, only in these circumstances
- code capable of handling multiple aces, including those dea (implemented here in nested IF clause)

N.B. other solutions exist and should be given full credit if they woul

```
acesCounted = 0
while score < 17 and len(deck) != 0:
   card = deck.pop()
   hand.append(card)
   score = score + getValue(card)
   if score > 21 and "A" in han
      if acesCounted < har
         score -= 10
         aces
```

B	3

Ten marks for modified/additional code

Award marks for:

- modification of deck declaration to multiply by 500
- player and computer score both to reset to zero on each ite
- computer to draw cards in the same way that player draws c updated and aces being tracked
- selection structure to handle playe[illegible] being higher
- selection to handle comput[illegible] being higher
- selection to handl[illegible] and computer scores being the sa
- selection [illegible] player being bust
- [illegible] summary to include games won vs lost
- [illegible] to include all percentage calculations (won with blac with >= 17, lost with >= 17, bust)
- all output correct (format does not need to be identical)

```
deck = ["A", "2", "3", "4", "5", "6", "7", "8", "9",

...

while not gameOver:

   playerHand = []
   playerScore = 0
   acesCounted = 0

   while playerScore < 17 and len(deck) != 0:
      card = deck.pop()
      playerHand.append(card)
      playerScore += getValue(card)
      if playerScore > 21 and "A" in playerHand:
         if acesCounted < playerHand.count("A"):
            playerScore -= 10
            acesCounted += 1

   computerHand = []
   computerScore = 0
   acesCounted = 0

   while computerScore < 17 and len(deck) != 0:
      card = deck.pop()
      computerHand.append(card)
      computerScore += getValue(card)
      if computerScore > 21 and "A" in computerHan
         if acesCounted < computerHand.count("A"):
            computerScore -= 10
            acesCounted += 1

   if playerScore == 21:
      if playerScore == computerScore:
         gamesLost[0] += 1
      else:
         gamesWon[0] += 1
   elif playerScore < 21:
      if computerScore<21 and computerScore>=playe
         gamesLost[1] += 1
      else:
         gamesWon[1] += 1
   else:
      gamesLost[2] += 1
```

(continues on the next page)

(from previous page)

```
  if len(deck) < 1:
    gameOver=True

number_of_games = sum(gamesWon) + sum(gamesLost)
print("\nOut of " + str(number_of_games) + " game
print("- hit Blackjack " + str(gamesWon[0]) + " t
str(100*gamesWon[0]/number_of_games)[0:5] + "% of
" +str(gamesWon[0]*100/(gamesWon[0]+gamesLost[0])
print("- hit (>16) " + str(gamesWon[1]) + " ti
str(100*gamesWon[1]/number_of_games)[0:5] + "% of
+str(gamesWon[1]*100/(gamesWon[1]+gamesLost[1])
print("- went bust " + str(gamesLost[2]) + " time
str(100*gamesLost[2]/number_of_games)[0:5] + "% o

input("Press enter to exit.")
```


EXERCISE 10 - CONNECT FOUR

In theory there are an almost infinite number of ways to program a solution to a pro
following answers you should understand they are <u>one</u> way of the <u>many</u> ways to pro

A 1

One mark: player is set to 1 at the beginning of each loop (so will neve
One mark: assignment into player variable moved before loop

```
board = [[0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0],[0,0,0,0,0],[0,0
won = False
player = 1 # This line has been moved outside of t

while not won == True:

   draw(board)

   print("It is player " + str(player) + "'s go."

...
```

A 2

One mark: arrays begin with an index of 0, not 1 OR column headers (
indices will be 0-4

One mark: subtracting 1 from each of row and column (this could be i
and the mark can be awarded if 1 is subtracted anywhere between en

```
def add_piece(grid, column, row, player):
   if player == 0:
      piece = "B"
   else:
      piece = "R"
   grid[row-1][column-1] = piece # Changed here
   return grid
```

A 3

One mark: the choice loops around for negative values. For example,
gives the second-to-last column.

Two marks for new code

Award marks for

- loops that repeat until data in valid range is entered
- error messages that only appear when invalid data is entered

```
while not c_choice > 0 and c_choice < 6:
   print("There has been an error")
   c_choice = int(input("Enter the column number.

while not r_choice > 0 and r_choice < 5:
   print("There has been an error")
   r_choice = int(input("Enter the row number.  "
```

A 4

One mark: description of checking that the selected space is empty

Two marks for code

Award marks for

- IF statement to check that the space is either empty or not e
- IF and ELSE clauses correctly either place the piece or displa

```
if grid[row-1][column-1] == "0"
   grid[row-1][column-1] = piece
else:
   print("Space is already taken!  Turn is being
```

A 5

Three marks for new code

Award marks for

- reference to row no longer included as a parameter
- either loop from the bottom of the column upward until a sp
  from the top downward until a counter is found, then move
- checking whether the column is full

```
def add_piece(grid, colum , pl er):

   if player  :
      pi
   e
      piece = "R"

   # Find the lowest row that can fit the piece.
   # fill up from the bottom, we can count upward
   row = -1
   for i in range(len(board)):
      if grid[i][column-1] == "0":
         row = i

   # If row = -1 then a space could not be found,
   # should be skipped.  Otherwise we can insert

   if row == -1:
      print("Column is full!  Skipping turn")
   else:
      grid[row][column-1]  piece
```

B 1

e rks for new code

ard marks for

- loop to add correct number of column headers based on ar
- nested loop to build the board itself
- row headers added for all rows using variable that increme

```
def draw(grid):
   print("")

   # Build the column reference row
   headers = " 1"
   for i in range(2,len(grid[0]) + 1):
      headers += " " + str(i)
   print(headers)

   # Build the act  ard.
   for x in  nge( ),len(grid)):
      r  .  (grid[x][0])
      y in range(1,len(grid[0])):
         row += " " + str(grid[x][y])
      row += " row " + str(x+1)
      print(row)
```

B 2

One mark: updating validation routines to account for the size of the b

```
while not (c_choice > 0 and c_choice <= len(board
   print("There has been an error")
   c_choice = int(input("Enter the column number.

while not (r_choice > 0 and r_choice <= len(board
   print("There has been an error")
   r_choice = int(input("Enter the row number.  ")
```

Four marks for code

Award for

- loop in place to handle invalid dimensions (outside range 0-
- prompting the user for both rows and columns
- error message for invalid row or column entry
- nested loop to construct the board if valid date is entered

```
rows=0
cols=0
board=[]
while rows<1 or cols<1 or rows>9 or cols>9:
   try:
      rows=int(input("How many rows would you like
      cols=int(input("How many columns would you l
      if rows<1 or cols<1 or rows>9 or cols>9:
         print("Rows and columns must be in the range
      else:
         for i in range(rows):
            board.append([])
            for i in range(cols):
               board[i].append("0")
   except:
      rows=0
      cols=0
      board=[]
      print("Invalid entry, please try again. ")
```

B 3

One mark: the won variable is never set to true

Eight marks for new code

Award marks for

- declaration of new function with appropriate return value
- separate checking for a victory along a horizontal, vertical or
  orientations, even if incorrect
- horizontal checking involves eith[illegible] consecutive counter
  with a counter that is ch[illegible] value of 4
- vertical checked [illegible]
- two ma[illegible] or [illegible]ward diagonal code (one can be awarded f
  [illegible]ul) for a nested loop that iterates through both ro
- two marks for downward diagonal code (one can be awarde
  unsuccessful) for a nested loop that iterates through both ro

```
def check_winner(grid):

   # Checking the rows
   for row in grid:
      row_string = " ".join(row)
      if "BBBB" in row_string or "RRRR" in row_str
         return True

   # Checking the columns
   for i in range(len(grid[0])):
      column = [row[i] for row in grid]
      column_string = " ".join(column)
      if "BBBB" in column_string or "RRRR" in colu
         return True

   # Checking the upward diagonals
   diagonals=[]
   for i in range(len(grid)):
      diagonals.append("")
      for j in range(i,-1,-1):
         if i-j<len(grid[0]):
            diagonals[i]+=grid[j][i-j]
   for i in range(1,len(grid[0])):
      diagonals.append("")
      for j in range(len(grid)-1,-1,-1):
         if i-j+len(grid)-1<len(grid[0]):
            diagonals[i+len(grid)-1]+=grid[j][i-j+1
   for i in range(len(diagonals)):
      if "BBBB" in diagonals[i] or "RRRR" in diago
         return True

   # Checking the downward diagonals
   diagonals=[]
   for i in range(len(grid)-1,-1,-1):
      diagonals.append("")
      for j in range(len(grid)-i):
         diagonals[len(grid)-1-i]+=grid[i+j][j]
   for i in range(1,len(grid[0])):
      diagonals.append("")
      for j in range(len(grid)):
         if i+j<len(grid[0]):
            diagonals[i+len(grid)-1]+=grid[j][i+j]
   for i in range(len(diagonals)):
      if "BBBB" in diagonals[i] or "RRRR" in diago
         return True

   return False
```

Python Quick Help Sheet

Variable assignment:

Variable	Constant
x = 16	MYCONSTANT = 16 *# no constants in Python, but convention is to use*

Arithmetic operations:

Add	Subtract	Multiply	Divide	Power	
1+2 = 3	5-4 = 1	*= 12	10/4 = 2.5	3**2 = 9	1

Boolean operators (in conditions):

AND	OR	NOT
True and False	False or True	not True

Boolean (comparison) operators:

Less than	Less than or equal to	Greater than	Greater than or equal to	
<	<=	>	>=	
3<4	3<=3	4>3	4>=4	

The three standard control statements:

IF	FOR	

x = 1
if x == 1:
 print("x = 1")
elif x == 2:
 print("x = 2")
else:
 print("x =/= 1 or 2")
	for i in range(10):
	 print(i)
		x = 3
		while x
		 print(x
		 x = x

For each statement – (iterates through the list allowing you to directly look at the list

FOR EACH
y = [1,2,3,4,5] for item in y: print(item)

String manipulation:

Function	Description	
[x]	Returns the character in the x'th slot	st = "Hello World!" print(st[0]) >> H
[x:y]	Returns the string starting at the x'th slot, finishing before the y'th slot	st = "Hello World!" print(st[0:2]) >> He
len	Returns the length of the string	st = "Hello World!" print(len(st)) >> 12
+	Concatenates two strings	print("Hello" + "World") >> HelloWorld!

Character manipulation:

Character to ASCII code	ASCII code to character
ord("a") (= 97)	chr(97) (="a")

Type conversion:

to Boolean	to String	to Integer	to Real Num
bool(1) (= True)	str(5) (="5")	int("2") (= 2)	float(".5") (= 0.5)

Printing to sc

Print
print("Hello", "world!") >> Hello world!

File handling:

Reading	Writing	
file = open("a.txt",'r') x = file.read() file.close()	file = open("a.txt",'w') file.write("Hello!") file.close()	file = x = fi file.cl

List comprehension:

Examples	
x = [i for i in range(10)]	[0, 1, 2, 3, 4, 5, 6, 7, 8
y = [i**2 for i in range(10)]	[0, 1, 4, 9, 16, 25, 36, 4
z = [i**2 if i % 2 == 1 else i for i in range(10)]	[0, 1, 4, 3, 16, 5, 36, 7

List manipulation:

Function	Description	
[x]	Returns the element in the x'th slot	li = [1,2,3,4,5] print(li[0]) >> 1
[x:y]	Returns an array of the elements in the range from x to y	li = [1,2,3,4,5] print(li[0:2]) >> [1,2]
[-x:]	Returns the last x elements in the array	li = [1,2,3,4,5] print(li[-1:]) >> [5]
len	Returns the length of the list	li = [1,2,3,4,5] print(len(li)) >> 5
+	Joins two lists	[1,2] + [3,4] = [1

Other commands:

Function	Syntax	
def	def functionName(p1, p2....):	def addUp(num1, return num1+nu print(addup(2,4)) >> 6
range	range (start, end, step)	for i in range(0,6, print(i) >> 0 2 4
import	import libraryName	import random

try...except	try:
	  Code to try
	except:
	  Code when exception generated
		try:
		  return int(card)
		except:
		  if card == "J" or
		  return 10
		  else:
		  return 11

External libraries:

Library	Description
random	Provides functions to generate random numbers
turtle	Provides a separate screen which you can use to control a vi

Python Common Error Guide

Programming can be frustrating – especially when there are errors in your code that y nice to us – if there is an obvious error in your program it will not run, and often states does not, however, deal with what are known as logic errors. These are errors in your p not in the way that you actually intend.

The guide quickly runs through the way to interpret common r messages, gives exa errors, and shows how you can fix them.

1 – Syntax (PRINT statements)

Code

Consider the f ng erroneous code:

```
print(Hello world!)
```

Error message

```
 File "test.py", line 1
 print(Hello world!)
   ^
SyntaxError: invalid syntax
```

Description of the error

We are trying to print a string – but the interpreter does not recognise what we have fixed by wrapping what we have written in quotation marks.

Fixed Code

```
print("Hello world!")
```

2 – Syntax (IF statements)

Code

Consider the following erroneous code:

```
x = 1
if x = 1:
 print("Hello world")
```

Error message

The error message shown below is printed to the screen.

```
 File "test.py", line 2
 if x = 1:
  ^
SyntaxError: invalid syntax
```

Description of the error

A syntax error when Python does not recognise what has been written. In the operator in the IF statement. This can be fixed by using the correct sign for equa

Fixed Code

```
x = 1
if x == 1:
 print("Hello world")
```

3 – Logic (IF statements)

Code

Consider the following erroneous code. It is meant to add 1 to the variable x, and th

```
x = 1

if x == 1:
 x = 2
if x == 2:
 x = 3
if x == 3:
 x = 4
print(x)
```

Error mess[illegible]

A logic error occurs when the program runs without crashing, but the intended funct work correctly. Because this is a logic error, there is no error message. The program actually want it to return the value 2.

Description of the error

This can be fixed using ELIF statements. In this case it means that the first IF stateme incremented, and then the program will jump to the end of the IF statement.

Fixed Code

```
x = 1

if x == 1:
 x = 2
elif x == 2:
 x = 3
elif x == 3:
 x = 4

print(x)
```

4 – Syntax (IF Statements)

Code

Consider the following erroneous code:

```
x = 1
if x == 1
 print("Hello world")
```

Error message

The error message shown below is printed to the screen.

```
File "test.py", line 2
 if x = 1
   ^
SyntaxError: invalid syntax
```

Descriptio[illegible] error

The error occu[illegible]ause a colon is missing.

Fixed Code

```
x = 1
if x == 1:
 print("Hello world")
```

5 – Syntax (FOR loops)

Code

Consider the following erroneous code:

```
for x in range(12)
 print(x)
```

Error message

The error message shown below is printed to the screen.

```
File "test.py", line 1
 for x in range(12)
    ^
SyntaxError: invalid syntax
```

Description of the error

The error occurs because a colon is missing.

Fixed Code

```
for x in range(12):
 print(x)
```

N.B. This error is exactly the same as Error 4 – colons should be used after IF, ELIF, EL

6 – Logic (FOR loops)

Code

Consider the following erroneous code. You wish to print the numbers 1–10.

```
for x in range(10):
 print(x)
```

Error message

Because this is a logic error, there is no error message.
The program prints: `0, 1, 2, 3, 4, 5, 6, 7, 8, 9.`

Description of the error

The error occurs because FOR loops start at 0 if the start is not specified, and Python upper bound.

Fixed Code

```
for x in range(1,11):
 print(x)
```

7 – Logic (DEF statements)

Code

Consider the following erroneous code. You wish to increment x by one and print th

```
def f(x):
 result = x + 1

x = 1
print( f(x) )
```

Error message

Because this is logic error, there is no error message.
The program returns None

Description of the error

The error occurs because no value is returned from the function.

Fixed Code

```
def f(x):
 return x + 1

x = 1
print( f(x) )
```

8 – Type (INPUT statements)

Code

Consider the following erroneous code:

```
x = input("Enter a number")

if x < 10:
 print("Less than 10")
else:
 print("Greater than 9")
```

Error message

The error message is shown below.

```
Traceback (most recent call last):
 File "test.py", line 3, in <module>
 if x < 10:
TypeError: unorderable types: str() < int()
```

Description of the error

The user's input is stored as a string. When checking if the string is less than 10 an e
compare a string to an integer.

Fixed Code

```
x = int(input("Enter a number: "))

if x < 10:
 print("Less than 10")
else:
 print("Greater than 9")
```

9 – File (File handling)

Code

Consider the following erroneous code:

```
file = open("test.txt")
file.write("Hello World! ")
file.close()
```

Error message

The error message is shown b

```
Traceback (mo  ec  ast last):
 File "test.  ine 1, in <module>
 file = open(  t.txt")
FileNotFoundError: [Errno 2] No such file or directory: 'test.txt'
```

Description of the error

This error has occurred because the file that the program is trying to open does not

Fixed Code

Nothing needs to be changed in the program; a file named 'test.txt' needs to be in t

10 – I/O (File handling)

Code

Consider the following erroneous code:

```
file = open("test.txt")
file.write("Hello W
file.close
```

Error message

The error message is shown below.

```
Traceback (most recent call last):
 File "test.py", line 2, in <module>
 file.write("Hello World!")
io.UnsupportedOperation: not writable
```

Description of the error

This error has occurred because the file has been opened in a way that only allows it

Fixed Code

```
file = open("test.txt",'w')
file.write("Hello World!")
file.close()
```

11 – Name (External libraries)

Code

Consider the following erroneous code:

```
print(math.sqrt(4))
```

Error message

The error message is shown below.

```
Traceback (most recent call last):
  File "test.py", line 1, in <module>
    print(math.sqrt(4))
NameError: name 'math' is not defined
```

Description of the error

This error has occurred because the external library `math` has not been imported.

Fixed Code

```
import math
print(math.sqrt(4))
```

12 – Index (Arrays and Lists)

Code

Consider the following erroneous code:

```
x = []
x[0] = 1
x[1] = 2
x[2] = 3
```

Error message

The error message is shown below.

```
Traceback (most recent call last):
  File "test.py", line 2, in <module>
    x[0] = 1
IndexError: list assignment index out of range
```

Description of the error

This error has occurred because the size of the list has not been defined. Instead, to should use .append()

Fixed Code

```
x = []
x.append(1)
x.append(2)
x.append(3)
```

13 – Logic (Arrays and Lists)

Code

Consider the following erroneous code. It is meant to print out the elements in the l

```
x = [1,2,3,4]

for i in range(1,4):
 print(x[i])
```

Error message

As this is a logic error, no error message is printed. The program prints 2, 3, 4.

Description of the error

This error has occurred because the size of the list has not been defined. Instead, to should use .append()

Fixed Code

```
x = []
x.append(1)
x.append(2)
x.append(3)
```

14 – Type (Strings)

Code

Consider the following erroneous code. It is meant to print out the elements in the l

```
print("This is a numb      3)
```

Error mess

```
Traceback (most recent call last):
 File "test.py", line 2, in <module>
 print("This is a number: " + 3)
TypeError: Can't convert 'int' object to str implicitly
```

Description of the error

This error has occurred because you cannot concatenate a string with a number. You a string.

Fixed Code

```
print("This is a number: " + str(3))
```