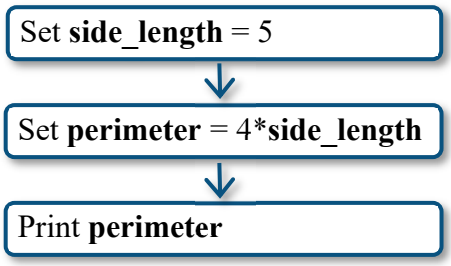
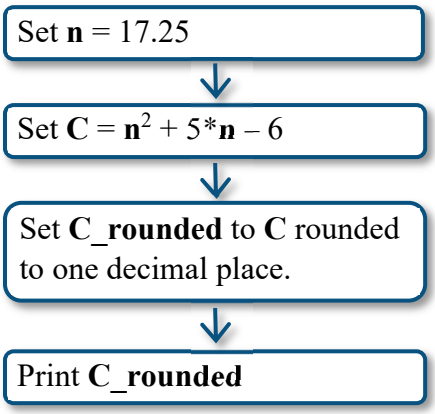
PART A

1) The blocks of code shown on the right are used to calculate the perimeter of a square.
   a) What are the names of the variables used in this program?
   b) Explain what is happening in each block of code.
   c) What will be the output of the program when it is run?
   d) How could the code be altered to calculate the perimeter of a regular octogon?





2) Consider the blocks of code shown on the left.
   a) What are the names of the variables in this program?
   b) Explain what is happening in each block of code.
   c) What will be the output of the program when it is run?

3) Consider the Python program shown on the right.
   a) What is the purpose of the lines beginning with the # symbol? Are these lines necessary for the program to run?
   b) What are the names of the variables used in this program?
   c) What will be the output of the program when it is run?

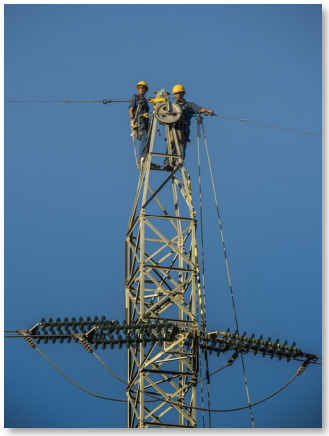
```
1  # Set value for x.
2  x=3
3
4  # Calculate y.
5  y=6*x+5
6
7  # Print y.
8  print(y)
```

PART B

4) Consider the Python program shown below, in which a company's profit is calculated based on the number of items sold using the equation $P = -0.1n^2 + 64n - 4340$.
   a) What are the names of the variables used in this program?
   b) What operation does **2 indicate?
   c) What is the purpose of line #8?
   d) Predict the output of the program.
   e) Copy the code into a Python editor and repeatedly alter the value assigned to *n* to determine the maximum profit for the given model (to the nearest dollar).
   f) Modify the program so that the word *dollars* appears after the rounded profit value (on the same line).

```
1  # Set value for number of items sold.
2  n=200
3
4  # Calculate profit.
5  P=-0.1*n**2+64*n-4340
6
7  # Round the profit.
8  P_rounded=round(P)
9
10 # Print the profit.
11 print("The profit is:")
12 print(P_rounded)
```

5) While working at the top of a tower in a remote area, a technician discarded a broken part by throwing it to the ground below. The part's height above the ground (in metres), t seconds after it was released, is given by the equation $h = -4.9t^2 - 2t + 45$.



a) Create a Python program to help calculate the part's height above the ground, rounded to the nearest tenth of a metre (one decimal place). Use a time value of 1.5 seconds, but design your program so that the time can be quickly changed to calculate another height.

b) Using your program, repeatedly change the time value to complete the table of values shown on the right (include the time values not shown between 0.4 and 2.6 as well).

c) Use your completed table to estimate how long it takes for the part to hit the ground.

d) Interpret the meaning of the final height value in the table.

Time (sec)	Height (m)
0.0	45.0
0.2	44.4
0.4	43.4
⋮	⋮
2.6	
2.8	
3.0	

6) Julian wants to create a box by cutting squares out of the corners of a rectangular piece of cardboard and folding up the resulting flaps. He determined that if the square cutouts have a side length of s cm, the volume of the resulting box is given by the expression $4s^3 - 100s^2 + 600s$.

To investigate how he can achieve the greatest volume for the box, Julian created the following Python program to quickly calculate the box's volume, V, based on the side length of the square cutouts.

```
1  V=4s^3-100s^2+600s
2
3  s=2
4
5  print("Side length of square cutout: ",s,"centimetres")
6  print("Volume of box: ",V,cubic centimetres)
```

a) Julian's program resulted in several errors. Identify the cause of the errors.

b) What would the program's output be after the errors have been corrected?

c) Use a corrected version of Julian's program to determine the side length of the square cutouts that will give the box with the greatest volume.

PART C

7) A rectangle has a perimeter of 450 mm.

a) Write a Python program to determine the length of the rectangle based on its width. Use a width of 150 mm, but design your program so that the width can easily be changed to calculate another length.

b) Modify your program such that the rectangle's area is displayed along with its length.

c) Modify your program such that only the rectangle's area is shown, but the area calculation is done in a single line.

d) Use your program to determine the maximum area of a rectangle with a perimeter of 450 mm. What are the dimensions of this rectangle?

ANSWERS

1) a) **side_length** and **perimeter**
b) Block #1: The variable **side_length** is defined with an assigned value of 5.
Block #2: The variable **perimeter** is defined as four times **side_length**.
Block #3: The value of **perimeter** is displayed.
c) `20` d) Redefine **perimeter** as 8***side_length**.

2) a) **n**, **C** and **C_rounded**
b) Block #1: The variable **n** is defined with an assigned value of 17.25.
Block #2: The variable **C** is defined as $\mathbf{n}^2 + 5*\mathbf{n} - 6$.
Block #3: The variable **C_rounded** is defined as **C** rounded to one decimal place.
Block #4: The value of **C_rounded** is displayed.
c) `377.8`

3) a) These lines are *comments*. They are simply notes for reference or clarification. They are not needed for the program to run, but can be helpful to explain the intentions of the code.
b) **x** and **y** c) `23`

4) a) **n**, **P** and **P_rounded** b) squaring
c) The purpose of line #8 is to round **P** to the nearest integer.
d)
```
The profit is:
4460
```
e) $5900
f)
```
1  # Set value for number of items sold.
2  n=200
3
4  # Calculate profit.
5  P=-0.1*n**2+64*n-4340
6
7  # Round the profit.
8  P_rounded=round(P)
9
10 # Print the profit.
11 print("The profit is:")
12 print(P_rounded,"dollars")
```

5) a)
```
1  # Set value for time.
2  t=1.5
3
4  # Calculate height.
5  h=-4.9*t**2-2*t+45
6
7  # Round the height.
8  h_rounded=round(h,1)
9
10 # Print the height.
11 print("The height is",h_rounded,"metres.")
```

b)

Time (sec)	Height (m)
0.0	45.0
0.2	44.4
0.4	43.4
0.6	42.0
0.8	40.3

Time (sec)	Height (m)
1.0	38.1
1.2	35.5
1.4	32.6
1.6	29.3
1.8	25.5

Time (sec)	Height (m)
2.0	21.4
2.2	16.9
2.4	12.0
2.6	6.7
2.8	1.0
3.0	–5.1

c) approximately 2.8 seconds

d) The negative height value indicates that the part had already hit the ground before a time of 3.0 seconds (the model is not valid for that time).

6) a) - The variable **s** is used before it is defined (used in line #1, but not defined until line #3).
- ** is used to denote an exponent (not ^).
- The multiplication symbol (*) must be used on line #1 (`4*s**3-100*s**2+600*s`).
- On line #6, the text *cubic centimetres* should be surrounded by quotation marks.

b)
```
Side length of square cutout: 2 centimetres
Volume of box: 832 cubic centimetres
```

c) The maximum volume is achieved when the side length of the square cutouts is approximately 3.9 cm.

7) a)
```
1  # Set value for width.
2  w=150
3
4  # Calculate length.
5  l=(450-2*w)/2
6
7  # Print length.
8  print("The length is",l,"mm")
```

b)
```
1  # Set value for width.
2  w=150
3
4  # Calculate length.
5  l=(450-2*w)/2
6
7  # Calculate area.
8  A=l*w
9
10 # Print length and area.
11 print("The length is",l,"mm")
12 print("The area is",A,"sq mm")
```

c)
```
1  # Set value for width.
2  w=150
3
4  # Calculate area.
5  A=w*(450-2*w)/2
6
7  # Print area.
8  print("The area is",A,"sq mm")
```

d) The maximum area is 12 656.25 mm^2, which occurs when the length and width are both 112.5 mm (a square).