

ENGR 102 – Fall 2021
Lab Assignment #3b

Deliverables for Lab Assignment #3b:

Please complete the two activities as described below. Each activity is an individual assignment, but you may consult your teammates and others as you work. Please submit the following files to Mimir.

- Lab3b_Act1_a.py
- Lab3b_Act1_b.py
- Lab3b_Act1_c.py
- Lab3b_Act1_d.py
- Lab3b_Act2.py
- Lab3b_challenge.py (optional)

Activity #1: *Writing Programs – individual*

Convert your program from Lab 2b Activity #1 to new programs that produce identical output. However, your new programs should take in input from the user as appropriate, store values in variables, and output in the required format. Please name the programs **Lab3b_Act1_a.py**, **Lab3b_Act1_b.py**, and so on.

Produce output for the following calculations:

- a) Use **Newton's Second Law** to calculate the net force applied to an object with a given mass in kg and a given acceleration in m/s^2 . Display the result with one (1) decimal place.
- b) Calculate the **wavelength** of x-rays scattering from a crystal lattice with a given distance between crystal layers in nm and a given scattering angle in degrees. Assume first order diffraction. Display the result with four (4) decimal places. (See **Bragg's Law** from Lab 1b and 2b)
- c) Calculate how much Radon-222 is left given a time in days, an initial amount in g, and a half-life of 3.8 days. Display the result with two (2) decimal places. (See **radioactive decay** from Labs 1b and 2b)
- d) Use the **Ideal Gas Law** to calculate the pressure of an ideal gas for a given number of moles, a given volume in m^3 , and a given temperature in K. Use a value of $8.314 \text{ m}^3\text{Pa/K}\cdot\text{mol}$ for the gas constant. Display the result with zero (0) decimal places.

Each program should perform the following tasks:

- Print what the program does to the screen
- Prompt the user to enter required data from the keyboard. Include proper units in the prompt as shown in the example output below.
- Get the inputs from the user and store them in appropriately named variables
- Perform the necessary calculations
- Output the result to the screen with proper labels and units

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See the example output on the next page for the exact wording of the input prompts and output statements. With respect to the example output below, you do **NOT** need to make your input text appear red and bold; this is only done below to highlight the example input. As always, include descriptive comments in your code so that someone may follow your programming logic.

Example output (using example inputs **2** and **5**):

```
This program calculates the applied force given mass and acceleration
Please enter the mass (kg): 2
Please enter the acceleration (m/s^2): 5
Force is 10.0 N
```

Example output (using example inputs **1** and **20**):

```
This program calculates the wavelength given distance and angle
Please enter the distance (nm): 1
Please enter the angle (degrees): 20
Wavelength is 0.6840 nm
```

Example output (using example inputs **2** and **25**):

```
This program calculates how much Radon-222 is left given time and
initial amount
Please enter the time (days): 2
Please enter the initial amount (g): 25
Radon-222 left is 17.36 g
```

Example output (using example inputs **5**, **0.2**, and **400**):

```
This program calculates the pressure given moles, volume, and
temperature
Please enter the number of moles: 5
Please enter the volume (m^3): 0.2
Please enter the temperature (K): 400
Pressure is 83 kPa
```

Activity #2: *Writing a longer program – individual*

This program provides practice for writing programs to perform multiple complex calculations, and to give you practice with basic functions.

Write a program that calculates dimensions of several regular polygons when given an area. Your program should take as input from the user a value for area and output the following values:

- The radius of a circle
- The side length of an equilateral triangle
- The side length of a square
- The side length of a regular pentagon
- The side length of a regular dodecagon (12 sides)

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We're going to ignore units for this problem. Have your program output the area using two (2) decimal places, and the shapes' dimensions with three (3) decimal places according to the example output below. Name your program `Lab3b_Act2.py`.

Before you beginning coding, you should stop and think briefly about how you want to structure your program. This activity is a great way to practice writing functions. For example, you could write one function to calculate the radius of a circle, another to calculate the side length of an equilateral triangle, and so on. Consider the short program below.

```
def howdy(num):  
    mystr = "Howdy " * num  
    print(mystr)  
  
num = int(input("How many howdys? "))  
howdy(num)
```

The function `howdy()` prints out the string "Howdy " the number of times that the user types in. Other functions can then be added that print something else, like Whoop, Gig 'em, or Reveille. These short functions help organize the code to make it easy to follow and make changes.

Example output (using input **1.25**):

```
Please enter the area: 1.25  
A circle with area 1.25 has a radius 0.631  
An equilateral triangle with area 1.25 has a side 1.699  
A square with area 1.25 has a side 1.118  
A pentagon with area 1.25 has a side 0.852  
A dodecagon with area 1.25 has a side 0.334
```

Helpful Hint: When testing/debugging a program that requires input from the keyboard, it can be quite frustrating to have to retype the input every time you want to run the program. One technique for dealing with this problem is to simply "hard code" the variable values during the debugging process (assign variable values in the code rather than retrieving values from the keyboard), then add the code to retrieve the input from the keyboard after you are sure the code works.

Challenge Program (Optional 10 bonus points):

Using *only the commands we have covered in class so far*, write a program that asks a user for a number of digits, and prints the number π (pi) rounded to that many digits of precision. Do **NOT** use the `round()` function. Instead, get creative and think of another way!

Example output (using input **5**):

```
Please enter the number of digits of precision for pi: 5  
The value of pi to 5 digits is: 3.14159
```

If you complete this challenge correctly, you will receive 10 bonus points on this assignment. Please name your program `Lab3b_challenge.py` and submit with the rest of your files.