ENGR 102 – Fall 2022
Lab 1b: ZyBook Topic 1

[11 points]

Reading assignment:

Lecture Slides	L01- L02
zyBook	*Ch1: 1.9 , 1.10, 1.11, 1.12*

Deliverables:
This is an individual assignment, but you may consult your classmates and others as you work. You must submit your own code. Please submit the following files. I suggest testing it in Python IDE first to get the hang of things, then submit your working files to **zyBooks**. If you have trouble completing any of the activities, please ask a member of the Teaching Team for assistance.

ZyBook Submission

No submission on Canvas

- `howdy_world.py`
- `print_math.py`
- `follow_directions.py`

Activity #0.[0] Login to ZyBook.

Complete 1.9 Lab: First Submission for practice

Activity #1: [2]1.10 Howdy World – individual

Write a program named `howdy_world.py` that outputs:

A) `Howdy, World!`
B) One sentence giving some interesting fact about yourself

Example output:
```
Howdy, World!
I code in python for fun.
```

Activity #2:[4] 1.11 Print math – individual
The purpose of this activity is to familiarize you with some basic engineering equations and provide practice writing a simple Python program that performs calculations and displays results.

For the equations below, write code that will display the numerical result of using the equation with the specified inputs. Notice that the inputs have units associated with them and that you will need to interpret the result using the correct units. Please include comments in your code, as needed, to describe what your code is doing.

Example: Let's say we want to compute the area of a rectangle of length 5 inches and height 3 inches. The line of code below will print the numerical result.

Code:
```
print(5 * 3)
```
Output:
```
15
```

If that is all we include in the code and in the output, it will be extremely difficult for someone to understand what the code does or to properly interpret the result. That someone may be the person grading your work, or may be you if you look back at this code in a few weeks!

Note: The code includes the line `print(5 * 3)` and not `print(15)`. We want to use a mathematical expression inside the parentheses. You'll understand why when we reuse this code in the next lab assignment.

It's good practice to use comments to document what your code is doing. You can also print out extra information to make the output more meaningful and easier to read.

New code:
```
# Calculate/print the area of a rectangle of length 5 in
# and height 3 in
print("Area of rectangle is", 5 * 3, "in^2")
```

New output:
```
Area of rectangle is 15 in^2
```

In the new version of the code, the first comment simply describes what the line of code below it does. It is not printed to the screen. Next, three separate items of information are printed to the screen using one `print()` statement:

1. `"Area of rectangle is"` – a description of the output value
2. `5 * 3` – the result of the mathematical operation
3. `"in^2"` – another string that indicates the units

Notice that these three items are separated by commas in the `print()` statement and that the "strings" consist of text enclosed inside double quotation marks. By default, when print items are separated by a comma, a space is inserted between the items when printed. If someone looks at this code and the output, they should be able to tell what you are doing without having to ask too many questions.

Write a program named `print_math.py` to produce output for the following calculations:

A) Calculate the force in Newtons applied to an object with mass 3 kg and acceleration 5.5 m/s^2. According to **Newton's Second Law** the net force applied to an object produces a proportional acceleration.

B) Calculate the wavelength of x-rays scattering from a crystal lattice with a distance between crystal layers of 0.025 nm, scattering angle of 25 degrees, and first order diffraction. **Bragg's Law** describes the scattering of waves from a crystal using the equation

$$n\lambda = 2d \sin\theta$$

The standard unit of wavelength in the SI system is nanometers (nm).

C) Calculate how much Radon-222 is left after 3 days of radioactive decay given an initial amount of 5 g and a half-life of 3.8 days. The equation for **radioactive decay** is

$$N(t) = N_0 2^{-t/t_{1/2}}$$

where N_0 is the intial amount (units of grams), t is the time (units of days), and $t_{1/2}$ is the half-life (units of days).

D) Calculate the pressure of 5 moles of an ideal gas with a volume of 0.25 m^3, and temperature of 415 K. The **Ideal Gas Law** is the equation of state of a hypothetical ideal gas and is a good approximation of the behavior of gases under many conditions. Use a value of 8.314 m^3Pa/K·mol for the gas constant. The standard unit of pressure in the SI system is kilopascals (kPa).

Example output:
```
Force is 16.5 N
Wavelength is 0.021130913087034974 nm
Radon-222 left is 2.8927755932067996 g
Pressure is 69.00619999999999 kPa
```

Activity #3 [5]: 1.12 Follow directions – individual

The purpose of this activity is to get you used to zyBooks, and to learn to follow directions. You will encounter limits of functions in calculus and learn to work with them analytically. Writing this program will introduce how limits can be calculated numerically and provide additional practice creating computational Python programs.

Certain functions are difficult to evaluate at particular values, where infinity or division by zero are involved, but can be understood by evaluating them at a number of values that approach zero or infinity. You are to write a program that produces several evaluations for one function. You should perform these evaluations by creating a sequence of print statements that output the desired numbers.

Write a program named `follow_directions.py` that performs the following tasks for the function $f(x) = (x^2 - 1)/(x - 1)$ evaluated close to $x = 1$. Use values of x ranging from 1.1 to 1.00000001 by inserting another zero after the decimal of the previous value ($x = 1.1$, $x = 1.01$, $x = 1.001$…).

1) First, print a line of text stating the purpose of the program
2) Next, print a line of text stating your guess for the final calculated value
    a. There are no wrong answers, just make a guess
    b. Think about the answer then see if your guess was close
3) Next, print out a sequence of 8 numbers, representing evaluating the function at 8 different values of x
4) Finally, print one blank line, followed by a statement of how good your guess is

As an example, for the equation $f(x) = \tan(x)/x$ evaluated close to $x = 0$, your output would look like what's shown below. Make sure your code evaluates $f(x) = (x^2 - 1)/(x - 1)$.

Example output (using $\tan(x)/x$):
```
This shows the evaluation of tan(x)/x evaluated close to x=0
My guess is 2
1.5574077246549023
1.0033467208545055
1.0000333346667207
1.0000003333334668
1.0000000033333334
1.0000000000333333
1.0000000000003333
```

```
1.0000000000000033

My guess was a little off
```