Ideal Gas Law, Pressure and Volume

# Abstract

The purpose of this exercise is to calculate the pressure and volume of the ideal gas law. The calculation will plot a scatter graph showing the relationship between pressure and volume.

# Problem Statement

Showing the relationship between variables through visual representation allows us to make better decisions based on the outcomes. The main variables withing the program are R, n, T, P, V, and temp.

# Methodology

Utilizing Python and Matplotlib to do the graphing make solving the problem fast. The Volume and Pressure are charted showing their relationship to each other based on the temperature specified. The axis labels are set withing python as well. Once the user inputs the temperature which can be set using by the user by entering the temperature and adding a space, then C, F, K. The default is set to kelvin, so no unit is needed. Then the script will output the results based on the information provided.

'''

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Functions Part 1

09/13/2020

EGN3214 - Assignment 4

Variables:

pressure - List of Pressures

volume - List of Calculated Volumes

P - Pressure in atm

n - Number of mols

T - Temperature in Kelvin

R - Universal Gas Constant on atm.L/(mol.K)

V - volume in liters

temp - throw away variable

'''

from scipy.constants import convert\_temperature

import matplotlib.pyplot as plt

import re

pressure = [0.8, 0.9, 1.0, 1.1, 1.2]

volume = []

n = 1

T = 473

def CalculateVolume(P, n, T):

R = 0.0821 # Universal Gas Constant on atm.L/(mol.K)

V = (n\*R\*T)/P

return V

def calculatePlot():

for P in pressure:

volume.append(CalculateVolume(P, n, T))

plt.xlabel("Pressure (atm)")

plt.ylabel("Volume (liters)")

plt.title(f'Pressure and Volume at {T:.2f} degrees Kelvin.')

plt.scatter(pressure, volume, color='red')

plt.show()

temperature = str(input('Enter Temperate as Temperature and Unit, i.e. 40 C Units are C,F,K defualt K: ').upper())

# Convert F to Kelvin

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if temperature[-1] == 'F':

temp = int(temperature[:-1])

T = convert\_temperature(temp, 'Fahrenheit', 'Kelvin')

calculatePlot()

# Convert C to Kelvin

elif temperature[-1] == 'C':

temp = int(temperature[:-1])

T = convert\_temperature(temp, 'Celsius', 'Kelvin')

calculatePlot()

# It is Kelvin

elif (temperature[-1] == 'K' or len(temperature.split(' ')) == 1):

if len(temperature.split(' ')) == 1:

T = int(temperature)

calculatePlot()

else:

T = int(temperature[:-1])

calculatePlot()

# It is not Kelvin

else:

print('Please enter a valid temperature and unit!')

# Solution

The following variables was set to run the script at 473 Kelvin and then again at 70 Fahrenheit. The following graphs were outputted by matplotlib.

A screenshot of a cell phone

Description automatically generated

Figure 1: Pressure and Volume at 473 Kelvin

A screenshot of a cell phone

Description automatically generated

Figure 2: Pressure and Volume at 70 Fahrenheit

# Conclusion

The ideal gas law is a perfect example of using an array and plotting the outcome. By outputting the data in a visual representation, we can interpret the information faster, instead of looking at a spreadsheet of differing numbers across multiple columns. The same conclusion can be done, but it will take much longer to conclude the wall of numbers.