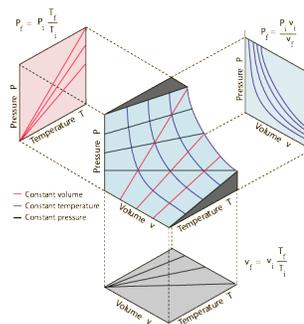


## 11B Lab 10: Ideal Gas Lab

### Objectives:

- Investigate the ideal gas law  $PV=nRT$
- Compare ideal vs. non-ideal gases

**Introduction:** An ideal gas is defined as one in which all collisions between atoms or molecules are perfectly elastic and in which there are no intermolecular attractive forces. One can visualize it as a collection of perfectly hard spheres, which collide but which otherwise, do not interact with each other. In such a gas, all the internal energy is in the form of kinetic energy and any change in internal energy is accompanied by a change in temperature. An ideal gas can be characterized by three state variables: absolute pressure (P), volume (V), and absolute temperature (T). The relationship between is called the



Ideal Gas Law:  $PV=nRT=N_A kT$

- $n$  = number of moles
- $R$  = universal gas constant = 8.3145 J/mol K
- $N$  = number of molecules
- $k$  = Boltzmann constant =  $1.38066 \times 10^{-23}$  J/K =  $8.617385 \times 10^{-5}$  eV/K
- $k = R/N_A$
- $N_A$  = Avogadro's number =  $6.0221 \times 10^{23}$  /mol

### Procedure:

1. Explore the setup:
  - a) How would you move the piston to ensure that you've maintained thermal equilibrium with the walls of the container?
  - b) Calibrate the volume and display it in Logger Pro.
  - c) Fill with Helium and take a data (Pressure and Volume) run at room temperature.
  - d) Trim the data and plot it in a way that reveals the ideal gas behavior.
  - e) Find the extra volume of the tubing and sensor from your graph. Use this value in subsequent calculations.
  - f) Normalize the data to make direct comparisons between different gases and other groups data.
2. Take a set of data with Helium. If your data from part 1 is clean enough, then you can move to the next step.
3. Take a set of data with Butane.

### Lab Write-up:

- For both Helium and Butane do the following.
  - Include a graph of V vs. P
  - Include a graph of this linearized. Find slope and intercept
  - What is the significance of the y-intercept?
  - Normalize the graph for comparison.
  - Include a single plot of He, Butane, and theory.
- Include a summary statement