THERMAL PROCESSES INTRO ACTIVITY

<u>BACKGROUND</u>:
An ideal gas is made up of "small, hard, perfectly elastic spheres acting on one another only during impact" at relatively low pressures. The relationship b/w pressure *P*, volume *V*, and temperature *T* for ideal gases is described by the Ideal Gas Law:

$$PV = nRT$$

where *n* is the number of moles, and *R* is the universal gas constant 8.31451 J/mol·K.
Another useful bit of information is the value of the Boltzmann constant: $k_B = R/N_A = 1.38066 \times 10^{-23}$ J/K

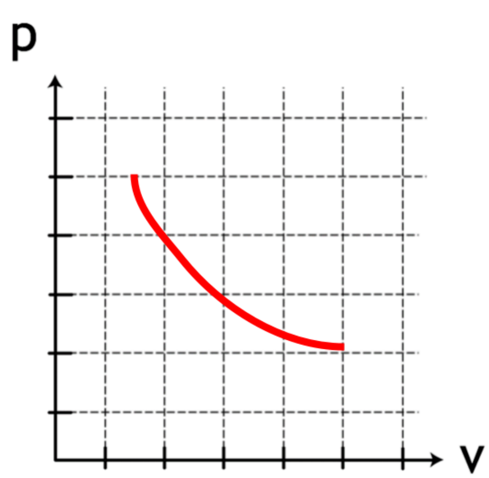
In AP Physics, ideal gases are usually encountered isolated in a piston or other container. Ideal gases can be made to go through several processes. Although an idealization, these processes have broad applications and you should make an effort to fully understand them. Here are four common ones.

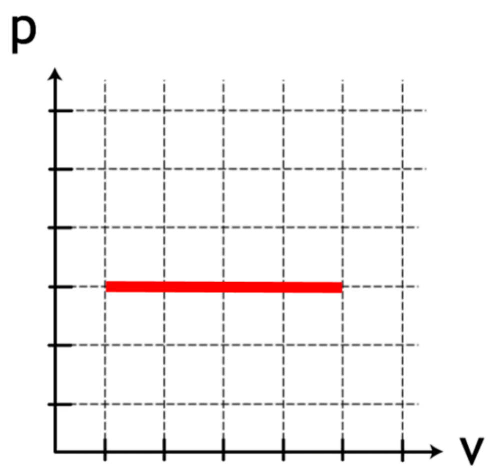
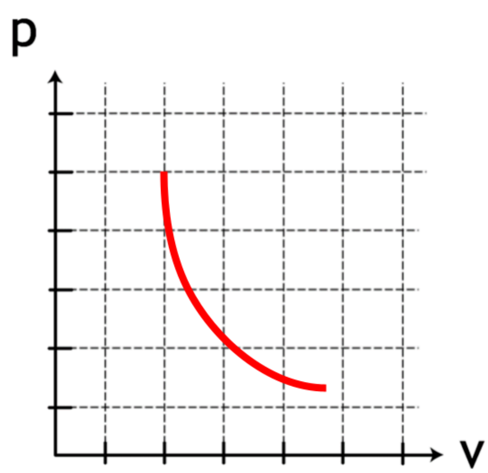
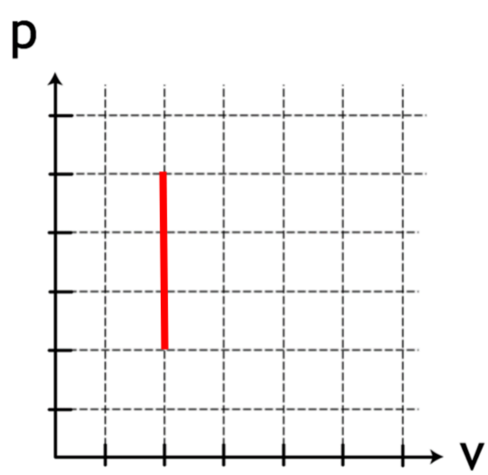
- ❏ **isothermal** – a thermodynamic process that occurs at constant temperature.
- ❏ **isobaric** – a thermodynamic process that occurs at constant pressure.
- ❏ **adiabatic** – a process in which the temperature of the gas does not change, b/c it the gas is so well insulated from the environment, or because it happens in a short time.
- ❏ **isovolumic** or **isochoric** – a process in which the volume remains constant.

<u>INSTRUCTIONS</u>:
Go to this site: http://physics.bu.edu/~duffy/HTML5/PV_diagram_heattransfer.html (linked on our site)
View the Thermodynamic processes: isobaric, isochoric, and isothermal. Add Heat at constant Volume (isochoric), Pressure (isobaric) and temperature (isothermal) and note the shape of the graph and any changes you see below.

You will also need to look at "Adiabatic processes."
Go to this site: http://physics.bu.edu/~duffy/HTML5/PV_diagram_isothermal_adiabatic.html (linked on our site)
Compare the shape of the isothermal compression and expansion to the adiabatic compression and expansion and record the shape of the adiabatic graphs and any differences you notice below.

For each process, first quickly guess the shape the graph will make, then run the simulation for that type of process and compare it to your guess and sketch/describe the shape. After that describe what happens to the pressure, volume, temperature, internal energy, heat added and work done on the gas during the process as best you can.

PROCESS	SHAPE OF GRAPH	DESCRIPTION OF CHANGES
ISOTHERMAL		The temperature stays the same, so the product of P*V is also constant. So if P gets bigger, V gets smaller resulting in an inverse relationship

ISOBARIC		Pressure is constant, so as volume increases so does temperature.
ADIABATIC		No heat is added, so all three variable may change. The shape of the graph should be a little steeper than that for an isothermal process
ISOCHORIC		Volume is constant, so as Pressure is increased the temperature also increases