***Pressure/Volume Work:*** Many engines that do work involve pistons and cylinders. Everybody know what they are? A cylinder is tube and a piston is a solid cylindrical device that exactly fits into the cylinder so that there is very little gap between the piston and the side of the cylinder.

* The piston can move up and down in the cylinder.
* Inside the cylinder, under the piston, is a gas.
* The gas cannot escape around the piston.
* Push down on the piston and the gas is compressed into a smaller volume.
* Pull up on the piston and the gas expands into a larger volume.
* The motion of the piston involves work. If you do work on the piston, you make it move. If the gas expands or is compressed causing the piston to move, then work is done on the piston.

If you add heat to the cylinder, the gas expands and pushes the piston upwards, doing work on it. We make a major assumption – that the pressure stays constant. This is actually reasonable. The area on the top of the piston doesn’t change, so the force exerted on it by the atmosphere is constant. When the piston rises to some position, the force pushing down is still the same, so the force inside pushing up must be the same as well. Since this force comes from the pressure, the pressure must still be the same.

A process like this where the pressure stays the same is called an ***isobaric process***.

The piston has moved a distance of ***Δ y***.

* A force pushed the piston upward.
* Work happens when a force causes an object to move.

So can we figure out how much work was done on the piston?

Well, we know that pressure is the force divided by the area it acts on:



The force exerted by the pressure is equal to:

*F = PA*

The definition of work is:



So, plugging in the value of the force, we get:



We know that the area of this cylinder multiplied by its height is its change in volume:





Therefore, plugging this in for *Ad* we get:

 So



We have now found that for an isobaric process, the work done is equal to the pressure multiplied by the change in volume.

To make this general, we look at a graph of pressure vs volume. For our isobaric process, the graph looks like this (see graph to the right):

The area under the curve is equal to the work that is done.



This is also true for any graph of pressure vs volume. The area under the curve is always equal to the work.

***Work done on the system is equal to the area under the curve on a P-V graph.***

