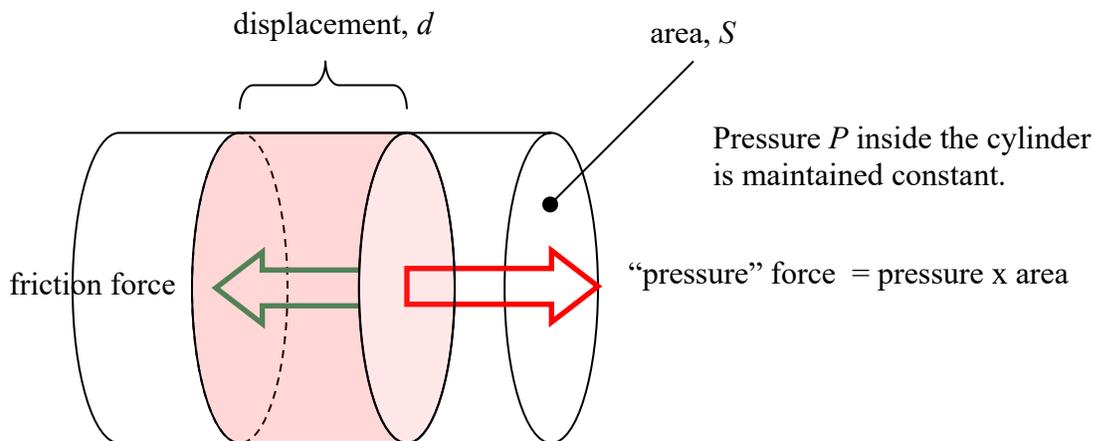


Homework 25.

Work, done by the gas.

We have learned is that gas can do work. Consider gas in a cylinder with a piston. We increased pressure inside the cylinder (say, connected the cylinder to a high-pressure gas bottle). The piston moves at a constant velocity since the “pressure force” is compensated by the friction force. The expanding gas performs the work and heats the cylinder through friction. Let us calculate this work:



Work = force x displacement = pressure x area x displacement.

Or in a short form:

$$W = P S d.$$

But, as we can see, area multiplied by the displacement gives us change in volume, which we denote as ΔV . This change in volume is represented as the pink cylinder in the figure. So,

$$W = P \cdot \Delta V$$

It is interesting that this formula is valid for a cylinder of any shape as long as the pressure is *maintained constant*. If the gas is just expanding in a cylinder, the pressure changes as the gas pushes the piston outside and the work cannot be calculated that simply.

Problems:

1. There is a cylinder with a piston. The mass of the piston is 100kg, its area is 100cm². The weight of the piston compresses the gas inside the cylinder. The volume of the compressed gas inside the cylinder is 2 liters at $T_1=273\text{K}$. The cylinder is heated up to $T_2=373\text{K}$. Calculate work done by the gas. The atmospheric pressure is $\sim 101,000\text{ Pa}$.
2. The gas in the piston of an area of 200 cm² is being heated from 250K to some higher temperature and performs work of 400J. The volume of the gas at 250K is 4 liters. The piston is weightless and can move without friction. Find the final temperature of the gas. The atmospheric pressure is $\sim 101,000\text{ Pa}$.