Combined Gas Law

We have derived the **combined gas law**: the combination $\frac{pV}{T}$ is the same in initial and final state. Because our initial and final states were completely arbitrary, we conclude that this combination is always a constant for a given gas:

$$\frac{pV}{T} = const.$$

This law contains all three gas laws what we previously discussed. Note that we only used two laws (Boyle's law and Gay-Lussac's law) in derivation and as a result we see the third one (Charles' law) as well. We have already seen this - Charles' law can be derived from the other two (in fact, if you start with any two of the three laws, the third one would follow).

The value of the combined gas law is that if we know all three parameters in a state 1 of the gas and we know two parameters in a state 2, we can find the remaining parameter in state 2.

But can we say something about the constant in the right hand side? Imagine that we consider two containers with gas, each with the same pressure and temperature but one being two times bigger in volume. Then in each half of the bigger container the amount of molecules is the same as in the smaller container. Overall we have twice as many molecules in the big container. $\frac{pV}{T}$ in the large container is also two times larger than in the small container (volume is two times bigger), so the constant in the combined gas law has to be proportional to the number of molecules.

Homework:

1. Temperature of a gas is increased 2 times (measured in Kelvin) and its' volume is decreased 3 times. How does the pressure change?

2. Draw the cyclic process shown in a figure below in the coordinates P,T and V,T.