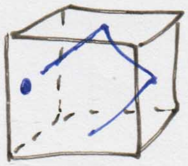
5/9/19 L!



Kinetic Energy $KE = \frac{1}{2}mv^2$

Case #1 – Balloon in fridge

Imagine a balloon is filled at regular atmospheric pressure at 25 °C. The size the balloon will adopt depends on when inside and outside pressures are equal to each other. If the balloon is then put into a refrigerator at the same external pressure, then the average kinetic energy of the molecules inside the balloon will drop due to the lower temperature. This means the molecules are not colliding with as much force on the interior of the balloon, so the volume will decrease until the pressure inside and outside are equal again.

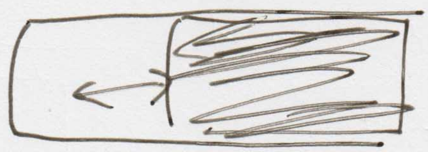
$V \propto T$ $V = cT$

↑ "is proportional to"

Case #2 – Rigid metal can

– Imagine a metal can is filled with a gas at 80 °C at regular atmospheric pressure. The can is then placed in a refrigerator. Due to the drop in temperature, the molecules on the inside of the can will move more slowly. If the can is unable to change shape, this means the pressure inside the can will drop, since the molecules won't be hitting the inside of the can with as much force.

$P \propto T$ $P = cT$



Case #3 — Piston

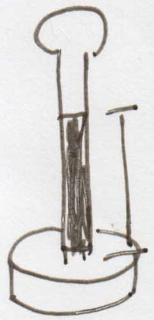
Image a sample of gas is placed inside a piston at regular atmospheric pressure at 25 °C. If the piston is then compressed, aside from lowering volume, it also reduces the surface area that the gas molecules collide with. This will cause the pressure inside the piston to increase.

$P \propto \frac{1}{V}$ $\qquad$ $PV = c$

$PV = nRT$

P — pressure; V — volume; n — moles; R — gas constant; T — temperature — <u>always</u> in K

Ideal Gas Law



1 atmosphere (atm) = 760 mm Hg

1 Pascal (Pa) = N/m^2

$$R = 0.08206 \frac{L \cdot atm}{K \cdot mol}$$

Imagine a 5.0-L container is filled with 0.50 mol of $N_2(g)$ at 20 °C. What will be the pressure inside the container?

$$P = \frac{nRT}{V} = \frac{(0.50\,mol)(0.08206\,\frac{L \cdot atm}{K \cdot mol})(293\,K)}{5.0\,L} = 2.4\,atm$$

$P_1V_1 = nRT_1$ $\qquad$ $P_2V_2 = nRT_2$

$\frac{P_1V_1}{T_1} = nR$ $\qquad$ $\frac{P_2V_2}{T_2} = nR$ $\qquad \Rightarrow \qquad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

50.0 L $\quad$ 6.89 atm $\quad$ 3 °C = 276 K

$\Rightarrow$ 22 °C = 295 K $\quad$ 0.988 atm

$$\frac{(6.89\,atm)(50.0\,L)}{276\,K} = \frac{V_2(0.988\,atm)}{295\,K} \qquad V_2 = 373\,L$$