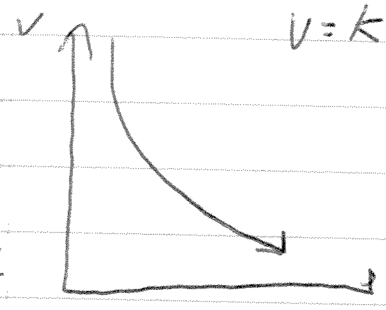
3.6 Gas Laws & Absolute Temperature

Problem: Gas generally expands to fill whatever container it is in when looking at gas, you need to look at its pressure, Volume, & Temp - (equation of state)

Boyle's Law: $PV = \text{Const.}$ $\quad V = k\frac{1}{P}$

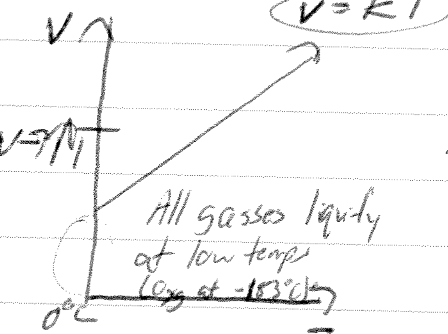
$\uparrow P \Rightarrow \downarrow V$

$\frac{PV}{T} = \text{Const.}$



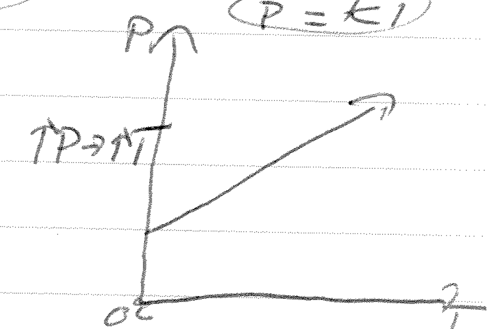
At const T

Charles Law $V = kT$



At Const. P

Gay-Lussac's $P = kT$



At const V

Ideal gas law - low pressure, high temp.

Formula to know $\quad \frac{PV}{T} = \frac{PV}{T}$ $\quad$ (T must be in kelvin)

Ex. If 5.00 m^3 of gas initially @ STP is under a const. pressure of 4 atm, the temp rises from 0°C to 40°C. Find its new volume?

$$\frac{PV}{T} = \frac{PV}{T} \qquad \frac{5\,m^3}{273\,K} = \frac{V_f}{313°} \qquad V_f = 5.73\,m^3$$

Ideal Gases

1) Large number of molecules (N) each w/ mass m moving in random directions
2) Molecules are far apart from each other
3) Molecules obey classical mechanics rules, only interact when they collide (ignore PE)
4) Collisions w/ molecules or walls are elastic

Result: Pressure on wall is due to the bombardment of molecules   ½ ↓ V ⇒ ↑ 2x strikes per sec. ⇒ ↑ 2x Pressure

* Temperature Related to KE of Molecules

$KE = \frac{3}{2} kT$ $k = 1.38 \times 10^{-23}$ J/K)

Ex. Find the average translational KE of a molecule @ 37°C

$KE = \frac{3}{2} kT = \frac{3}{2}(1.38 \times 10^{-23}\ J/K)(310) = 6.42 \times 10^{-21}\ J$

Ideal Gas Law $PV = nRT$

n = number of moles
R = universal gas constant
R = 8.315 J/(mol·K)

Volume must be in m^3