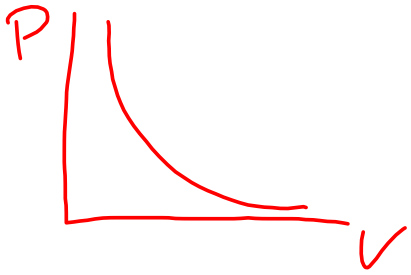
Ideal Gas Laws

Boyle's law Robert Boyle (1627-1691)

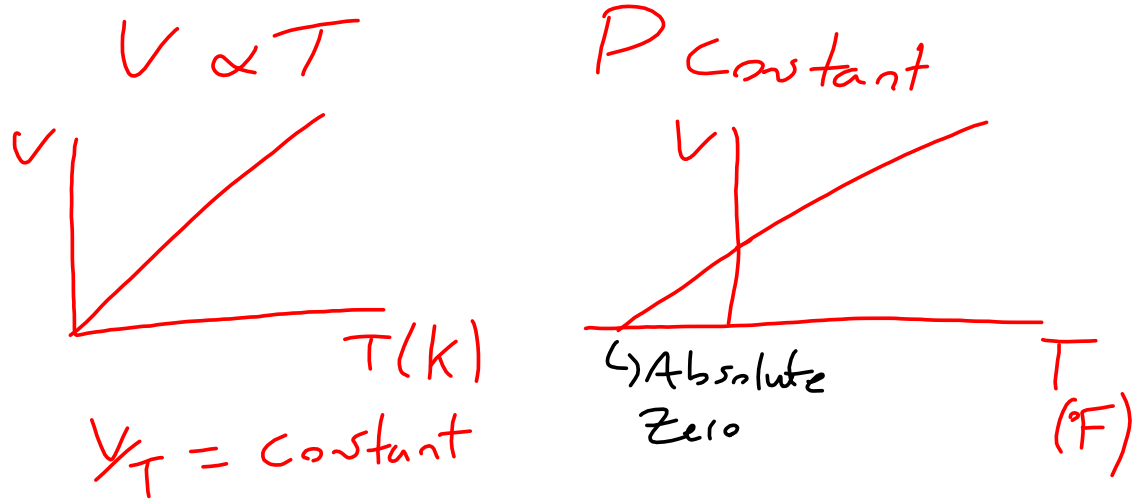
$V \propto \frac{1}{P}$

$PV = \text{Constant}$

T is constant



Charles' law Jacques Charles (1746-1823)



$T(K) = T(^{\circ}C) + 273.15$

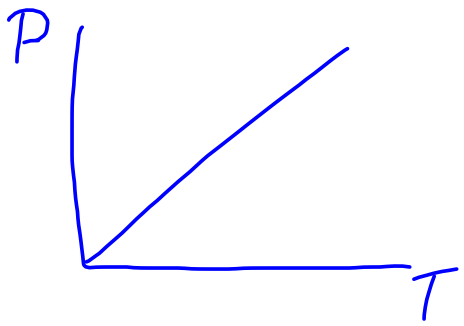
Note: Strictly, while 0 °C (actually, the melting point of ice is <0.001 °C below this) remains the standard freezing temperature of water, the boiling point of water (Vienna Standard Mean Ocean Water - VSMOW) is 99.9839 °C. The Celsius scale is now defined by absolute zero (-273.15 °C) and the triple point of water (0.01 °C) See

http://en.wikipedia.org/wiki/Celsius#The_melting_and_boiling_points_of_water

Guy-Lussac's law (Joseph Guy-Lussac, 1778-1850)

$P \propto T$ V held constant

$\frac{P}{T} = \text{constant}$



Ideal Gas Law

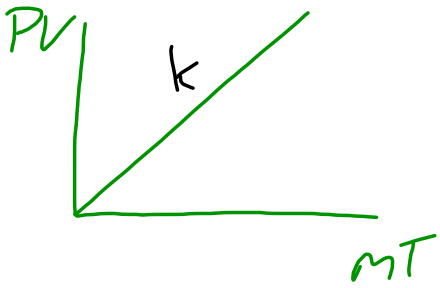
The 3 relationships suggest (but don't insist) that

$PV \propto T$

=) If we factor in mass

$PV \propto mT$

$PV = kmT$ ← k dependent on the gas



$PV = kMT$ ← k universal constant

$n = \frac{m}{M} = \frac{\text{mass}}{\text{Molar mass}}$

$PV = nRT$ → ideal gas constant $= 8.315 \frac{J}{mol \cdot K}$

$n \cdot N_A = N$ (# of molecules)

↓ mol

$PV = N\frac{R}{N_A}T$ → k (Boltzmann's constant)

$$\boxed{PV = NkT}$$

Unit of Pressure: Pa (Pascal)

$1\ Pa = 1\ \frac{N}{m^2}$

$101.325\ kPa = 1\ atm$