Gas Laws Math Summary

Ideal Gas Law	Combined Gas Law	Dalton's Law and Mole Fractions	Molar Volume	Molar Mass Kitty Cat	Gas Stoich
$\mathrm{PV = nRT}$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$	$P_{total} = P_1 + P_2 + \cdots$ $P_A = P_{total} \times X_A$ where $X_A = \frac{\text{moles A}}{\text{total moles}}$	$1\ \text{mol} = 22.4\ \text{L}$ at STP	$MM = \frac{DRT}{P} = \frac{mRT}{PV}$	One chemical (g, mol, L) → another chemical (g, mol, or L)
Use when you have **only one** of each variable	Use when conditions have **changed**	Use when you have a mixture of gases	Use to convert between quantity and volume of a gas	Use to calculate gas density	Use to convert from one chemical to a different chemical
Things to watch for: • Temp: need K • Choose R based on unit for pressure • Volume: need L	Things to watch for: • Temp: need K • Units for each variable need to be the same on both sides	Things to watch for: • Gas collection over water (or collection by water displacement): pure gas is mixed with **water vapor**	Only true at STP!!! (273 K, 1.0 atm)	Potential shortcut **When at STP:** $D = \frac{molar\ mass}{22.4\ L}$	Two types: • **L → L** (at same T and P) • **Non-STP (or NOT at same T and P):** use stoich for mol → mol, and use PV=nRT for L ↔ mol

Gas Laws Conceptual Summary

1. **Temperature is directly proportional to average kinetic energy**, which means:
   a. Same temperature = same average kinetic energy!
   b. Same temperature, different gases? High molar mass = slower, low molar mass = faster
   c. Same gas, different temperature? Higher temperature = faster, lower temperature = slower

2. **Kinetic Molecular Theory** (5 postulates): gas particles are vert small and very far apart; are in constant, rapid, random motion; bounce off things with no energy loss (elastic collisions); do not attract or repel (negligible IMFs), kinetic energy directly proportional to velocity

3. **Ideal vs Real Gases**
   a. Ideal gases: follow KMT postulates (**most ideal at high T, low P**)
   b. Real gases: have actual volume or attractive forces (most real at low T, high P)