Totally Epic AP Chem Review: Gases FTW!

Math Based on the Ideal Gas Law

Ideal Gas Law	Combined Gas Law	Molar Mass/ Density
$PV = nRT$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$	$MM = \frac{DRT}{P} = \frac{mRT}{PV}$
On the formula chart	NOT on the formula chart	NOT on the formula chart
Use when you have only 1 of each variable	Use when conditions have changed	Use to calculate molar mass or density of a gas
Things to watch out for: torr = 1 mmHg. • Temp: convert to K • Choose R based on unit for P • Volume: convert to L	Things to watch out for: • Temp: convert to K • Units for each variable need to be the Same on both sides	Time-saver: • At STP, $Density = \frac{molar\ mass}{molar\ volume}$ (22.4 L)

Other Math

Dalton's Law and Mole Fractions	Molar Volume	Gas Stoich
$P_{total} = P_1 + P_2 + \cdots$ $P_A = P_{total} \times X_A$ where $X_A = \frac{\text{moles A}}{\text{total moles}}$ (mole fraction)	1 mol = 22.4 L at STP	One chemical (g, mol, L) → another chemical (g, mol, or L)
On the formula chart	On the formula chart	NOT on the formula chart
Use when you have a mixture of gases	Use to convert between quantity and volume of a gas	Use to convert from one chemical to a different chemical
Things to watch out for: • Gas collection over water (or collection by water displacement): pure gas is mixed with H_2O vapor	Only true at STP!!! (~~273~~ K, 1.0 atm) 273.15K	Two types: • **L → L** (at same T and P) • **Non-STP (or NOT at same T and P):** When you're not at STP, Use $PV = nRT$!

Conceptual Summary

1. **Temperature is directly proportional to average kinetic energy**, which means: b/c $KE = \frac{1}{2}mv^2$
   a. Same temperature = same average kinetic energy!
   b. Same temperature, different gases? Higher molar mass = slower, lower molar mass = faster
   c. Same gas, different temperature? Heat 'em up, Speed 'em up!

2. **Kinetic Molecular Theory** (5 postulates)
    a. Gas particles are very Small and very far apart (so gases are very compressible)
    b. Gas particles bounce off walls and each other with no loss of energy (elastic collisions)
    c. Gas particles are in constant, rapid, random motion (can't stop, won't stop!)
    d. Gas particles do **NOT** attract or repel each other (no IMFs !)
    e. Average kinetic energy of a gas particle is directly proportional to its velocity: $KE = \frac{1}{2} mv^2$

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)

Let's Practice! $22g / 0.5 mol = 44 g/mol$ $11.2/22.4 = 0.5 mol$

1. A 22.0 gram sample of an unknown gas occupies 11.2 L at STP. Which of the following could be the identity of the gas?

    (a.) CO_2 b. SO_3 c. O_2 d. He

    MM = 44 g/mol

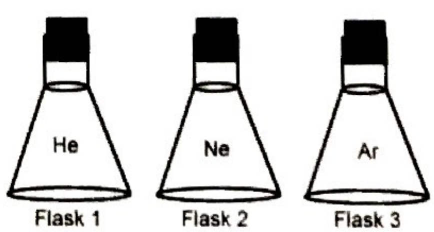
2. A sample of oxygen gas at 50°C (323 K) is heated, reaching a final temperature of 100°C (373 K). Which statement best describes the behavior of the gas molecules?
    a. Their velocity increases by a factor of two.
    b. Their velocity increases by a factor of four.
    c. Their kinetic energy increases by a factor of two.
    (d.) Their kinetic energy increases by a factor of less than two.

3. A mixture of gases contains 1.5 moles of oxygen, 3.0 moles of nitrogen, and 0.5 mole of water vapor. If the total pressure is 700 mmHg, what is the partial pressure of the nitrogen gas?

    a. 210 mmHg b. 280 mmHg c. 350 mmHg (d.) 420 mmHg

    $X_{N_2} = \frac{3.0}{5.0} = 0.6$

    $P_{N_2} = 0.6 \times 700$



4. If all of these flask are the same size, at the same temperature, and contain the same number of molecules, in which flask will the pressure be the highest?

    a. Flask 1 b. Flask 2 c. Flask 3 (d.) All have the same pressure.

    Same n, V, T ⇒ Same P