Molar Volume → #3

Name: _____
Date: _____

WHAT IS VOLUME?

- The amount of Space that an object takes up
- A solid's or liquid's volume is determined by the Size + Spacing of its particles
- At a higher temperature, particles are moving FASTER, hitting each other and bouncing further apart
- Volume is greater at higher temperatures → Grade 8 (KMT)

Mass of a mole of substance is called: Molar Mass

Volume of a mole of substance is called: Molar Volume

Avogadro's Hypothesis

- Equal volumes of different gases, measured at the same temperature and pressure, have equal equal # of particles
- Standard Temperature & Pressure → STP
  - 0°C
  - 1 atm = 101.3 kPa

The molar volume at STP is: 22.4 L

Conversion Factor: $\frac{22.4\text{ L}}{1\text{ mol}}$ OR $\frac{1\text{ mol}}{22.4\text{ L}}$

Example:
What is the volume of 1.3 mol of NO_2 gas at STP?

$$?\text{ L } NO_2 = 1.3\text{ mol } NO_2 \times \frac{22.4\text{ L}}{1\text{ mol}} = \boxed{29\text{ L}}$$

Natural gas is used to heat many homes. It consists primarily of the gas methane, CH_4. What is the mass of 8.9 L of CH_4 at STP?

$$?\text{ g } CH_4 = 8.9\text{ L } CH_4 \times \frac{1\text{ mol}}{22.4\text{ L}} \times \frac{16.05\text{ g}}{1\text{ mol}} = \boxed{6.4\text{ g } CH_4}$$

Questions: (use your Mole Maps to help!)

1. How many moles of SO_2 are in 9.5 L of SO_2 at STP?

$$?\,mol\,SO_2 = 9.5\,L\,SO_2 \times \frac{1\,mol}{22.4\,L} = \boxed{0.42\,mol\,SO_2}$$

2. 6.00 L of air at STP is compressed into a scuba tank. How many molecules of air are in the tank?

$$?\,molec\,Air = 6.00\,L\,air \times \frac{1\,mol}{22.4\,L} \times \frac{6.02 \times 10^{23}\,molec}{1\,mol} = \boxed{1.61 \times 10^{23}\,molec}$$

3. H_2S gas is released from rotten eggs. What volume of H_2S gas at STP contains 1.07g H_2S?

$$?\,L\,H_2S = 1.07\,g\,H_2S \times \frac{1\,mol}{34.09\,g} \times \frac{22.4\,L}{1\,mol} = \boxed{0.703\,L\,H_2S}$$

4. In 1 mol of H_2SO_4...
   a. How many moles of hydrogen? 2 mols
      i. What is the ratio of # mol H_2SO_4 to # mol of hydrogen? $1\,H_2SO_4 = 2\,H$
   b. How many moles of sulfur? 1 mol
      i. What is the ratio of # mol H_2SO_4 to # mol of sulfur? $1\,H_2SO_4 = 1\,S$
   c. How many moles of oxygen? 4
      i. What is the ratio of # mol H_2SO_4 to # mol of oxygen? $1\,H_2SO_4 = 4\,O$

5. How many moles of **hydrogen** are in 6.0 moles of water? → H_2O

$$?\,mol\,H = 6.0\,mol\,H_2O \times \frac{2\,H}{1\,H_2O} = \boxed{12\,mol\,H}$$

6. How many moles of **carbon** are there in 14.0 moles of C_3H_8?

$$?\,mol\,C = 14.0\,mol\,C_3H_8 \times \frac{3\,C}{1\,C_3H_8} = \boxed{42.0\,mol\,C}$$

7. Fill in the missing entry in each conversion factor below to determine the mass of carbon in 2.0 L of propane, C_3H_8 at STP.

$$\frac{2.0\,L\,C_3H_8}{1} \times \frac{1\,mol\,C_3H_8}{22.4\,L\,C_3H_8} \times \frac{3\,mol\,C}{1\,mol\,C_3H_8} \times \frac{12.01\,g\,C}{1\,mol\,C} = \boxed{3.2\,g\,C}$$

8. What volume of CO_2 at STP contains 0.20 g of carbon?

$$?\,L\,CO_2 = 0.20\,g\,C \times \frac{1\,mol}{12.01\,g} \times \frac{1\,CO_2}{1\,C} \times \frac{22.4\,L}{1\,mol} = \boxed{0.37\,L}$$