

9/11/25

CH.3 Stoichiometry

What is a Mole? fundamental unit in chemistry representing a specific number of particles.

What is Avogadro's Number?

$$6.022 \times 10^{23}$$

How many moles are in 24g of magnesium?

$$24. \text{g Mg} \cdot \frac{1 \text{ mol}}{24.305 \text{ g Mg}} = \boxed{0.987 \text{ mol Mg}}$$

- 3 sig figs

How many atoms are in 2.50 mol of calcium chloride?

$\begin{matrix} +2 & -1 \\ \text{Ca} & \text{Cl} \end{matrix} \rightarrow \text{CaCl}_2$
 M + NM = Ionic

$$2.50 \text{ mol CaCl}_2 \cdot \frac{6.022 \times 10^{23} \text{ formula units}}{1 \text{ mol CaCl}_2} \cdot \frac{3 \text{ atoms}}{1 \text{ formula unit}} = 4.5165 \times 10^{24}$$

4.517×10^{24}
 atoms
 CaCl_2

How many sulfuric acid molecules are in 5.25 g of H_2SO_4 ?

$\text{H: } 2 \times 1.008 =$
 $\text{S: } 1 \times 32.06 =$
 $\text{O: } 4 \times 16 =$
 added
 molar mass 98.076 g/mol

$$5.25 \text{ g H}_2\text{SO}_4 \cdot \frac{1 \text{ mol H}_2\text{SO}_4}{98.076 \text{ g H}_2\text{SO}_4} \cdot \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol H}_2\text{SO}_4} = \boxed{3.22 \times 10^{22} \text{ molecules H}_2\text{SO}_4}$$

How many oxygen atoms are in 6.75 g of $\text{Ca}(\text{NO}_3)_2$?

$\text{Ca: } (1 \times 40.078)$
 $\text{N: } (2 \times 14.007)$
 $\text{O: } (6 \times 16.000)$
 164.092 g/mol

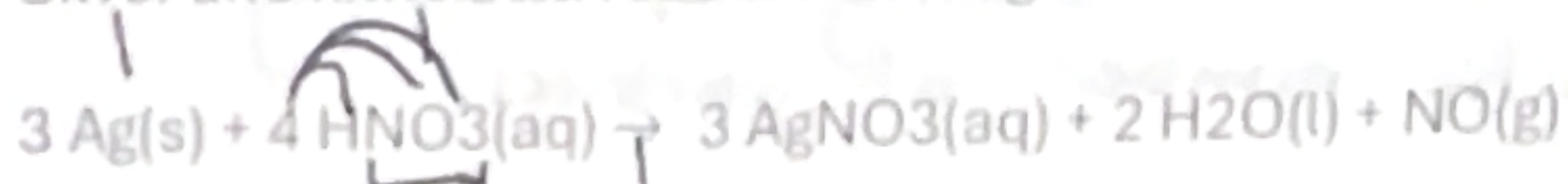
$$6.75 \text{ g Ca}(\text{NO}_3)_2 \cdot \frac{1 \text{ mol}}{164.092 \text{ g Ca}(\text{NO}_3)_2} \cdot \frac{6.022 \times 10^{23} \text{ formula units}}{1 \text{ mol}} \cdot \frac{6 \text{ atoms O}}{1 \text{ formula unit}} = \boxed{1.49 \times 10^{23} \text{ atoms Oxygen}}$$

How many formula units of calcium chloride (CaCl_2) are present in 15.0 grams of CaCl_2 ?

(Molar mass of $\text{CaCl}_2 = 110.98 \text{ g/mol}$)

$$15.0 \text{ g CaCl}_2 \cdot \frac{1 \text{ mol}}{110.98 \text{ g}} \cdot \frac{6.022 \times 10^{23} \text{ formula units}}{1 \text{ mol}} = \boxed{8.13 \times 10^{22} \text{ formula units CaCl}_2}$$

Silver and nitric acid react according to the following balanced equation:



A. How many moles of silver are needed to react with 40 moles of nitric acid?

Mole
to
Mole

$$40 \text{ mol HNO}_3 \cdot \frac{3 \text{ mol Ag}}{4 \text{ mol HNO}_3} = 30 \text{ mol Ag}$$

B. From the amount of nitric acid given in Part A, how many moles of silver nitrate will be produced?

$$40 \text{ mol HNO}_3 \cdot \frac{3 \text{ mol AgNO}_3}{4 \text{ mol HNO}_3} = 30 \text{ mol AgNO}_3$$

C. From the amount of nitric acid given in Part A, how many moles of water will be produced?

$$40 \text{ mol HNO}_3 \cdot \frac{2 \text{ mol H}_2\text{O}}{4 \text{ mol HNO}_3} = 20 \text{ mol H}_2\text{O}$$

D. From the amount of nitric acid given in Part A, how many moles of nitrogen monoxide will be made?

$$40 \text{ mol HNO}_3 \cdot \frac{1 \text{ mol NO}}{4 \text{ mol HNO}_3} = 10 \text{ mol NO}$$

What is an Empirical Formula?

Simplest whole number ratio of atoms
in a chemical compound.

List 3 steps to determine an empirical formula from the percent composition

1.) Change % to grams

2.) Change grams to moles

★ Make adjustments
when there's halves (x2)
or thirds (x3)

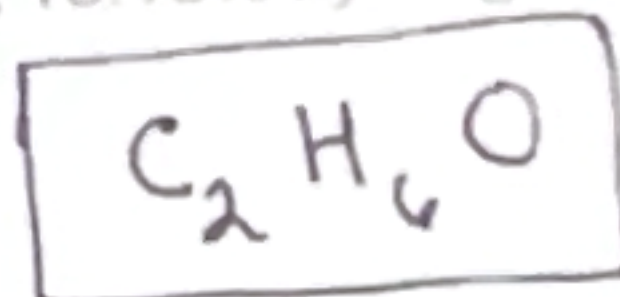
3.) Divide by least # of moles

Determine the empirical formula of a compound that is 52.14% carbon, 13.13% hydrogen, and 34.73% oxygen.

$$C - 54.14 g \cdot \frac{1 \text{ mol}}{12.011 g} = 4.34 \text{ mol} \div 2.17 \approx 2$$

$$H - 13.13 g \cdot \frac{1 \text{ mol}}{1.008 g} = 13.03 \text{ mol} \div 2.17 \approx 6$$

$$O - 34.73 g \cdot \frac{1 \text{ mol}}{16 g} = 2.17 \text{ mol} \div 2.17 = 1$$

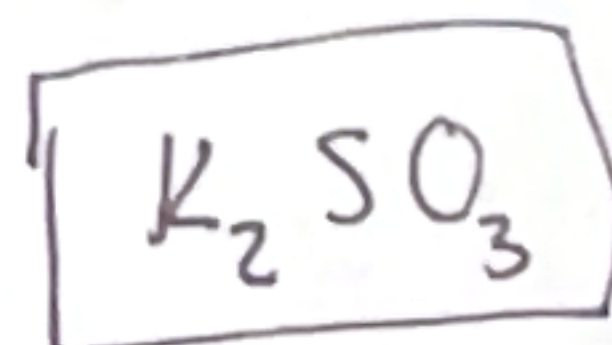


What's the empirical formula of a compound that contains 49.4% K, 20.3% S, and 30.3% O by mass?

$$49.4 g K \cdot \frac{1 \text{ mol}}{39.098 g} = 1.263 \text{ mol} \div 0.623 = 2$$

$$20.3 g S \cdot \frac{1 \text{ mol}}{32.06 g} = 0.633 \text{ mol} \div 0.623 = 1$$

$$30.3 g O \cdot \frac{1 \text{ mol}}{16.00 g} = 1.894 \text{ mol} \div 0.623 \approx 3$$



A compound has an empirical formula of CH and a molar mass of 78 g/mol.

What is its molecular formula?

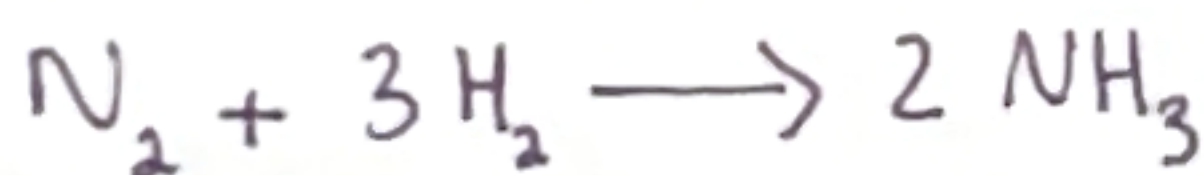
$$\frac{GFM}{EFM} = \frac{\text{molar mass}}{\text{empirical formula}}$$

$$\begin{array}{l} C: 12.011 \\ H: 1.008 \\ \hline E.F.M. \quad 13.019 \end{array} \quad \frac{78 \text{ g/mol}}{13.019 \text{ g/mol}} \approx 6 (CH) \quad \boxed{C_6H_6}$$

Define a limiting reactant:

The reactant present in smallest amount. Gets used up first.

What is the limiting reactant when 5.00 moles of nitrogen gas (N_2) react with 12.00 moles of hydrogen gas (H_2) to form ammonia (NH_3)?



$$5.00 \text{ mol } N_2 \cdot \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2} = 15 \text{ mol } H_2$$

Hydrogen gas (H_2) is limiting reactant.

Since available amount 12.00 mol is less than required amount 15 mol

Write the Percent Yield formula:

$$\frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

During the synthesis of aspirin, the theoretical yield is calculated to be 15.8 grams. If the actual amount of aspirin obtained is 12.3 grams, what is the percent yield of the reaction?

$$\begin{aligned} &= \frac{12.3 g}{15.8 g} \times 100 \\ &= \boxed{77.9\%} \end{aligned}$$