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? 6.022×10^{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?

Ca^{+2} Cl^{-1} → $CaCl_2$ ① + ② = ③

M + NM = Ionic

$$2.50\ \text{mol } CaCl_2 \cdot \frac{6.022\times10^{23}\ \text{formula units}}{1\ \text{mol } CaCl_2} \cdot \frac{3\ \text{atoms}}{1\ \text{formula units}} = 4.5165\times10^{24}$$

$\boxed{4.517\times10^{24}\ \text{atoms } CaCl_2}$

H: 2 x 1.008 =
S: 1 x 32.06 =
O: 4 x 16 =
molar mass 98.076 g/mol

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

added

$$5.25\text{g } H_2SO_4 \cdot \frac{1\ \text{mol } H_2SO_4}{98.076\ \text{g } H_2SO_4} \cdot \frac{6.022\times10^{23}\ \text{molecules}}{1\ \text{mol } H_2SO_4} = \boxed{3.22\times10^{22}\ \text{molecules } H_2SO_4}$$

How many oxygen atoms are in 6.75 g of $Ca(NO_3)_2$?

Ca: (1 x 40.078)
N: (2 x 14.007)
O: ((6 x 16.000))
164.092 g/mol

$$6.75\text{g } Ca(NO_3)_2 \cdot \frac{1\ \text{mol}}{164.092\ \text{g } Ca(NO_3)_2} \cdot \frac{6.022\times10^{23}\ \text{form. units}}{1\ \text{mol}} \cdot \frac{6\ \text{atoms O}}{1\ \text{form. units}} = \boxed{1.49\times10^{23}\ \text{atoms Oxygen}}$$

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

(Molar mass of $CaCl_2$ = 110.98 g/mol)

$$15.0\ \text{g } CaCl_2 \cdot \frac{1\ \text{mol}}{110.98\ \text{g}} \cdot \frac{6.022\times10^{23}\ \text{formula units}}{1\ \text{mol}} = \boxed{8.13\times10^{22}\ \text{formula units } CaCl_2}$$

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

$$3\,Ag(s) + 4\,HNO_3(aq) \rightarrow 3\,AgNO_3(aq) + 2\,H_2O(l) + NO(g)$$

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

Mole to Mole

$$40\ mol\ HNO_3 \cdot \frac{3\ mol\ Ag}{4\ HNO_3} = 30\ mol\ Ag$$

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

$$40\ mol\ HNO_3 \cdot \frac{3\ mol\ AgNO_3}{4\ mol\ HNO_3} = 30\ mol\ AgNO_3$$

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

$$40\ mol\ HNO_3 \cdot \frac{2\ mol\ H_2O}{4\ mol\ HNO_3} = 20\ mol\ H_2O$$

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

$$40\ mol\ HNO_3 \cdot \frac{1\ mol\ NO}{4\ mol\ HNO_3} = 10\ mol\ NO$$

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.

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

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

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

C_2H_6O

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

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

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

$30.3\,g\,O \cdot \frac{1\,mol}{16.000} = 1.894\,mol \div 0.623 \approx 3$

K_2SO_3

A compound has an empirical formula of CH and a **molar mass** of 78 g/mol. What is its molecular formula?

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

C: 12.011

H: 1.008

E.F.M 13.019

$\frac{78\,g/mol}{13.019\,g/mol} \approx 6(CH)$

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)?

$N_2 + 3H_2 \longrightarrow 2NH_3$

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

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?

'actual

$= \frac{12.3\,g}{15.8\,g} \times 100$

$= 77.9\,\%$