Stoichiometry Class Problems #2

1. According to the equation below, adding copper (Cu) to silver nitrate ($AgNO_3$) allows a chemical reaction to occur that produces silver (Ag) and copper nitrate ($Cu(NO_3)_2$).

$$Cu + 2\,AgNO_3 \rightarrow Cu(NO_3)_2 + 2\,Ag$$

A- Molecules to grams (Steps 1-4)

If 3.33×10^7 molecules of Cu are available, how many grams of silver nitrate $AgNO_3$ would react with it?

$$3.33\times10^{7}\ \text{molec Cu} \times \frac{1\ \text{mol Cu}}{(6.02\times10^{23}\ \text{molec Cu})} \times \frac{2\ \text{mol } AgNO_3}{1\ \text{mol Cu}} \times \frac{169.88\ \text{g } AgNO_3}{1\ \text{mol } AgNO_3} =$$

$$= 1.88\times10^{-4}\ \text{g } AgNO_3$$

B- Grams to atoms (Steps 1-4)

If 400.0 g of copper nitrate $Cu(NO_3)_2$ was produced, how many Cu atoms must have reacted with the copper nitrate?

$$400.0\ \text{g } Cu(NO_3)_2 \times \frac{1\ \text{mol } Cu(NO_3)_2}{187.50\ \text{g } Cu(NO_3)_2} \times \frac{1\ \text{mol Cu}}{1\ \text{mol } Cu(NO_3)_2} \times \frac{6.02\times10^{23}\ \text{Cu atoms}}{1\ \text{mol Cu}}$$

$$= 1.284\times10^{24}\ \text{Cu atoms}$$

C- Atoms to moles (Steps 1-3)

If 7.5×10^4 Ag atoms are available, how many moles of silver nitrate $AgNO_3$ would react with it?

$$7.5\times10^{4}\ \text{Ag atoms} \times \frac{1\ \text{mol Ag}}{(6.02\times10^{23}\ \text{Ag atoms})} \times \frac{2\ \text{mol } AgNO_3}{2\ \text{mol Ag}} =$$

$$= 1.2\times10^{-19}\ \text{mol } AgNO_3$$

D- Moles to molecules (steps 1, 3 and 4)

If 3.0 moles of Cu were used in the reaction, how many molecules of $Cu(NO_3)_2$ would be produced?

$$3.0\ \text{mol Cu} \times \frac{1\ \text{mol } Cu(NO_3)_2}{1\ \text{mol Cu}} \times \frac{6.02\times10^{23}\ \text{molec } Cu(NO_3)_2}{1\ \text{mol } Cu(NO_3)_2} =$$

$$= 1.8\times10^{24}\ \text{molec } Cu(NO_3)_2$$

2. Use the equation below to solve questions A and B

$$2\ HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2\ H_2O$$

A- If 700.0 g of water was produced, how many molecules of magnesium chloride ($MgCl_2$) must have reacted with the oxygen?

$$700.0\text{g}\ H_2O \times \frac{1\text{mol}\ H_2O}{18.02\text{g}\ H_2O} \times \frac{1\text{mol}\ MgCl_2}{2\text{mol}\ H_2O} \times \frac{6.02\times10^{23}\ \text{molec}\ MgCl_2}{1\text{mol}\ MgCl_2} = 1.169\times10^{25}\ \text{molec}\ MgCl_2$$

B- If 3.3×10^9 molecules of HCl are available, how many moles of water react with it?

$$3.3\times10^{9}\ \text{molec}\ HCl \times \frac{1\text{mol}\ HCl}{6.02\times10^{23}\ \text{molec}\ HCl} \times \frac{2\text{mol}\ H_2O}{2\text{mol}\ HCl} = 5.5\times10^{-15}\ \text{mol}\ H_2O$$

Mole and stoichiometry combination questions

1. 200.0 mL of NaI whose concentration is 2.0 M are reacted with $Pb(NO_3)_2$ in order to obtain the precipitate PbI_2 . Calculate the mass of PbI_2 obtained.

$$\frac{2.0\text{mol}}{L} \times .2000\text{L} = .4\text{mol}$$

$$2\ NaI + Pb(NO_3)_2 \rightarrow PbI_2 + 2\ Na(NO_3)$$

$$.4\text{mol}\ NaI \times \frac{1\text{mol}\ PbI_2}{2\text{mol}\ NaI} \times \frac{461.00\text{g}\ PbI_2}{1\text{mol}\ PbI_2} = 92\text{g}\ PbI_2$$

2. 75mL of $BaCl_2$ is used to produce $BaCrO_4$. If 4.81g of $BaCrO_4$ is made, what is the concentration of the $BaCl_2$ used? The following equation represents the reaction:

$$K_2CrO_{4\,(aq)} + BaCl_{2(aq)} \rightarrow BaCrO_{4(s)} + 2KCl_{(aq)}$$

$$4.81\text{g}\ BaCrO_4 \times \frac{1\text{mol}\ BaCrO_4}{253.33\text{g}\ BaCrO_4} \times \frac{1\text{mol}\ BaCl_2}{1\text{mol}\ BaCrO_4} = 0.018987092\text{mol}$$

$$\frac{0.018987092\text{mol}}{.075\text{L}} = .25\text{mol/L}$$

3. How many mL of a 6.0M solution of HCl are needed to react with 4.85g of $NaHCO_3$? The equation that represents the reaction follows.

$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$

$$4.85\text{g}\ NaHCO_3 \times \frac{1\text{mol}\ NaHCO_3}{84.01\text{g}\ NaHCO_3} \times \frac{1\text{mol}\ HCl}{1\text{mol}\ NaHCO_3} = 0.057731222\text{mol}$$

$$\frac{0.057731222\text{mol}}{x} = \frac{6.0\text{mol}}{L}$$

$$x = 9.6\text{mL}$$