Stoichiometry Practice #1

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 ($Cu(NO_3)_2$).

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

(x g) (2.0 g)

107.87 + 14.01 + 3(16.00) = 169.88 g/mol (107.87 g/mol)

2 : 2

You need 2.0 g of silver (Ag) for an experiment. What mass of the silver nitrate will you require to obtain the 2.0 g of silver that you need?

① balance
② given
③ molar mass
④ mole ratio

given

$$2.0\text{ g Ag} \times \frac{1\text{ mol Ag}}{107.87\text{ g Ag}} \times \frac{2\text{ mol AgNO}_3}{2\text{ mol Ag}} \times \frac{169.88\text{ g AgNO}_3}{1\text{ mol AgNO}_3} = \frac{679.520}{215.74} = 3.149\text{ g}$$

3.1 g

2. To neutralize hydrochloric acid (HCl), magnesium hydroxide ($Mg(OH)_2$), a base is added. The neutralization reaction is represented by the following equation:

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

(4.0 mol) (x g)

1.01 + 35.45 = 36.46 g/mol

24.31 + 2(16.00) + 2(1.01) = 58.33 g/mol

What mass of the $Mg(OH)_2$ is required to neutralize 4.0 moles of HCl?

2 : 1

b → g → mm → mr

given

$$4.0\text{ mol HCl} \times \frac{1\text{ mol Mg(OH)}_2}{2\text{ mol HCl}} \times \frac{58.33\text{ g Mg(OH)}_2}{1\text{ mol Mg(OH)}_2} = 116.66$$

120 g $Mg(OH)_2$

3. The following equation describes the oxidation of iron.

448g xg

$4\,Fe + 3\,O_2 \rightarrow 2\,Fe_2O_3$

How much Fe_2O_3 is formed by the complete oxidation of 448 g of iron?

55.85 g/mol $\qquad$ 2(55.85) + 3(16.00) = 159.70 g/mol

4 : 2

given

$$448\text{ g Fe} \times \frac{1\text{ mol Fe}}{55.85\text{ g}} \times \frac{2\text{ mol } Fe_2O_3}{4\text{ mol Fe}} \times \frac{159.70\text{ g } Fe_2O_3}{1\text{ mol } Fe_2O_3} = \frac{143091.200}{223.400}$$

640.516 → **641 g**

4. How many moles of ammonia (NH_3) are needed to obtain 7.00 moles of copper (Cu) according to the following unbalanced equation?

x mol 7.00 mol

$3\,CuO + 2\,NH_3 \rightarrow N_2 + 3\,Cu + 3\,H_2O$

2 : 3

$$7.00\text{ mol Cu} \times \frac{2\text{ mol } NH_3}{3\text{ mol Cu}} \rightarrow 4.666 \rightarrow \boxed{4.67\text{ mol } NH_3}$$

5. You would like to produce 40.0 g of iron (Fe), what mass of iron oxide (Fe_2O_3) is needed? The following balanced equation represents the reaction.

x g 40.0g

$Fe_2O_3 + 3\,C \rightarrow 2\,Fe + 3\,CO$

159.7g/mol 55.85 g/mol

1 : 2

given

$40.0\,g\,Fe \times \frac{1\,mol\,Fe}{55.85\,g\,Fe} \times \frac{1\,mol\,Fe_2O_3}{2\,mol\,Fe} \times \frac{159.7\,g\,Fe_2O_3}{1\,mol\,Fe_2O_3} = 57.1888$

$\downarrow$

$57.2\,g\,Fe_2O_3$

6. According to the following unbalanced equation, how many molecules of the product will be made if 6 moles of water react?

6 mol x molecules

$B_2O_3 + 3\,H_2O \rightarrow 2\,H_3B_2O_3$

3 : 2

$6\,mol\,H_2O \times \frac{2\,mol\,H_3BO_3}{3\,mol\,H_2O} \times \frac{6.023 \times 10^{23}\,molecules\,H_3BO_3}{1\,mol\,H_3BO_3}$

2.408×10^{24}

$\downarrow$

2×10^{24} molecules H_3BO_3

7. 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:

75 mL 4.81 g

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

$137.33 + 2(35.45) = 208.23\ g/mol$ → $137.33 + 52.00 + 4(16.00) = 253.33\ g/mol$

1 : 1

(1) Given

$4.81\ g\ BaCrO_4 \times \frac{1\ mol\ BaCrO_4}{253.33\ g/mol} \times \frac{1\ mol\ BaCl_2}{1\ mol\ BaCrO_4} = 0.018987\ mol$

(2) $\frac{0.018987\ mol}{75\ ml} : \frac{x\ mol}{1000\ ml} = 0.25316 \rightarrow$ **0.25 mol/L**

8. 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.

4.85 g 6.0M

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

$22.99 + 1.01 + 12.01 + 3(16.00) = 84.01\ g/mol$ → $1.01 + 35.45 = 36.46\ g/mol$

1 : 1

Given

(1) $4.85\ g\ NaHCO_3 \times \frac{1\ mol\ NaHCO_3}{84.01\ g\ NaHCO_3} \times \frac{1\ mol\ HCl}{1\ mol\ NaHCO_3} \rightarrow 0.0577\ mol$

(2) $\frac{0.0577\ mol}{x\ ml} : \frac{6.0\ mol}{1000\ ml} \rightarrow 9.61666 \rightarrow$ **9.6 ml**