KEY

Solutions Worksheet (Solution Stoichiometry)

1. How many mL of 0.125M NaOH will react with 30.00 mL of 0.400M $CuSO_4$ solution?

$$2NaOH_{(aq)} + CuSO_{4(aq)} \rightarrow Cu(OH)_{2(s)} + Na_2SO_{4(aq)}$$

$$mL\ NaOH = 30.00\ mL\ CuSO_4 \times \frac{0.400\ mol\ CuSO_4}{1000\ mL\ Sol} \times \frac{2\ mol\ NaOH}{1\ mol\ CuSO_4} \times \frac{1000\ mL\ NaOH}{0.125\ mol\ NaOH}$$

$$= 192\ mL\ NaOH$$

2. How many grams of barium sulfate will result from mixing 345 mL of 0.237 M sodium sulfate with 484 mL of 0.132 M barium chloride?

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_{4(s)} + 2NaCl$$

You need to recognize this is a limiting reagent problem!

$BaCl_2$ Path

$$mol\ BaSO_4 = \frac{0.132\ mol\ BaCl_2}{1000\ mL\ Sol.} \times 484\ mL\ Sol \times \frac{1\ mole\ BaSO_4}{1\ mole\ BaCl_2} = 6.39 \times 10^{-2}\ mol\ BaSO_4$$

Na_2SO_4 Path

$$mol\ BaSO_4 = \frac{0.237\ mol\ Na_2SO_4}{1000\ mL\ Sol.} \times 345\ mL\ Sol \times \frac{1\ mol\ BaSO_4}{1\ mol.\ Na_2SO_4} = 8.18 \times 10^{-2}\ mol\ BaSO_4$$

$6.39 \times 10^{-2} < 8.18 \times 10^{-2}$ ∴ $BaCl_2$ is limiting

$$g\ BaSO_4 = 6.39 \times 10^{-2}\ mole\ BaSO_4 \times \frac{233.4\ g}{1\ mole\ BaSO_4} = \boxed{14.9\ g\ BaSO_4}$$

molar mass $BaSO_4 = 233.4\ g/mol$

Answers: 1) 192 mL NaOH 2) 14.9 g $BaSO_4$

3. If 25.0 mL of 0.0500M $FeCl_2$ solution are mixed with 5.00 mL of 0.200M K_3PO_4 solution, how many grams of $Fe_3(PO_4)_2$ (s) will form?

$$3FeCl_2(aq) + 2K_3PO_4(aq) \longrightarrow Fe_3(PO_4)_2 + 6KCl(aq)$$

$FeCl_2$ Path

$$\text{mol } Fe_3(PO_4)_2 = 25.0\text{ mL } FeCl_2 \text{ Sol} \times \frac{0.0500\text{ mol } FeCl_2}{1000\text{ mL Sol}} \times \frac{1\text{ mole } Fe_3(PO_4)_2}{3\text{ mole } FeCl_2} = 4.167 \times 10^{-4} \text{ mol } Fe_3(PO_4)_2$$

K_3PO_4 Path

$$\text{mol } Fe_3(PO_4)_2 = 5.00\text{ mL } K_3PO_4 \text{ Sol} \times \frac{0.200\text{ mol } K_3PO_4}{1000\text{ mL Sol}} \times \frac{1\text{ mol } Fe_3(PO_4)_2}{2\text{ mol } K_3PO_4} = 5.00 \times 10^{-4} \text{ mol } Fe_3(PO_4)_2$$

$4.17 \times 10^{-4} < 5.00 \times 10^{-4}$ ∴ $FeCl_2$ is limiting

$$g\ Fe_3(PO_4)_2 = 4.167 \times 10^{-4}\text{ mole } Fe_3(PO_4)_2 \times \frac{357.5\text{ g}}{1\text{ mole } Fe_3(PO_4)_2} = \boxed{0.149\text{ g } Fe_3(PO_4)_2}$$

4. How many mL of 0.422 M silver nitrate will be necessary to precipitate all the chloride in 125 mL of 0.274 M magnesium chloride solution?

$$2AgNO_3(aq) + MgCl_2(aq) \longrightarrow 2AgCl(s) + Mg(NO_3)_2(aq)$$

$$\text{mL } AgNO_3 = 125\text{ mL } MgCl_2 \text{ Sol} \times \frac{0.274\text{ mol } MgCl_2}{1000\text{ mL}} \times \frac{2\text{ mole } AgNO_3}{1\text{ mole } MgCl_2} \times \frac{1000\text{ mL}}{0.422\text{ mol } AgNO_3}$$

$$= \boxed{162\text{ mL } AgNO_3}$$

Answers: 3) 0.149 g $Fe_3(PO_4)_2$ 4) 162 mL $AgNO_3$