Name _____ AP Chem ___/___/___

## Chapter 4 Homework #1

In a few minutes I will add 20.0 mL of 0.50 M lead(II) nitrate to 15.0 mL of 1.0 M sodium iodide.

1. What is the formula of the precipitate?
2. What substance is the limiting reagent?
3. What mass of precipitate formed?
4. Determine the concentration of each ion remaining in solution.

① $PbI_2$

② $Pb(NO_3)_2 + 2NaI \rightarrow 2NaNO_3 + PbI_2$

$0.50 = \frac{x}{20}$ $\quad 1.0 = \frac{x}{15}$

$x = 10$ mmol $\quad x = 15$ mmol

NaI is the Limiting Reagent

③ $0.015$ mol NaI $\left|\frac{1\text{ mol } PbI_2}{2\text{ mol NaI}}\right|\left|\frac{461.0\text{ g } PbI_2}{1\text{ mol } PbI_2}\right| = \boxed{3.5\text{ g } PbI_2}$

④ $Na^+$ : $15$ mmol $\div 35$ mL $= \boxed{0.43\text{ M } Na^+}$

$NO_3^{1-}$ : $10$ mmol $\times 2 = 20$ mmol $\div 35$ mL $= \boxed{0.57\text{ M } NO_3^{1-}}$

$Pb^{2+}$ : $\left|\frac{15\text{ mmol NaI}}{2\text{ mol NaI}}\right|\left|\frac{1\text{ mol } Pb(NO_3)_2}{}\right| = 7.5$ mmol $Pb(NO_3)_2$ needed

$10. - 7.5 = 2.5$ mmol excess $\div 35$ mL $= \boxed{0.071\text{ M } Pb^{2+}}$

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**Molarity Practice** - Solve each of the following without using a calculator.

1. How many moles of solid $Ba(NO_3)_2$ should be added to 400. mL of 0.20 molar $Fe(NO_3)_3$ to increase the concentration of the $NO_3^-$ ion to 1.0 molar? (Assume that the volume of the solution remains constant.)

$.20 = \frac{x}{0.400}$ $x = 0.080 \times 3 = 0.24$ $1.0 = \frac{x}{0.40}$ $x = 0.40$ $0.40 - 0.24 = 0.16$ $0.16 \div 2 = 0.080$ mol

2. When 70. milliliters of 3.0-molar $Na_2CO_3$ is added to 30. milliliters of 1.0-molar $NaHCO_3$ the resulting concentration of $Na^+$ is:

$3 \times 70 = 210$ mmol $\times 2 = 420$ $1 \times 30 = 30$ $\frac{450}{100} = 4.5$ M

3. The weight of $H_2SO_4$ (molecular weight 98.1) in 250.0 milliliters of a 6.00 molar solution is:

$6 = \frac{x}{0.25}$ $x = 1.5$ mol $\times 98.1 =$ 150. g

4. When 140. mL of 3.0-molar $Na_2CO_3$ is added to 30. milliliters of 1.0-molar $NaHCO_3$ the resulting concentration of $Na^+$ is:

$3 \times 140 = 420 \times 2 = 840$ $1 \times 30$ $\frac{30}{870}$ $\frac{870}{170} = 5.1$ M

5. The weight of $H_2SO_4$ (molecular weight 98.1) in 50.0 milliliters of a 6.00 molar solution is:

$6 = \frac{x}{0.050}$ $x = 0.30 \times 98.1 =$ 30 g

6. What is the final concentration of barium ions, $[Ba^{2+}]$, in solution when 100. mL of 0.10 M $BaCl_2(aq)$ is mixed with 100. mL of 0.050 M $H_2SO_4(aq)$?

$BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

.01 mol .005 mol

1:1 ratio $0.01 - 0.005 = 0.005$ mol excess

$[Ba^{2+}] = \frac{0.005}{0.2} = 0.025$ M

7. How many moles of solid $Ba(NO_3)_2$ should be added to 300. mL of 0.20 molar $Fe(NO_3)_3$ to increase the concentration of the $NO_3^-$ ion to 1.0 molar? (Assume that the volume of the solution remains constant.)

$.20 = \frac{x}{0.300}$ $x = 0.060 \times 3 = 0.18$ $1.0 = \frac{x}{0.300}$ $x = 0.300$ $0.300 - 0.18 = 0.12$ $0.12 \div 2 = 0.060$ mol

8. How many moles of solid $Ba(NO_3)_2$ should be added to 700. mL of 0.20 molar $Fe(NO_3)_3$ to increase the concentration of the $NO_3^-$ ion to 0.80 molar? (Assume that the volume of the solution remains constant.)

$.2 = \frac{x}{0.700}$ $x = 0.14 \times 3 = 0.42$ $0.80 = \frac{x}{0.700}$ $x = 0.56$ $0.56 - 0.42 = 0.14$ $0.14 \div 2 = 0.070$ mol

9. When 90. milliliters of 3.0-molar $Na_2CO_3$ is added to 40. milliliters of 1.0-molar $NaHCO_3$ the resulting concentration of $Na^+$ is:

$3 = \frac{x}{90}$ $x = 270$ mmol $\times 2 = 540$ $1 = \frac{x}{40}$ $x = 40$ mmol $540 + 40 = \frac{580 \text{ mmol}}{130 \text{ mL}} =$ 4.5 M

10. The weight of $H_2SO_4$ (molecular weight 98.1) in 150.0 milliliters of a 3.00 molar solution is:

$3 = \frac{x}{0.150}$ $x = 0.450 \times 98.1 =$ 45 g