Name:________________

SCH 4C
Stoichiometry Unit Test

1. Balance the following equations

a) $3Li_2CO_3 + 2FeCl_3 \rightarrow 6LiCl + Fe_2(CO_3)_3$

b) $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

2. Perform each unit conversion. Be sure to use complete and extended units:

a) convert 72.9 g of NH_3 to number of molecules of NH_3

$$72.9 \text{ g } NH_3 \times \frac{1 \text{ mol } NH_3}{17.04 \text{ g } NH_3} \times \frac{6.022 \times 10^{23} \text{ molec } NH_3}{1 \text{ mol } NH_3} = 2.57 \times 10^{24} \text{ molec } NH_3$$

b) convert 8.79×10^{24} H atoms to the equivalent mass of CH_4

$$8.79 \times 10^{24} \text{ atoms H} \times \frac{1 \text{ molec } CH_4}{4 \text{ atoms H}} \times \frac{1 \text{ mol } CH_4}{6.022 \times 10^{23} \text{ molec } CH_4}$$

$$\times \frac{16.04 \text{ g } CH_4}{1 \text{ mol } CH_4} = 58.5 \text{ g } CH_4$$

3. What mass of strontium nitrate is required to form 890.0 g of strontium phosphate?

$3Sr(NO_3)_2 + 2K_3PO_4 \rightarrow Sr_3(PO_4)_2 + 6KNO_3$

$$890.0 \text{ g } Sr_3(PO_4)_2 \times \frac{1 \text{ mol } Sr_3(PO_4)_2}{452.80 \text{ g } Sr_3(PO_4)_2} \times \frac{3 \text{ mol } Sr(NO_3)_2}{1 \text{ mol } Sr_3(PO_4)_2}$$

$$\times \frac{211.64 \text{ g } Sr(NO_3)_2}{1 \text{ mol } Sr(NO_3)_2} = 1248 \text{ g } Sr(NO_3)_2$$

4. What amount of sodium carbonate is require to form 450.0 g of iron(III) carbonate

$$3Na_2CO_3 \quad + \quad 2Fe(NO_3)_3 \quad \rightarrow \quad Fe_2(CO_3)_3 \quad + \quad 6NaNO_3$$

$$450.0 \text{ g } Fe_2(CO_3)_3 \text{ x } \frac{1 \text{ mol } Fe_2(CO_3)_3}{291.73 \text{ g } Fe_2(CO_3)_3} \text{ x } \frac{3 \text{ mol } Na_2CO_3}{1 \text{ mol } Fe_2(CO_3)_3}$$

$$= 4.63 \text{ mol } Na_2CO_3$$

5. What is the maximum possible mass of chromium(III) hydroxide that can form from 40.0 g of chromium(III) sulphate and 22.0 g of sodium hydroxide

$Cr_2(SO_4)_3$	+	$6NaOH$	$\rightarrow$	$2Cr(OH)_3$	+	$3Na_2SO_4$
40.0 g		22.0 g		? g		

$$40.0 \text{ g } Cr_2(SO_4)_3 \text{ x } \frac{1 \text{ mol } Cr_2(SO_4)_3}{392.21 \text{ g } Cr_2(SO_4)_3} \text{ x } \frac{2 \text{ mol } Cr(OH)_3}{1 \text{ mol } Cr_2(SO_4)_3}$$

$$\text{x } \frac{103.03 \text{ g } Cr(OH)_3}{1 \text{ mol } Cr(OH)_3} = 21.0 \text{ g } Cr(OH)_3$$

$$22.0 \text{ g NaOH x } \frac{1 \text{ mol NaOH}}{40.00 \text{ g NaOH}} \text{ x } \frac{2 \text{ mol } Cr(OH)_3}{6 \text{ mol NaOH}}$$

$$\text{x } \frac{103.03 \text{ g } Cr(OH)_3}{1 \text{ mol } Cr(OH)_3} = 18.9 \text{ g } Cr(OH)_3$$

therefore the maximum possible mass of chromium(III) hydroxide that can form is 18.9 g $Cr(OH)_3$

6. Determine the concentration of each of the following solutions:

a) 550 mL of a solution that contains 0.025 mol of HCl

n = 0.025 mol HCl C = ? V = 550 mL ➜ 0.550 L	$C = \frac{n}{V}$ $C = \frac{0.025\ \text{mol}}{0.550\ \text{L}}$ C = 0.0455 mol / L C = 0.0455 M

b) 750 mL of a solution that contains 0.025 g of HCl

$n = 0.025\ \text{g HCl} \times \frac{1\ \text{mol HCl}}{36.46\ \text{g HCl}} = 0.000686\ \text{mol HCl}$ C = ? V = 750 mL ➜ 0.750 L	$C = \frac{n}{V}$ $C = \frac{0.000686\ \text{mol}}{0.750\ \text{L}}$ C = 0.000914 mol / L C = 0.000914 M

c) 4.0 L of a solution of sulphuric acid made through the dilution of 25 mL of 12.0 M H_2SO_4

C_S = 12.0 M V_S = 25 mL ➜ 0.025 L C_D = ? V_D = 4.0 L	$C_D = \frac{C_S \times V_S}{V_D}$ $C_D = \frac{12.0\ \text{M} \times 0.025\ \text{L}}{4.0\ \text{L}}$ C_D = 0.075 M

7. Determine the mass of Na_2CO_3 required to make 4.0 L of 0.1 M sodium carbonate solution.

n = ? C = 0.1 M V = 4.0 L	$n = CV$ $n = 0.1 \ \text{mol}/\text{L} \times 4.0 \ \text{L}$ $n = 0.4 \ \text{mol} \ Na_2CO_3$ $0.4 \ \text{mol} \ Na_2CO_3 \times \frac{105.99 \ \text{g} \ Na_2CO_3}{1 \ \text{mol} \ Na_2CO_3} = 42.4 \ \text{g} \ Na_2CO_3$

8. Determine the concentration of solution that would result if 45.0 g of $NaHCO_3$ is dissolved in 1.0 L of water. What will this concentration become if 4.0 L of water is added?

$n = 45.0 \ \text{g} \ NaHCO_3 \times \frac{1 \ \text{mol} \ NaHCO_3}{84.01 \ \text{g} \ NaHCO_3} = 0.536 \ \text{mol} \ NaHCO_3$ C = ? V = 1.0 L	$C = \frac{n}{V}$ $C = \frac{0.536 \ \text{mol}}{1.0 \ \text{L}}$ $C = 0.536 \ \text{mol} / \text{L}$ $C = 0.536 \ \text{M}$

Adding 4.0 L of water to 1.0 L increases the total volume to 5.0 L. There is no change in amount. Therefore	
n = 0.536 mol $NaHCO_3$ (see above) C = ? V = 5.0 L	$C = \frac{n}{V}$ $C = \frac{0.536 \ \text{mol}}{5.0 \ \text{L}}$ $C = 0.107 \ \text{mol} / \text{L}$ $C = 0.107 \ \text{M}$

9. What is the maximum possible amount of lead(II) iodide precipitate that could form from the reaction of 500 mL of 0.25 M lead(II) nitrate mixed with 400 mL of 0.30 M potassium iodide?

$$Pb(NO_3)_2(aq) \quad + \quad 2KI(aq) \quad \rightarrow \quad PbI_2(s) \quad + \quad 2KNO_3(aq)$$

consider $Pb(NO_3)_2$

n = ? C = 0.25 M V = 500 mL ➜ 0.500 L	$n = CV$ $n = 0.25\ \text{mol}/\text{L} \times 0.500\ \text{L}$ $n = 0.125\ \text{mol}$
$0.125\ \text{mol}\ Pb(NO_3)_2 \times \frac{1\ \text{mol}\ PbI_2}{1\ \text{mol}\ Pb(NO_3)_2} = 0.125\ \text{mol}\ PbI_2$	

consider KI

n = ? C = 0.30 M V = 400 mL ➜ 0.400 L	$n = CV$ $n = 0.30\ \text{mol}/\text{L} \times 0.400\ \text{L}$ $n = 0.12\ \text{mol}$
$0.12\ \text{mol KI} \times \frac{1\ \text{mol}\ PbI_2}{2\ \text{mol KI}} = 0.06\ \text{mol}\ PbI_2$	

therefore the maximum possible amount of lead(II) iodide is 0.06 mol PbI_2

BONUS: Determine the concentration of potassium ion in p.p.m. for 250 mL of solution that contains a mass of 0.0015 g of K_2CO_3

$$\frac{0.0015\ \text{g}\ K_2CO_3}{250\ \text{mL}} \times \frac{1\ \text{mol}\ K_2CO_3}{138.21\ \text{g}\ K_2CO_3} \times \frac{2\ \text{mol}\ K^{1+}}{1\ \text{mol}\ K_2CO_3} \times \frac{39.10\ \text{g}\ K^{1+}}{1\ \text{mol}\ K^{1+}}$$

$$\times \frac{1000\ \text{mg}}{1\ \text{g}} \times \frac{1000\ \text{mL}}{1\ \text{L}} = \frac{3.395\ \text{mg}\ K^{1+}}{1\ \text{L}} \rightarrow 3.395\ \text{p.p.m.}\ K^{1+}\ \text{ion}$$