Name:_____

Stoichiometry Review
SCH 4C

1. Balance each of the following equations:

a) $Na_2O + H_2O \rightarrow 2NaOH$

b) $K_2CO_3 \rightarrow K_2O + CO_2$

c) $Pb_3N_2 + 6KCl \rightarrow 2K_3N + 3PbCl_2$

d) $O_2 + 2H_2O \rightarrow 2H_2O_2$

e) $2KCl + 3O_2 \rightarrow 2KClO_3$

2. Perform each of the requested conversions

a) convert 23.6 g of CO_2 to an amount (in mol) of CO_2

$$23.6\,g\,CO_2 \times \frac{1\,mol\,CO_2}{44.01\,g\,CO_2} = 0.536\,mol\,CO_2$$

b) convert 8.7 mol of NaCl to a mass in g of NaCl

$$8.7\,mol\,NaCl \times \frac{58.44\,g\,NaCl}{1\,mol\,NaCl} = 508\,g\,NaCl$$

c) convert 1.40 mol of $C_6H_{12}O_6$ to number of molecules

$$1.40\,mol\,C_6H_{12}O_6 \times \frac{6.022\times10^{23}\,molec\,C_6H_{12}O_6}{1\,mol\,C_6H_{12}O_6} = 8.43\times10^{23}\,molec\,C_6H_{12}O_6$$

d) convert 1.40 mol of $C_6H_{12}O_6$ to number of hydrogen atoms

$$1.40\,mol\,C_6H_{12}O_6 \times \frac{6.022\times10^{23}\,molec\,C_6H_{12}O_6}{1\,mol\,C_6H_{12}O_6} \times \frac{12\,H\,atoms}{1\,molec\,C_6H_{12}O_6} = 1.01\times10^{25}\,atoms$$

e) convert 2.37×10^{24} molecules of C_2H_6 to a mass in g of C_2H_6

$$2.37\times10^{24}\,molec\,C_2H_6 \times \frac{1\,mol\,C_2H_6}{6.022\times10^{23}\,molec\,C_2H_6} \times \frac{30.08\,g\,C_2H_6}{1\,mol\,C_2H_6} = 118\,g\,C_2H_6$$

3. What mass of silver chloride will form if 24.3 g of aluminum chloride is reacted.

$$3\ AgNO_3 + AlCl_3 \rightarrow 3\ AgCl + Al(NO_3)_3$$

$$24.3g\ AlCl_3 \times \frac{1mol\ AlCl_3}{133.33g\ AlCl_3} \times \frac{3mol\ AgCl}{1mol\ AlCl_3} \times \frac{143.32g\ AgCl}{1mol\ AgCl} = 78.4g\ AgCl$$

4. What mass of sodium phosphate is required to form 122 g of calcium phosphate

$$2\ Na_3PO_4 + 3\ Ca(NO_3)_2 \rightarrow Ca_3(PO_4)_2 + 6\ NaNO_3$$

$$122g\ Ca_3(PO_4)_2 \times \frac{1mol\ Ca_3(PO_4)_2}{310.18g\ Ca_3(PO_4)_2} \times \frac{2mol\ Na_3PO_4}{1mol\ Ca_3(PO_4)_2} \times \frac{163.94g\ Na_3PO_4}{1mol\ Na_3PO_4} = 128.96g\ Na_3PO_4$$

5. What amount of lithium carbonate will form from the reaction of 3.42 g of lithium metal

$$2\ Li + H_2CO_3 \rightarrow Li_2CO_3 + H_2$$

$$3.42g\ Li \times \frac{1mol\ Li}{6.94g\ Li} \times \frac{1mol\ Li_2CO_3}{2mol\ Li} = 0.246\ mol\ Li_2CO_3$$

6. What mass of uranium hexafluoride will form from the reaction of 25.0 mol of fluoride gas

$$2\ UO_3 + 6\ F_2 \rightarrow 2UF_6 + 3O_2$$

$$25.0mol\ F_2 \times \frac{2mol\ UF_6}{6mol\ F_2} \times \frac{352.03g\ UF_6}{1mol\ UF_6} = 2930g\ UF_6$$

7. What mass of sodium sulphate and what mass of hydrogen carbonate will form from 65.0 g of sodium carbonate

$$H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + H_2CO_3$$

$$65.0g\ Na_2CO_3 \times \frac{1mol\ Na_2CO_3}{105.99g\ Na_2CO_3} \times \frac{1mol\ Na_2SO_4}{1mol\ Na_2CO_3} \times \frac{142.05g\ Na_2SO_4}{1mol\ Na_2SO_4}$$

$$= 87.11g\ Na_2SO_4$$

$$65.0g\ Na_2CO_3 \times \frac{1mol\ Na_2CO_3}{105.99g\ Na_2CO_3} \times \frac{1mol\ H_2CO_3}{1mol\ Na_2CO_3} \times \frac{62.03g\ H_2CO_3}{1mol\ H_2CO_3} = 38.0g\ H_2CO_3$$

8. What mass of aluminum carbonate will form from the reaction of 32.0 g of aluminum nitrate with 22.0 g of potassium carbonate

$$2\,Al(NO_3)_3 + 3\,K_2CO_3 \rightarrow Al_2(CO_3)_3 + 6\,KNO_3$$

$$32.0\,g\ Al(NO_3)_3 \times \frac{1\,mol\ Al(NO_3)_3}{213.00\,g\ Al(NO_3)_3} \times \frac{1\,mol\ Al_2(CO_3)_3}{2\,mol\ Al(NO_3)_3} \times \frac{233.99\,g\ Al_2(CO_3)_3}{1\,mol\ Al_2(CO_3)_3}$$

$$= 17.6\,g\ Al_2(CO_3)_3$$

$$22.0\,g\ K_2CO_3 \times \frac{1\,mol\ K_2CO_3}{138.21\,g\ K_2CO_3} \times \frac{1\,mol\ Al_2(CO_3)_3}{3\,mol\ K_2CO_3} \times \frac{233.99\,g\ Al_2(CO_3)_3}{1\,mol\ Al_2(CO_3)_3}$$

$$= 12.4\,g\ Al_2(CO_3)_3$$

↑ limiting

9. Determine the maximum possible mass of ammonium carbonate can be formed from 15.0 g of ammonia and 25.0 g of hydrogen carbonate

$$2\,NH_3 + H_2CO_3 \rightarrow (NH_4)_2CO_3$$

$$15.0\,g\ NH_3 \times \frac{1\,mol\ NH_3}{17.04\,g\ NH_3} \times \frac{1\,mol\ (NH_4)_2CO_3}{2\,mol\ NH_3} \times \frac{96.11\,g\ (NH_4)_2CO_3}{1\,mol\ (NH_4)_2CO_3} = 42.3\,g\ (NH_4)_2CO_3$$

$$25.0\,g\ H_2CO_3 \times \frac{1\,mol\ H_2CO_3}{62.03\,g\ H_2CO_3} \times \frac{1\,mol\ (NH_4)_2CO_3}{1\,mol\ H_2CO_3} \times \frac{96.11\,g\ (NH_4)_2CO_3}{1\,mol\ (NH_4)_2CO_3} = 38.7\,(NH_4)_2CO_3$$

↑ limiting

10. Determine the concentration of each solution

a) 4.5 mol of NaBr is dissolved in 18 L of solution

$n = 4.5\ mol$ $\quad C = \frac{n}{V}$ $\quad C = 0.25\ M$

$C = ?$

$V = 18\ L$ $\quad C = \frac{4.5\ mol}{18\ L}$

b) 42.5 g of K_2CO_3 is dissolved in 15.5 L of solution

$n = 42.5\ g \times \frac{1\ mol}{138.21\ g} = 0.308\ mol\ K_2CO_3$ $\quad C = \frac{n}{V}$ $\quad C = 0.0198\ M$

$C = ?$

$V = 15.5\ L$ $\quad C = \frac{0.308}{15.5\ L}$

c) 500 mL of 6.0M H_2SO_4 is diluted to 2.5 L

$C_S = 6.0M$

$V_S = 500\ mL \rightarrow 0.500\ L$ $\quad C_D = \frac{C_S V_S}{V_D}$ $\quad C_D = 1.2\ M$

$C_D = ?$

$V_D = 2.5\ L$ $\quad C_D = \frac{6.0\ M \times 0.500\ L}{2.5\ L}$

11. Determine the mass of sodium sulphate (Na_2SO_4) that is required to make 5.0 L of 2.0 M solution.

$n = ?$ $\quad n = CV$ $\quad 10.0\ mol \times \frac{142.05\ g}{1\ mol} = 1420\ g$

$C = 2.0M$ $\quad n = 2.0\ mol/L \times 5.0\ L$

$V = 5.0\ L$ $\quad n = 10.0\ mol$

12. Determine the mass of aluminum carbonate ($Al_2(CO_3)_3$) is required to make 250 mL of 0.0001 M solution

$n = ?$ $\quad n = CV$

$C = 0.0001M$ $\quad n = 0.0001\ mol/L \times 0.250\ L$

$V = 250\ mL \rightarrow 0.250\ L$ $\quad n = 0.000025\ mol$

$0.000025\ mol \times \frac{233.99\ g}{1\ mol} = 0.00585\ g$

13. Determine the maximum mass of aluminum sulphide that can be obtained from mixing 300 mL of 0.5 M aluminum chloride and 400 mL of 0.5 M sodium sulphide. Which of these two reactants is the limiting reagent.

$$2\,AlCl_3(aq) + 3\,Na_2S(aq) \rightarrow Al_2S_3(s) + 6\,NaCl(aq)$$

$n = ?$	$n = CV$	$n = ?$	$n = CV$
$C = 0.5\,M$	$n = 0.5\,mol/L \times 0.300\,L$	$C = 0.5\,M$	$n = 0.5\,mol/L \times 0.400\,L$
$V = 300\,mL$	$n = 0.15\,mol\ AlCl_3$	$V = 400\,mL$	$n = 0.20\,mol\ Na_2S$
$\hookrightarrow 0.300\,L$		$\hookrightarrow 0.400\,L$	

$$0.15\,mol\ AlCl_3 \times \frac{1\,mol\ Al_2S_3}{2\,mol\ AlCl_3} \times \frac{150.17\,g\ Al_2S_3}{1\,mol\ Al_2S_3} = 11.3\,g\ Al_2S_3$$

$$0.20\,mol\ Na_2S \times \frac{1\,mol\ Al_2S_3}{3\,mol\ Na_2S} \times \frac{150.17\,g\ Na_2S}{1\,mol\ Na_2S} = 10.0\,g\ Al_2S_3$$

$\therefore$ limiting

14. What is the concentration in p.p.m. of gold ~~metal~~ ion in a 0.0001 M gold(III) nitrate solution ($Au(NO_3)_3$)?

$$Au(NO_3)_3 \rightarrow Au^{3+} + 3NO_3^{1-}$$

$$\frac{0.0001\,mol\ Au(NO_3)_3}{1\,L} \times \frac{1\,mol\ Au^{3+}}{1\,mol\ Au(NO_3)_3} \times \frac{196.97\,g\ Au^{3+}}{1\,mol\ Au^{3+}} \times \frac{1000\,mg}{1\,g} = \frac{19.7\,mg\ Au^{3+}}{1\,L}$$

$\hookrightarrow 19.7\,p.p.m.$

15. What is the concentration in p.p.m. of sodium ion in a solution that is made be dissolving 0.002 g of sodium carbonate (Na_2CO_3) in 750 mL of solution?

$$Na_2CO_3$$

$$0.002\,g\ Na_2CO_3 \times \frac{1\,mol\ Na_2CO_3}{105.99\,g\ Na_2CO_3} \times \frac{2\,mol\ Na^{1+}}{1\,mol\ Na_2CO_3} \times \frac{22.99\,g\ Na^{1+}}{1\,mol\ Na^{1+}} \times \frac{1000\,mg}{1\,g}$$

$$= 0.868\,mg\ Na^{1+}$$

$$750\,mL \times \frac{1\,L}{1000\,mL} = 0.750\,L$$

$$\frac{0.868\,mg\ Na^{1+}}{0.750\,L} = 1.16\,p.p.m\ Na^{1+}$$