REVIEW QUESTIONS
Chapter 6

1. Classify the type of each of the following reactions:

a) $(NH_4)_2SO_4 \rightarrow 2\ NH_3 + SO_2 + H_2$ __**decomposition**__

b) $Br_2 + 2\ KI \rightarrow 2\ KBr + I_2$ __**single replacement**__

c) $2\ Na + Cl_2 \rightarrow 2\ NaCl$ __**synthesis**__

d) $Al(OH)_3 + 3\ HCl \rightarrow AlCl_3 + 3\ H_2O$ __**double replacement**__

2. Balance each of the equations shown below:

a) __**5**__ C + __**2**__ $SO_2 \rightarrow$ __**1**__ CS_2 + __**4**__ CO

b) __**2**__ $Na_3N \rightarrow$ __**6**__ Na + __**1**__ N_2

c) __**1**__ C_3H_8 + __**5**__ $O_2 \rightarrow$ __**3**__ CO_2 + __**4**__ H_2O

d) __**2**__ Al + __**3**__ $H_2SO_4 \rightarrow$ __**1**__ $Al_2(SO_4)_3$ + __**3**__ H_2

3. Predict the products for each reaction and balance the equation. If no reaction occurs, write "No Reaction" after the arrow:

a) __**2**__ Al (s) + __**6**__ HCl (aq) $\rightarrow$ **2 $AlCl_3$ (aq) + 3 H_2 (g)**

b) __**3**__ Mg (s) + __**2**__ $FeCl_3$ (aq) $\rightarrow$ **3 $MgCl_2$ (aq) + 2 Fe (s)**

c) __**1**__ F_2 (g) + __**2**__ KCl (aq) $\rightarrow$ **2 KF (aq) + Cl_2 (g)**

d) Cu (s) + $Ca(NO_3)_2 \rightarrow$ **No Reaction (Ca is more reactive than Cu)**

e) __**1**__ Pb (s) + __**2**__ $AgNO_3$ (aq) $\rightarrow$ **$Pb(NO_3)_2$ (aq) + 2 Ag (s)**

4. Identify each reaction below as oxidation or reduction:

a) $Pb \rightarrow Pb^{2+} + 2\,e^{-}$ ____**oxidation**____ **(loss of electrons)**

b) $C_2H_2 + H_2 \rightarrow C_2H_4$ ____**reduction**____ **(gain of hydrogen)**

c) $Cr^{3+} + 3\,e^{-} \rightarrow Cr$ ____**reduction**____ **(gain of electrons)**

d) $C_2H_5OH \rightarrow C_2H_4O + H_2$ ____**oxidation**____ **(loss of hydrogen)**

5. In the following reactions, identify which reactant is oxidized and which is reduced:

a) $2\,Li\,(s) + F_2\,(g) \rightarrow 2\,LiF\,(s)$

oxidized: ____**Li**____ reduced: ____**F_2**____

b) $Cl_2\,(g) + 2\,KI\,(aq) \rightarrow 2\,KCl\,(aq) + I_2\,(g)$

oxidized: ____**I^{-}**____ reduced: ____**Cl_2**____

c) $Zn\,(s) + CuSO_4\,(aq) \rightarrow ZnSO_4\,(aq) + Cu\,(s)$

oxidized: ____**Zn**____ reduced: ____**Cu^{2+}**____

d) $2\,PbO\,(s) \rightarrow 2\,Pb\,(s) + O_2\,(g)$

oxidized: ____**O^{2-}**____ reduced: ____**Pb^{2+}**____

6. Calculate each of the following quantities:

a) Number of moles in 112 g of aspirin, $C_9H_8O_4$

Molar mass = **[9(12.0)+8(1.01)+4(16.0)] = 180.1 g/mol**

$$\text{Moles} = 112\ \cancel{\text{g}} \times \frac{1\ \text{mol}}{180.1\ \cancel{\text{g}}} = 0.622\ \text{mol} \quad \text{(3 sig figs)}$$

b) Mass of 3.82 moles of silver acetate, $AgC_2H_3O_2$

Molar mass = **[107.9 + 2(12.0)+3(1.01)+2(16.0)] = 166.9 g/mol**

$$\text{Mass} = 3.82\ \cancel{\text{mol}} \times \frac{166.9\ \text{g}}{1\ \cancel{\text{mol}}} = 638\ \text{g} \quad \text{(3 sig figs)}$$

c) Number of molecules in 1.75 moles of CO_2

Molar mass = **12.0 +2(16.2) = 44.0 g/mol**

$$\#\ \text{of}\ CO_2\ \text{molecules} = 1.75\ \cancel{\text{mol}}\ CO_2 \times \frac{6.02\text{x}10^{23}\ \text{molecules}}{1\ \cancel{\text{mol}}} = 1.05\text{x}10^{24}\ \text{molecules} \quad \text{(3 sig figs)}$$

d) Number of mole of H atoms in 20.0 g of CH_4

Molar mass = **12.0+ 4(1.01)= 16.0 g/mol**

$$\#\ \text{of}\ CH_4\ \text{molecules} = 20.0\ \cancel{\text{g}}\ \cancel{CH_4} \times \frac{1\ \cancel{\text{mol}}}{16.0\ \cancel{\text{g}}} \times \frac{4\ \text{mo H atoms}}{1\ \cancel{\text{mol}\ CH_4}} = 5.00\ \text{mol H atoms (3 sig figs)}$$

7. Use the equation below to determine the mole ratios below:

$$2\ CH_4 + 3\ O_2 + 2\ NH_3 \rightarrow 2\ HCN + 6\ H_2O$$

A) $\frac{\text{mol } NH_3}{\text{mol } H_2O} = \frac{2}{6} = \frac{1}{3}$

C) $\frac{\text{mol } H_2O}{\text{mol } CH_4} = \frac{6}{2} = 3$

B) $\frac{\text{mol HCN}}{\text{mol } O_2} = \frac{2}{3}$

D) $\frac{\text{mol } O_2}{\text{mol } H_2O} = \frac{3}{6} = \frac{1}{2}$

Use the reaction shown below to answer the next 3 questions:

$$2\ C_2H_6\ (g) + 7\ O_2\ (g) \rightarrow 4\ CO_2\ (g) + 6\ H_2O\ (g)$$

8. How many moles of water can be produced when 1.8 moles of C_2H_6 are used?

$$1.8\ \cancel{\text{mol } C_2H_6} \times \frac{6\ \text{mol } H_2O}{2\ \cancel{\text{mol } C_2H_6}} = 5.4\ \text{mol } H_2O$$

9. How many moles of CO_2 are produced when 25.0 g of oxygen are consumed?

$$25.0\ \cancel{\text{g } O_2} \times \frac{1\ \cancel{\text{mol } O_2}}{32.0\ \cancel{\text{g } O_2}} \times \frac{4\ \text{mol } CO_2}{7\ \cancel{\text{mol } O_2}} = 0.446\ \text{mol } CO_2$$

10. How many grams of water is produced when 78.0 g of C_2H_6 are burned?

$$78.0\ \cancel{\text{g } C_2H_6} \times \frac{1\ \cancel{\text{mol } C_2H_6}}{30.06\ \cancel{\text{g } C_2H_6}} \times \frac{6\ \cancel{\text{mol } H_2O}}{2\ \cancel{\text{mol } C_2H_6}} \times \frac{18.0\ \text{g } H_2O}{1\ \cancel{\text{mol } H_2O}} = 140.\ \text{g } H_2O$$

11. In the reaction shown below, if 10.0 g of CH_4 is combined with 30.0 g of O_2, what is maximum amount of CO_2 that can be produced?

$$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (g)$$

Assume CH_4 is LR:

$$10.0\ \cancel{g\ CH_4} \times \frac{1\ \cancel{mol\ CH_4}}{16.04\ \cancel{g\ CH_4}} \times \frac{1\ mol\ CO_2}{1\ \cancel{mol\ CH_4}} = 0.623\ mol\ CO_2$$

Assume O_2 is LR:

$$30.0\ \cancel{g\ O_2} \times \frac{1\ \cancel{mol\ O_2}}{32.0\ \cancel{g\ O_2}} \times \frac{1\ mol\ CO_2}{2\ \cancel{mol\ O_2}} = 0.469\ mol\ CO_2$$

The second assumption is correct. Therefore, oxygen is the limiting reactant

$$0.469\ mol\ CO_2 \times \frac{44.0\ g}{1\ mol} = 20.6\ g\ CO_2$$

12. In an experiment with Zn and S, it was found that 30.7 g of ZnS was produced. If the percent yield of the reaction was 93.7%, what is the theoretical yield of this reaction?

Actual yield = 30.7 g
Theoretical yield = ???
Percent yield = 93.7

$$\%\ yield = \frac{Actual\ yield}{Theoretical\ yield}$$

$$Theoretical\ yield = \frac{Actual\ yield}{\%\ yield} = \frac{30.7\ g}{0.937} = 32.8\ g$$

13. How many grams of SO_2 can be produced from reaction of 10.0 g of H_2S and 10.0 g of O_2, as shown below:

$$2\ H_2S + 3\ O_2 \rightarrow 2\ SO_2 + 2\ H_2O$$

Assume H_2S is LR:

$$10.0\ \cancel{g\ H_2S} \times \frac{1\ \cancel{mol\ H_2S}}{34.1\ \cancel{g\ H_2S}} \times \frac{2\ mol\ SO_2}{2\ \cancel{mol\ H_2S}} = 0.293\ mol\ SO_2$$

Assume O_2 is LR:

$$10.0\ \cancel{g\ O_2} \times \frac{1\ \cancel{mol\ O_2}}{32.0\ \cancel{g\ O_2}} \times \frac{2\ mol\ SO_2}{3\ \cancel{mol\ O_2}} = 0.208\ mol\ SO_2$$

The second assumption is correct. Therefore, oxygen is the limiting reactant.

$$0.208\ mol\ SO_2 \times \frac{64.1\ g}{1\ mol} = 13.3\ g\ SO_2$$

14. When 50.0 g of N_2 is reacted with an excess of other reactants as shown below, 20.0 g of NaCN was produced. What is the percent yield of this reaction?

$$Na_2CO_3 + 4\ C + N_2 \rightarrow 2\ NaCN + 3\ CO$$

Calculate the theoretical yield:

$$50.0\ \cancel{g\ N_2} \times \frac{1\ \cancel{mol\ N_2}}{28.0\ \cancel{g\ N_2}} \times \frac{2\ \cancel{mol\ NaCN}}{1\ \cancel{mol\ N_2}} \times \frac{49.0\ g\ NaCN}{1\ \cancel{mol\ NaCN}} = 175\ g\ NaCN$$

Calculate the percent yield:

$$\%\ yield = \frac{Actual\ yield}{Theoretical\ yield} \times 100 = \frac{20.0\ g}{175\ g} \times 100 = 11.4\ \%$$

15. The formation of Fe_2O_3 from iron and oxygen gas releases 1.7×10^3 kJ of heat, as shown below:

$$4\ Fe\ (s) + 3\ O_2\ (g) \rightarrow 2\ Fe_2O_3\ (s) \qquad \Delta H = -1.7\times10^3\ kJ$$

a) How many kJ are released when 2.00 g of Fe react?

$$2.00\ \cancel{g\ Fe} \times \frac{1\ \cancel{mol\ Fe}}{55.85\ \cancel{g\ Fe}} \times \frac{1.7\times10^3\ kJ}{4\ \cancel{mol\ Fe}} = 15.2\ kJ$$

b) How many grams of Fe_2O_3 are produced when 475 kJ of heat are released?

$$475\ \cancel{kJ} \times \frac{2\ \cancel{mol\ Fe_2O_3}}{1.7\times10^3\ \cancel{kJ}} \times \frac{159.7\ g}{1\ \cancel{mol\ Fe_2O_3}} = 89.2\ g\ Fe_2O_3$$