**Limiting Reactant and Theoretical Yield Practice** Name: MICHELE SANLER

Box # _____

1. When 7.25mol of the Na reacts with 4.25mol of $Cl_2$ according to the following equation:

$$2Na(s) + Cl_2 \rightarrow 2NaCl(g)$$

a. What is the limiting reactant? Na

b. What is the theoretical yield of NaCl produced in moles? 7.25 mol NaCl

$\frac{7.25\ mol\ Na}{1}\left(\frac{2\ mol\ NaCl}{2\ mol\ Na}\right) = 7.25\ mol\ NaCl$ *

$\frac{4.25\ mol\ Cl_2}{1}\left(\frac{2\ mol\ NaCl}{1\ mol\ Cl_2}\right) = 8.5\ mol\ NaCl$

2. If 4.0mol of Ti is combined with 4.0mol $Cl_2$ according to the following equation:

$$Ti(s) + 2Cl_2(g) \rightarrow TiCl_4(s)$$

a. What is the limiting reactant? $Cl_2$

b. What is the theoretical yield of $TiCl_4$ in moles? 2.0 mol $TiCl_4$

$\frac{4.0\ mol\ Ti}{1}\left(\frac{1\ mol\ TiCl_4}{1\ mol\ Ti}\right) = 4.0\ mol\ TiCl_4$

$\frac{4.0\ mol\ Cl_2}{1}\left(\frac{1\ mol\ TiCl_4}{2\ mol\ Cl_2}\right) = 2.0\ mol\ TiCl_4$ *

3. If 4mol Mn reacts with 7mol $O_2$ according to the following equation:

$$Mn(s) + O_2(g) \rightarrow MnO_2(s)$$

a. What is the limiting reactant? Mn

b. What is the theoretical yield of $MnO_2$ in grams? 347.72 g $MnO_2$

$\frac{4\ mol\ Mn}{1}\left(\frac{1\ mol\ MnO_2}{1\ mol\ Mn}\right)\left(\frac{86.93\ g\ MnO_2}{1\ mol\ MnO_2}\right) = 347.72\ g\ MnO_2$

$\frac{7\ mol\ O_2}{1}\left(\frac{1\ mol\ MnO_2}{1\ mol\ O_2}\right)\left(\frac{86.93\ g\ MnO_2}{1\ mol\ MnO_2}\right) = 608.51\ g\ MnO_2$

4. If 100g of Cu are added to a solution, containing 100g of $AgNO_3$:

$$Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$$

a. What is the limiting reactant? $AgNO_3$

b. What is the theoretical yield of Ag metal in grams? 63.50 g Ag

$\frac{100\ g\ Cu}{1}\left(\frac{1\ mol\ Cu}{63.5\ g\ Cu}\right)\left(\frac{2\ mol\ Ag}{1\ mol\ Cu}\right)\left(\frac{107.9\ g\ Ag}{1\ mol\ Ag}\right) = 339.84\ g\ Ag$

$\frac{100\ g\ AgNO_3}{1}\left(\frac{1\ mol\ AgNO_3}{169.9\ g\ AgNO_3}\right)\left(\frac{2\ mol\ Ag}{2\ mol\ AgNO_3}\right)\left(\frac{107.9\ g\ Ag}{1\ mol\ Ag}\right) = 63.50\ g\ Ag$ *

5. When 1.22g of $O_2$ reacts with 1.05g of $H_2$ to produce $H_2O$:

$$O_2(g) + 2H_2(g) \rightarrow 2H_2O(l)$$

a. What is the limiting reactant? $O_2$

b. What is the theoretical yield of $H_2O$ in grams? 1.37g $H_2O$

$$\frac{1.22g\ O_2}{1}\left(\frac{1mol\ O_2}{32.0g\ O_2}\right)\left(\frac{2mol\ H_2O}{1mol\ O_2}\right)\left(\frac{18.02g\ H_2O}{1mol\ H_2O}\right) = 1.37g\ H_2O\ *$$

$$\frac{1.05g\ H_2}{1}\left(\frac{1mol\ H_2}{2.02g\ H_2}\right)\left(\frac{2mol\ H_2O}{2mol\ H_2}\right)\left(\frac{18.02g\ H_2O}{1mol\ H_2O}\right) = 9.37g\ H_2O$$

6. When 5.87g of $Mg(OH)_2$ reacts with 12.84g of HCl to form $MgCl_2$ and water.

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

a. What is the limiting reactant? $MgCl_2$

b. What is the theoretical yield of $MgCl_2$ in grams? 9.58g $MgCl_2$

$$\frac{5.87g\ Mg(OH)_2}{1}\left(\frac{1mol\ Mg(OH)_2}{58.33g\ Mg(OH)_2}\right)\left(\frac{1mol\ MgCl_2}{1mol\ Mg(OH)_2}\right)\left(\frac{95.21g\ MgCl_2}{1mol\ MgCl_2}\right) = 9.58g\ MgCl_2\ *$$

$$\frac{12.84g\ HCl}{1}\left(\frac{1mol\ HCl}{36.46g\ HCl}\right)\left(\frac{1mol\ MgCl_2}{2mol\ HCl}\right)\left(\frac{95.21g\ MgCl_2}{1mol\ MgCl_2}\right) = 16.76g\ MgCl_2$$

7. When 6.25g of $AgNO_3$ reacts with 4.12g of NaCl to form $NaNO_3$ and AgCl:

$$AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$$

a. What is the limiting reactant? $AgNO_3$

b. What is the theoretical yield of $NaNO_3$ in grams? 3.13g $NaNO_3$

c. What is the theoretical yield of AgCl in grams? 5.27g AgCl

$$\frac{6.25g\ AgNO_3}{1}\left(\frac{1mol\ AgNO_3}{169.91g\ AgNO_3}\right)\left(\frac{1mol\ NaNO_3}{1mol\ AgNO_3}\right)\left(\frac{85g\ NaNO_3}{1mol\ NaNO_3}\right) = 3.13g\ NaNO_3\ *$$

$$\frac{4.12g\ NaCl}{1}\left(\frac{1mol\ NaCl}{58.44g\ NaCl}\right)\left(\frac{1mol\ NaNO_3}{1mol\ NaCl}\right)\left(\frac{85g\ NaNO_3}{1mol\ NaNO_3}\right) = 5.99g\ NaNO_3$$

$$\frac{6.25g\ AgNO_3}{1}\left(\frac{1mol\ AgNO_3}{169.91g\ AgNO_3}\right)\left(\frac{1mol\ AgCl}{1mol\ AgNO_3}\right)\left(\frac{143.35g\ AgCl}{1mol\ AgCl}\right) = 5.27g\ AgCl\ *$$

$$\frac{4.12g\ NaCl}{1}\left(\frac{1mol\ NaCl}{58.44g\ NaCl}\right)\left(\frac{1mol\ AgCl}{1mol\ NaCl}\right)\left(\frac{143.35g\ AgCl}{1mol\ AgCl}\right) = 10.11g\ AgCl$$

8. When 6.33g of $H_2SO_4$ reacts with 5.92g of NaOH to produce $NaSO_4$ and water:

$$H_2SO_4 + NaOH \rightarrow NaSO_4 + H_2O$$

a. What is the limiting reactant? $H_2SO_4$

b. What is the theoretical yield of $NaSO_4$ in grams? 7.68g $NaSO_4$

c. What is the theoretical yield of $H_2O$ in grams? 1.16g $H_2O$

$$\frac{6.33g\ H_2SO_4}{1}\left(\frac{1mol\ H_2SO_4}{98.09g\ H_2SO_4}\right)\left(\frac{1mol\ NaSO_4}{1mol\ H_2SO_4}\right)\left(\frac{119.06g\ NaSO_4}{1mol\ NaSO_4}\right) = 7.68g\ NaSO_4\ *$$

$$\frac{5.92g\ NaOH}{1}\left(\frac{1mol\ NaOH}{40g\ NaOH}\right)\left(\frac{1mol\ NaSO_4}{1mol\ NaOH}\right)\left(\frac{119.06g\ NaSO_4}{1mol\ NaSO_4}\right) = 17.62g\ NaSO_4$$

$$\frac{6.33g\ H_2SO_4}{1}\left(\frac{1mol\ H_2SO_4}{98.09g\ H_2SO_4}\right)\left(\frac{1mol\ H_2O}{1mol\ H_2SO_4}\right)\left(\frac{18.02g\ H_2O}{1mol\ H_2O}\right) = 1.16g\ H_2O\ *$$