Objective 1

1. a. $2.75 \text{ mol } HOCl_2 \times \frac{324.93 \text{ g}}{1 \text{ mol}} = \boxed{89.4 \text{ g}}$

b. $3.01 \times 10^{24} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23}} \times \frac{132 \text{ g}}{1 \text{ mol}} = \boxed{660. \text{ g}}$

c. $4.5 \text{ mol} \times \frac{3 \text{ mol Li}}{1 \text{ mol } Li_3P} \times \frac{6.94 \text{ g}}{1 \text{ mol Li}} = \boxed{94 \text{ g}}$

2. a. $\frac{45.2 \text{ L } N_2}{1} \left| \frac{1 \text{ mol } N_2}{22.4 \text{ L}} \right| \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } N_2} = \boxed{1.21 \times 10^{24} \text{ molecules}}$

b. $65.3 \text{ g He} \times \frac{1 \text{ mol He}}{4 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol He}} = \boxed{366 \text{ L}}$

c. $450 \text{ L} \times .21 = 94.5 \text{ L } O_2$

$94.5 \text{ L } O_2 \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } O_2} \times \frac{2 \text{ atoms O}}{1 \text{ molecule}} = \boxed{5.08 \times 10^{24} \text{ atoms O}}$

3. a. $C_4H_4O_4$

C $4 \times 12 = 48$
H $4 \times 1 = 4$
O $4 \times 16 = 64$
116 g/mol

$\%C = \frac{48}{116} \times 100 = 41.4\%$
$\%H \frac{4}{116} \times 100 = 3.45\%$
$\%O \frac{64}{116} \times 100 = 55.2\%$

6. CHO

c. $13.5 \text{ g} \times .414 = \boxed{5.59 \text{ g of C}}$

4. Assume 100g

$36.763\,g\,Fe \times \frac{1\,mol}{55.845\,g} = \frac{.658\,mol}{.658\,mol} = 1$

$21.108\,g\,S \times \frac{1\,mol}{32\,g} = \frac{.659\,mol}{.658\,mol} = 1$

$42.128\,g\,O \times \frac{1\,mol}{16\,g} = \frac{2.63\,mol}{.658\,mol} = 4$

$\boxed{FeSO_4}$

5. Assume 100g

$21.955\,g\,S \times \frac{1\,mol}{32\,g} = \frac{.686\,mol}{.686\,mol} = 1$

$78.045\,g\,F \times \frac{1\,mol}{19\,g} = \frac{4.108\,mol}{.686\,mol} = 6$

$\boxed{SF_6}$ This is the empirical formula. We would need the molecular mass to know the molecular formula.

Objective 2:

1. $77\,g\,HClO \times \frac{1\,mol\,HClO}{52.45\,g} \times \frac{1\,mol\,H_2SO_4}{2\,mol\,HClO} \times \frac{98\,g}{1\,mol\,H_2SO_4} = \boxed{\frac{71.9\,g\,H_2SO_4}{72\,g\ w/\ sig\ figs}}$

2. $45\,g\,C_3H_6 \times \frac{1\,mol\,C_3H_6}{42\,g} \times \frac{6\,mol\,CO_2}{2\,mol\,C_3H_6} \times \frac{44\,g\,CO_2}{1\,mol\,CO_2} = \boxed{\frac{141\,g\,CO_2}{140\,g\ w/\ sig\ figs}}$

3. $2NH_3 \rightarrow 3H_2 + N_2$

$.145 \text{ mol } NH_3 \times \frac{1 \text{ mol } N_2}{2 \text{ mol } NH_3} = \boxed{.0725 \text{ mol } N_2}$

$.145 \text{ mol } NH_3 \times \frac{3 \text{ mol } H_2}{2 \text{ mol } NH_3} = .2175 \text{ mol} \rightarrow \boxed{.218 \text{ mol } H_2}$

4. $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

$5.00\text{g } Ca(OH)_2 \times \frac{1 \text{ mol } Ca(OH)_2}{74\text{g}} \times \frac{2 \text{ mol } HCl}{1 \text{ mol } Ca(OH)_2} \times \frac{1\text{L}}{.100 \text{ mol}} = \boxed{1.35\text{L}}$

5. $150.5\text{g } C_{10}H_{15}N \times \frac{1 \text{ mol } C_{10}H_{15}N}{149\text{g}} \times \frac{59 \text{ mol } O_2}{4 \text{ mol } C_{10}H_{15}N} \times \frac{22.4\text{L}}{1 \text{ mol}} = \boxed{333.7\text{L } O_2}$

$150.5\text{g } C_{10}H_{15}N \times \frac{1 \text{ mol } C_{10}H_{15}N}{149\text{g}} \times \frac{4 \text{ mol } NO_2}{4 \text{ mol } C_{10}H_{15}N} \times \frac{46\text{g } NO_2}{1 \text{ mol } NO_2} = \boxed{46.46\text{g } NO_2}$

6. $75\text{g } Fe_2O_3 \times \frac{1 \text{ mol } Fe_2O_3}{159.69\text{g}} \times \frac{1 \text{ mol } Al_2O_3}{1 \text{ mol } Fe_2O_3} \times \frac{6.02 \times 10^{23} \text{ formula units}}{1 \text{ mol } Al_2O_3} = \boxed{2.8 \times 10^{23} \text{ formula units}}$

7. $5.0\text{g Fe} \times \frac{1 \text{ mol Fe}}{55.845\text{g}} \times \frac{3 \text{ mol Ag}}{1 \text{ mol Fe}} = \boxed{.27 \text{ mol Ag}}$

8. $25\text{g Al} \times \frac{1\text{mol Al}}{27\text{g Al}} \times \frac{3\text{mol H}_2}{2\text{mol Al}} \times \frac{2\text{g H}_2}{1\text{mol}} = 2.8\text{g H}_2$

$90\text{g HCl} \times \frac{1\text{mol HCl}}{36.45\text{g}} \times \frac{3\text{mol H}_2}{6\text{mol HCl}} \times \frac{2\text{g H}_2}{1\text{mol}} = 2.5\text{g H}_2$

HCl is the limiting reagent; therefore **2.5g of H_2** will be produced.

9. $20\text{g N}_2 \times \frac{1\text{mol N}_2}{28\text{g}} \times \frac{2\text{mol NH}_3}{1\text{mol N}_2} = 1.4\text{ mol NH}_3$

$5.0\text{g H}_2 \times \frac{1\text{mol H}_2}{2\text{g}} \times \frac{2\text{mol NH}_3}{3\text{mol H}_2} = 1.7\text{ mol NH}_3$

N_2 is the limiting reagent.

10. $10.0\text{g Al} \times \frac{1\text{mol Al}}{27\text{g}} \times \frac{2\text{mol Al}_2\text{O}_3}{4\text{mol Al}} \times \frac{102\text{g}}{1\text{mol Al}_2\text{O}_3} = 18.9\text{g Al}_2\text{O}_3$

$20.0\text{g O}_2 \times \frac{1\text{mol O}_2}{32\text{g O}_2} \times \frac{2\text{mol Al}_2\text{O}_3}{3\text{mol O}_2} \times \frac{102\text{g}}{1\text{mol Al}_2\text{O}_3} = 42.5\text{g Al}_2\text{O}_3$

Al is the limiting reagent; therefore **18.9g Al_2O_3** is produced

11. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

$$15.0\,g\,C_3H_8 \times \frac{1\,mol\,C_3H_8}{44\,g} \times \frac{3\,mol\,CO_2}{1\,mol\,C_3H_8} = 1.02\,mol\,CO_2$$

$$60.0\,g\,O_2 \times \frac{1\,mol\,O_2}{32\,g} \times \frac{3\,mol\,CO_2}{5\,mol\,O_2} = 1.125\,mol\,CO_2$$

C_3H_8 is the limiting reagent; therefore **1.02 mol CO_2** will be produced.

12. Limiting reagent questions will tell amounts of both reactants. Basic stoich problems will only give you the one amount and the other will be in excess.

13. $2N_2 + O_2 \rightarrow 2N_2O$

$$17.3\,L \times \frac{1\,mol\,O_2}{22.4\,L} \times \frac{2\,mol\,N_2O}{1\,mol\,O_2} \times \frac{44\,g}{1\,mol\,N_2O} = 68.0\,g\,N_2O$$

$$45.3\,g \times \frac{1\,mol\,N_2}{28\,g} \times \frac{2\,mol\,N_2O}{2\,mol\,N_2} \times \frac{44\,g\,N_2O}{1\,mol\,N_2O} = 71.2\,g\,N_2O$$

a. O_2 is the limiting reactant

b. $\frac{5\,g}{68.0\,g} \times 100 =$ **7%**

c. $17.3\,L \times \frac{1\,mol\,O_2}{22.4\,L} \times \frac{2\,mol\,N_2}{1\,mol\,O_2} \times \frac{28\,g\,N_2}{1\,mol\,N_2} = 43.25\,g\,N_2$

c. $45.3\,g - 43.25\,g =$ **2.05 g N_2 in excess**

14. $85mL \times \frac{1L}{1000mL} \times \frac{.25mol\ HCl}{1L} \times \frac{1mol\ CO_2}{2mol\ HCl} \times \frac{1mol}{1mol} = .0106\ mol\ CO_2$

$.84g \times \frac{1mol}{74g} \times \frac{1mol\ CO_2}{1mol\ Li_2CO_3} = .0114\ mol\ CO_2$

a. HCl is the limiting reactant

b. $85mL \times \frac{1L}{1000mL} \times \frac{.25mol\ HCl}{1L} \times \frac{1mol\ Li_2CO_3}{2mol\ HCl} \times \frac{74g}{1mol} = .78g$

$.84g - .78g = \boxed{.06g\ Li_2CO_3\ \text{in excess}}$

c. $.0106mol\ CO_2 \times \frac{22.4L}{1mol} \times \frac{1000mL}{1L} = \boxed{237mL\ CO_2}$

d. $\frac{150mL}{237mL} \times 100 = \boxed{63\%}$