1. Lithium metal reacts with nitrogen in air to make solid lithium nitride.
   a. Write a balanced equation for the reaction
   b. Draw a model of the balanced chemical equation, with colors or shapes to indicate individual atoms by element.
   c. Solve for how many units of lithium nitride can be made if 9 lithium atoms and 4 nitrogen molecules are allowed to react. Determine if there is any remaining reactant.
   d. Draw a model for the above reaction, showing the accounting for all of the reactant atoms in the “products” picture.
   e. Solve how many g of LiN$_3$ can be formed from 50 g each of Li and N$_2$. Which is the limiting reactant?

2. The fat stored in the hump of a camel is a source of both energy and water. The fat in the hump can be approximated by the chemical formula of tristearin, C$_{57}$H$_{110}$O$_6$. An average Bactrian camel carries about 32.5 kg (72 pounds) of fat in its hump. Calculate the mass of water that can be obtained by the camel if, during metabolism, 47.5% of the fat in its hump reacts with O$_2$ forming only water and carbon dioxide.

3. During lab one day, you discover that potassium forms an ionic compound with chlorine and oxygen as the polyatomic anion. You know that the formula of the compound must be KClO$_x$, but you are unsure if $x=1$, 2, 3, or 4. When heated, 2.46 g of the unknown compound loses 0.963 g of oxygen gas, leaving behind only potassium chloride. Determine the chemical formula of the unknown compound.

UDone in lab, Week 5

1. Mercury and bromine will react with each other to produce mercury (II) bromide.
   a. What mass of mercury (II) bromide can be produced from 5.00 mL of mercury (d = 13.6 g/mL) when added to 5.00 mL of bromine (d = 3.10 g/mL).
   b. What mass of which reactant is left unreacted?

2. Aluminum nitrite and ammonium chloride react to form aluminum chloride, nitrogen and water.
   a. What mass of each substance is present after 62.5 g of aluminum nitrite and 54.6 g of ammonium chloride react completely.
   b. What was the limiting reactant?

3. What is the percent yield of a reaction in which 41.5 g of tungsten (VI) oxide reacts with excess hydrogen gas to produce metallic tungsten and 9.50 mL water (d = 1.00g/mL)? The elemental symbol for tungsten is W.

4. When 56.6 g of calcium and 30.5 g of nitrogen gas undergo a reaction that has a 93.0% yield, what mass of calcium nitride forms?
1. a. \[ \text{Li}_2 \text{(s)} + \text{N}_2 \text{(g)} \rightarrow 2 \text{Li}_3 \text{N} \text{(s)} \]

b. \[ \text{Li} + \Delta \rightarrow \text{O}_2 \text{O}_2 \]

\[ \text{O} = \text{Li} \quad \Delta = \text{N} \]

d. \[ \text{Li} + \Delta \Delta \Delta \rightarrow \text{O}_2 \text{O}_2 \Delta \Delta \]

solid leftover gas

e. \[ 50\text{g Li} \times \frac{1 \text{mol Li}}{6.94 \text{g Li}} \times \frac{2 \text{mol Li}_3 \text{N}}{6 \text{mol Li}} \times \frac{34.83 \text{g Li}_3 \text{N}}{1 \text{mol Li}_3 \text{N}} = 83.6 \text{g Li}_3 \text{N} \text{ from Li} \]

\[ 50\text{g N}_2 \times \frac{1 \text{mol N}_2}{28.02 \text{g N}_2} \times \frac{2 \text{mol Li}_3 \text{N}}{1 \text{mol N}_2} \times \frac{34.83 \text{g Li}_3 \text{N}}{1 \text{mol Li}_3 \text{N}} = 124 \text{g from N}_2 \]

\[ = 84 \text{g Li}_3 \text{N} \]

2. \[ 2 \text{C}_5\text{H}_{10} \text{O}_6 \text{(s)} + 16\text{O}_2 \rightarrow 11\text{O}_2 \text{H}_2 \text{O} + 11\text{CO}_2 \]

\[ 32,500 \text{g} \times 0.475 \times \frac{1 \text{mol fat}}{891.5 \text{g}} \times \frac{110 \text{mol H}_2 \text{O}}{2 \text{mol fat}} \times \frac{18.0 \text{g}}{1 \text{mol}} = 17.1 \text{kg H}_2\text{O} \]

3. \[ 2.46\text{g unk} \overset{\Delta}{\rightarrow} \text{O}_2 + \text{KCl} \]

\[ 0.963 \text{g} \quad 1.50 \text{g} \]

\[ \text{mol KCl} \times \frac{1 \text{mol KCl}}{74.55 \text{g}} = 0.0201 \text{ mol KCl} \]

\[ 0.963 \text{g O}_2 \times \frac{1 \text{mol O}_2}{32 \text{g O}_2} \times \frac{2 \text{mol O}}{1 \text{mol O}_2} = 0.0602 \text{ mol O atoms} \]

\[ \frac{\text{mol KCl}}{\text{mol O}} = \frac{0.0201 \text{ mol}}{0.0602 \text{ mol}} = \frac{1 \text{ mol KCl}}{3 \text{ mol O}} \]

\[ = \text{KClO}_3 \]
1. \[ \text{Hg} (l) + \text{Br}_2 (s) \rightarrow \text{HgBr}_2 (s) \]

\[ \frac{5.00 \text{ mL} \times 13.6 \text{ g Hg}}{\text{ml}} \times \frac{1 \text{ mol Hg}}{200 \text{ g Hg}} \times \frac{1 \text{ mol HgBr}_2}{1 \text{ mol Hg}} \times \frac{360.4 \text{ g}}{1 \text{ mol HgBr}_2} = 12.2 \text{ g} \]

\[ \frac{5.00 \text{ mL} \times 3.10 \text{ g Br}_2}{\text{ml}} \times \frac{1 \text{ mol Br}_2}{159.8 \text{ g Br}_2} \times \frac{1 \text{ mol HgBr}_2}{1 \text{ mol Br}_2} \times \frac{360.4 \text{ g}}{1 \text{ mol HgBr}_2} = 34.9 \text{ g} \]

\[ \text{or } 35.0 \text{ g HgBr}_2 \]

\( L_r \text{ is Br}_2 \)

\[ 35.0 \text{ g HgBr}_2 \times \frac{1 \text{ mol HgBr}_2}{360.4 \text{ g}} \times \frac{1 \text{ mol Hg}}{1 \text{ mol HgBr}_2} \times \frac{200 \text{ g Hg}}{1 \text{ mol Hg}} = 19.48 \text{ g used} \]

\[ \text{have } 5.00 \text{ mL } \frac{12.6 \text{ g Hg}}{\text{ml}} = 68.2 \text{ g Hg have } - 19.5 \text{ g used} \]

\[ 48.5 \text{ g Hg left} \]

2. \[ \text{Al(NO}_3\text{)}_3 + 3 \text{NH}_4\text{Cl} \rightarrow \text{AlCl}_3 + 2\text{N}_2 + 6\text{H}_2\text{O} \]

\[ 62.5 \text{ g Al(NO}_3\text{)}_3 \times \frac{1 \text{ mol Al(NO}_3\text{)}_3}{165.0 \text{ g}} \times \frac{1 \text{ mol AlCl}_3}{1 \text{ mol Al(NO}_3\text{)}_3} \times \frac{133.3 \text{ g}}{1 \text{ mol AlCl}_3} = 50.5 \text{ g AlCl}_3 \]

\[ 54.6 \text{ g NH}_4\text{Cl} \times \frac{1 \text{ mol NH}_4\text{Cl}}{53.5 \text{ g}} \times \frac{1 \text{ mol AlCl}_3}{3 \text{ mol NH}_4\text{Cl}} \times \frac{133.3 \text{ g}}{1 \text{ mol AlCl}_3} = 45.3 \text{ g AlCl}_3 \]

\[ 1.02 \text{ mol NH}_4\text{Cl} \times \frac{2 \text{ mol N}_2}{3 \text{ mol NH}_4\text{Cl}} \times \frac{28.02 \text{ g N}_2}{1 \text{ mol N}_2} = 19.0 \text{ g N}_2 \]

\[ 1.02 \text{ mol NH}_4\text{Cl} \times \frac{6 \text{ mol H}_2\text{O}}{3 \text{ mol NH}_4\text{Cl}} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol}} = 36.8 \text{ g H}_2\text{O} \]

\[ 1.02 \text{ mol NH}_4\text{Cl} \times \frac{1 \text{ mol Al(NO}_3\text{)}_3}{3 \text{ mol NH}_4\text{Cl}} \times \frac{105.0 \text{ g}}{1 \text{ mol Al(NO}_3\text{)}_3} = 56.1 \text{ g Al(NO}_3\text{)}_3 \]

\[ \text{have used } - 50.5 \text{ g Al(NO}_3\text{)}_3 \]

\[ = \text{ left } (5.4 \text{ g Al(NO}_3\text{)}_3 \text{ left}) \]
3. \[ \text{WO}_3(s) + 3 \text{H}_2(g) \rightarrow \text{W}(s) + 3\text{H}_2\text{O}(l) \]

\[
41.5 \text{ g WO}_3 \times \frac{1 \text{ mol WO}_3}{231.85 \text{ g}} \times \frac{3 \text{ mol H}_2\text{O}}{1 \text{ mol WO}_3} \times \frac{18.02 \text{ g}}{1 \text{ mol H}_2\text{O}} = 9.68 \text{ g H}_2\text{O theoretical}
\]

\[
9.50 \text{ mL} \times \frac{1 \text{ mL}}{1000 \text{ g}} = 9.50 \text{ g H}_2\text{O actual}
\]

\[
\frac{9.50 \text{ g H}_2\text{O actual}}{9.68 \text{ g H}_2\text{O theoretical}} \times 100\% = 98.2\% \text{ yield}
\]

4. \[3 \text{Ca}(s) + \text{N}_2(g) \rightarrow \text{Ca}_3\text{N}_2(s) \]

\[
56.6 \text{ g Ca} \times \frac{1 \text{ mol Ca}}{40.08 \text{ g Ca}} \times \frac{1 \text{ mol Ca}_3\text{N}_2}{3 \text{ mol Ca}} \times \frac{148.26 \text{ g}}{1 \text{ mol Ca}_3\text{N}_2} = 69.8 \text{ g Ca}_3\text{N}_2 \text{ (from Ca)}
\]

\[
30.5 \text{ g N}_2 \times \frac{1 \text{ mol N}_2}{28.02 \text{ g N}_2} \times \frac{1 \text{ mol Ca}_3\text{N}_2}{1 \text{ mol N}_2} \times \frac{148.26 \text{ g}}{1 \text{ mol Ca}_3\text{N}_2} = 161.39 \text{ g Ca}_3\text{N}_2 \text{ (Ca-N)}
\]

\[
69.8 \text{ g Ca}_3\text{N}_2 \times 0.930 = 64.9 \text{ g Ca}_3\text{N}_2
\]