Stoichiometry Review KEY

1. Potassium reacts with oxygen to produce potassium oxide.

   a. Write the balanced equation for this reaction.

   $4K + O_2 \rightarrow 2K_2O$

   b. What type of reaction is this?

   combo

   c. What is the mass of 5.0 L of oxygen at STP?

   $5.0\,L\,O_2 \left| \frac{1\,mol\,O_2}{22.4\,L\,O_2} \right| \frac{32.00\,g\,O_2}{1\,mol\,O_2} = \boxed{7.1\,g\,O_2}$

   d. What is the mass of 2.0×10^{22} molecules of potassium oxide?

   $2.0 \times 10^{22}\,molec\,K_2O \left| \frac{1\,mol\,K_2O}{6.022 \times 10^{23}\,molec\,K_2O} \right| \frac{94.20\,g\,K_2O}{1\,mol\,K_2O} = \boxed{3.1\,g\,K_2O}$

   e. Use the balanced equation to determine the mass of oxygen necessary to produce 4.0 g potassium oxide.

   $4.0\,g\,K_2O \left| \frac{1\,mol\,K_2O}{94.20\,g\,K_2O} \right| \frac{1\,mol\,O_2}{2\,mol\,K_2O} \left| \frac{32.00\,g\,O_2}{1\,mol\,O_2} \right| = \boxed{.68\,g\,O_2}$

2. Sodium chloride reacts with silver (I) nitrate to yield silver (I) chloride and sodium nitrate.

   a. Write the balanced equation for this reaction.

   $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

   b. What type of reaction is this?

   DR

   c. Write the complete ionic equation for this reaction.

   $Na^+(aq) + Cl^-(aq) + Ag^+(aq) + NO_3^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$

   d. Write the net ionic equation for this reaction.

   $Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$

   e. If 10.0 grams of silver (I) nitrate reacts with 15.0 grams of sodium chloride, what mass of sodium nitrate is produced?

   $10.0\,g\,AgNO_3 \left| \frac{1\,mol\,AgNO_3}{169.88\,g\,AgNO_3} \right| \frac{1\,mol\,NaNO_3}{1\,mol\,AgNO_3} \left| \frac{85.00\,g\,NaNO_3}{1\,mol\,NaNO_3} \right| = \boxed{5.00\,g\,NaNO_3}$

   $15.0\,g\,NaCl \left| \frac{1\,mol\,NaCl}{58.44\,g\,NaCl} \right| \frac{1\,mol\,NaNO_3}{1\,mol\,NaCl} \left| \frac{85.00\,g\,NaNO_3}{1\,mol\,NaNO_3} \right| = 21.8\,g\,NaNO_3$

   f. What is the limiting reagent? What is the excess reagent?

   LR = $AgNO_3$ ER = NaCl

   g. What mass of excess reagent is left over?

   $21.8\,g\,NaNO_3 - 5.00\,g\,NaNO_3 = 16.8\,g\,NaNO_3$

   $16.8\,g\,NaNO_3 \left| \frac{1\,mol\,NaNO_3}{85.00\,g\,NaNO_3} \right| \frac{1\,mol\,NaCl}{1\,mol\,NaNO_3} \left| \frac{58.44\,g\,NaCl}{1\,mol\,NaCl} \right| = \boxed{11.6\,g\,NaCl \text{ left over}}$

3. Lithium reacts with calcium carbonate.

a. Write the balanced equation for this reaction.

$2\,Li + CaCO_3 \rightarrow Li_2CO_3 + Ca$

b. What type of reaction is this?

SR

c. If 20.0 grams of lithium reacts with 20.0 grams of calcium carbonate, what is the theoretical yield of lithium carbonate?

$$\frac{20.0\,g\,Li}{} \left| \frac{1\,mol\,Li}{6.94\,g\,Li} \right| \frac{1\,mol\,Li_2CO_3}{2\,mol\,Li} \left| \frac{73.89\,g\,Li_2CO_3}{1\,mol\,Li_2CO_3} \right. = 106.\,g\,Li_2CO_3$$

$$\frac{20.0\,g\,CaCO_3}{} \left| \frac{1\,mol\,CaCO_3}{100.09\,g\,CaCO_3} \right| \frac{1\,mol\,Li_2CO_3}{1\,mol\,CaCO_3} \left| \frac{73.89\,g\,Li_2CO_3}{1\,mol\,Li_2CO_3} \right. = \boxed{14.8\,g\,Li_2CO_3}$$

d. If 13.7 g lithium carbonate is produced in the lab, what is the percent yield?

$$\%\ yield = \frac{A}{T} = \frac{13.7\,g\,Li_2CO_3}{14.8\,g\,Li_2CO_3} = \boxed{92.6\%}$$

4. Iron (III) nitrate reacts with calcium phosphate.

a. Write the balanced equation for this reaction.

$2\,Fe(NO_3)_3 + Ca_3(PO_4)_2 \rightarrow 2\,FePO_4 + 3\,Ca(NO_3)_2$

b. What type of reaction is this?

DR

c. You perform this reaction using 3.0 g iron (III) nitrate and 6.2 g calcium phosphate. What is your percent yield if you produce 2.9 g iron (III) phosphate in the lab?

$$\frac{3.0\,g\,Fe(NO_3)_3}{} \left| \frac{1\,mol\,Fe(NO_3)_3}{241.88\,g\,Fe(NO_3)_3} \right| \frac{2\,mol\,FePO_4}{2\,mol\,Fe(NO_3)_3} \left| \frac{150.82\,g\,FePO_4}{1\,mol\,FePO_4} \right. = \boxed{\begin{matrix} TY \\ 1.9\,g \\ FePO_4 \end{matrix}}$$

$$\frac{6.2\,g\,Ca_3(PO_4)_2}{} \left| \frac{1\,mol\,Ca_3(PO_4)_2}{270.10\,g\,Ca_3(PO_4)_2} \right| \frac{2\,mol\,FePO_4}{1\,mol\,Ca_3(PO_4)_2} \left| \frac{150.82\,g\,FePO_4}{1\,mol\,FePO_4} \right. = 6.9\,g\,FePO_4$$

$$\%\ yield = \frac{A}{T} = \frac{2.9\,g\,FePO_4}{1.9\,g\,FePO_4} = \boxed{150\%}$$

Uh oh! Something went wrong in the lab!