Ch. 3 (3-7)

More Balancing of equations!

1. $Fe + 3AgNO_3 \Longrightarrow Fe(NO_3)_3 + 3Ag$
2. $Al + HCl \Longrightarrow AlCl_3 + H_2$
3. $Cl_2 + NaBr \Longrightarrow NaCl + Br_2$
4. $Ca(OH)_2 + H_3PO_4 \Longrightarrow Ca_3(PO_4)_2 + H_2O$
5. $NaCl + H_2SO_4 \Longrightarrow Na_2SO_4 + HCl$
6. $FeCl_3 + Ca(OH)_2 \Longrightarrow Fe(OH)_3 + CaCl_2$
7. $KNO_3 \Longrightarrow KNO_2 + O_2$
8. $HCl + HNO_3 \Longrightarrow H_2O + NO_2 + Cl_2$
9. $HCl + Fe_2O_3 \Longrightarrow FeCl_3 + H_2O$
10. $Pb(NO_3)_2 + K_2CrO_4 \Longrightarrow PbCrO_4 + KNO_3$
11. $BaCl_2 + K_2CO_3 \Longrightarrow BaCO_3 + KCl$
12. $Ca(OH)_2 + (NH_4)_2CO_3 \Longrightarrow NH_3 + CaCO_3 + H_2O$
13. $H_2SO_4 + NH_4OH \Longrightarrow (NH_4)_2SO_4 + H_2O$
14. $HNO_3 + NaOH \Longrightarrow NaNO_3 + H_2O$
15. $FeCl_3 + H_2S \Longrightarrow FeCl_2 + HCl + S$

Ch. 3 (3-8) **Stoichiometry** - calculations based on balanced equations.

When doing stoichiometry, you must start with a balanced equation. Then the steps are always the same!

Step 1 : Convert *to* moles of given your substance A.

Step 2 : Convert *from* moles of given substance A *to* moles of desired substance B, by using the mole ratio of the balanced equation.

Step 3 : Convert *from* moles ofthe desired substance B.

#1. Example: How many grams of O_2 is produced from 50.0 grams H_2O decomposing according to the following reaction? $2\,H_2O \rightarrow 2\,H_2 + 1\,O_2$

Step 1: grams A → moles A $\quad \frac{50.0 \text{ grams } H_2O}{} \cdot \frac{1 \text{ mole}}{18.0 \text{ grams}} = 2.78 \text{ moles } H_2O$

Step 2 : moles A → moles B $\quad \frac{2.78 \text{ moles } H_2O}{} \cdot \frac{1 \text{ moles } O_2}{2 \text{ moles } H_2O} = 1.39 \text{ moles } O_2$

2 mol $H_2O \rightarrow$ 1 mol O_2

Step 3 : moles B → grams of B $\quad \frac{1.39 \text{ moles } O_2}{} \cdot \frac{32.0 \text{ grams}}{1 \text{ mole}} = 44.5 \text{ grams } O_2$

#2

1. First balance equations.
2. Find the number of moles of the given substance.
3. Inspect the balanced equation to determine the ratio of moles of required substance to moles of given substance.
4. Express the moles of required substance in terms of grams.

EXAMPLE: Mass-Mass

How many grams of copper(II) nitrate would be produced from 4.30 g of copper metal reacting with excess nitric acid?

Solving process:

Step 1. $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

Step 2. $\frac{4.30 \text{ g Cu}}{} \cdot \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \ldots$

Step 3. $\frac{4.30 \text{ g Cu}}{} \cdot \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \cdot \frac{1 \text{ mol } Cu(NO_3)_2}{1 \text{ mol Cu}} \ldots$

Step 4. $\frac{4.30 \text{ g Cu}}{} \cdot \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \cdot \frac{1 \text{ mol } Cu(NO_3)_2}{1 \text{ mol Cu}} \cdot \frac{187.5 \text{ g } Cu(NO_3)_2}{1 \text{ mol } Cu(NO_3)_2} = 12.7 \text{ g } Cu(NO_3)_2$

1. When copper(II) nitrate reacts with sodium hydroxide, copper(II) hydroxide is produced. How many grams of $Cu(OH)_2$ can be prepared from 12.7 g of $Cu(NO_3)_2$ and excess NaOH?

$Cu(NO_3)_2 + NaOH \rightarrow Cu(OH)_2 + NaNO_3$

2. When $Cu(OH)_2$ is heated, it decomposes to black CuO and H_2O. How many grams of CuO will be formed from the decomposition of 6.59 g of $Cu(OH)_2$?

$Cu(OH)_2 \rightarrow CuO + H_2O$

3. When 5.37 g of the black copper(II) oxide are mixed with excess sulfuric acid, the solution turns a clear blue, indicating the formation of copper(II) sulfate. How many grams of copper(II) sulfate will be formed in this double displacement reaction?

$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

4. If an excess of zinc metal is placed in a copper(II) sulfate solution, the zinc will displace the copper. If 10.8 g of copper(II) sulfate is reacted, how many grams of copper metal will be recovered from the solution? (Hint: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$.)