**Chemistry II—Chapter 9 Notes**

**Stoichiometry**

- The Arithmetic Of Equations:

- when you know the amount of one substance in a reaction, you can

calculate the amounts of the other reactants consumed or products

formed

- this method is called STOICHIOMETRY

- Greek stoichion (amount) and metry (to measure)

- Interpreting Chemical Equations:

N2(g) + 3 H2(g)  🡪 2 NH3(g)

2 atoms N 6 atoms H = 2 atoms N / 6 atoms H

1 molecule N2 3 molecules H2 = 2 molecules NH3

10 molecules N2 30 molecules H2 = 20 molecules NH3

1(6.02 x 1023 molecules) 3(6.02 x 1023 molecules) = 2(6.02 x 1023 molecules)

1 mole N2 3 moles H2 = 2 moles NH3

28 g N2 3 x 2g = 6 g H2 = 2 x 17g = 34 g NH3

34 g reactants = 34 g products

- Chemical Calculations:

- in ALL stoichiometric calculations you MUST begin with the

BALANCED CHEMICAL EQUATION!!!

- Mole-Mole Calculations:

- if you know the balanced equation, and the number of moles

of any substance in a reaction, you can find the number of

moles of any other substance in the reaction

- need a MOLE RATIO—a conversion factor relating moles of

one substance to moles of another substance in a balanced

equation

- use the COEFFICENTS from the balanced equation to get the

mole ratio

- use the FACTOR LABEL METHOD to solve problems

N2 + 3 H2 🡪 2 NH3

*How many moles of NH3 are formed if 2.7 moles of N2 react?*

- Mole-Mass calculations:

- need to use a mole ratio and then convert moles to grams

- Al(s) + O2(g) 🡪 Al2O3(s)

*How many grams of Al2O3 will form if 4.5 moles of Al react?*

4 Al(s) + 3 O2(g) 🡪 2 Al2O3(s)

4.5 mol ? g

- Mass-Mole calculations:

- need to convert grams to moles then use the mole ratio

- Fe(s) + O2(g) 🡪 Fe2O3(s)

*How many moles of Fe are needed to produce 62 grams of Fe2O3?*

4 Fe(s) + 3 O2(g) 🡪 2 Fe2O3(s)

?? mol 62 g

- Mass-Mass calculations:

- need to convert mass to moles, then use mole ratio, then

convert moles to mass

- H2(g) + O2(g) 🡪 H2O(l)

*How many grams of H2O will form if 10. g H2 react?*

2 H2(g) + O2(g) 🡪 2 H2O(l)

10.g ? g

**Mass A**

**(grams)**

**Moles A**

**(mol)**

**Moles B**

**(mol)**

**Mass B**

**(grams)**

- Limiting Reagent and Percent Yield:

- not all reactions complete so 100% of all reactants are used up to

form products

- THEORETICAL YIELD—the calculated amount of a product that

will form if the reaction goes to 100% completion (which rarely

happens!)

- any chemical reaction will continue until ALL of one reactant is

used up

- whenever ALL of one reactant is gone, the reaction stops and you

may have other reactants “leftover”

- LIMITING REAGENT—the reactant that limits the amount of

product that can be formed (the first one to be used up in the

reaction)

- EXCESS REACTANT—the reactant that is leftover when the

limiting reagent is used up

- Mg(s) + HCl(aq) 🡪 MgCl2(aq) + H2(g)

*If 5.00 g Mg reacts with 6.00 g HCl,*

*a) what is the limiting reagent?*

*b) what is the excess reagent?*

*c) what is the theoretical yield of H*2 *in grams?*

*d) how much of the excess reactant is left?*

* Mg(s) + 2 HCl(aq) 🡪 MgCl2(aq) + H2(g)

5.00 g 6.00g

* So 5.00 g Mg 🡪 0.416 g H2
* And 6.00 g Mg 🡪 0.167 g H2

**So we ONLY make 0.167 g H2 !! Because after we make 0.167 g of H2 there is NO MORE HCl so HCl is the limiting reactant and Mg is the excess reactant**

**So 5.00 g – 2.00 g = 3.00 g Mg LEFT!!**

- Percent Yield—a comparison of the ACTUAL yield (what an

experimenter actually gets from a reaction) and the

THEORETICAL yield (the calculated amount you should get if the

reaction goes to 100% completion)

ACTUAL

Percent Yield = ------------------------- x 100

THEORETICAL

- CaCO3(s) 🡪 CaO(s) + CO2(g)

*What is the theoretical yield of CaO if 24.8 grams of CaCO3 is heated?*

*What is the % yield if only 13.1 g CaO are produced?*

CaCO3(s) 🡪 CaO(s) + CO2(g)

24.8 g ? g

***theoretical yield***