CH 12 Stoichiometry

I. Stoichiometry - the study of how much reactant makes how much product

A. Law of conservation of mass: mass reactants = mass products

1. same number of mol of each element on each side of eqn.

2. all rxns. must be balanced before doing stoich.

B. Mole ratios - ratio of mol of any 2 substances in eqn.

1. use coefficients for ratios

ex) 2 K + F2 → 2KF balanced eqn

ratios: 2 K:2 KF

1 F2 : 2 KF

2 K : 1 F2

a. ratios can be reversed in order as well

II. Stoichiometric calculations

A. mole to mole conversions - given mole of one substance, find mole of other substance needed/made

ex) If you start with 0.5 mol of K, how much F2 is needed to completely use up the K?

a. balance eqn.

b. multiply given moles by mole ratio between the 2 substances

1) place given substance in denominator and desired stustance in numerator

0.5 mol K x (1 mol F2/2 mol K) = 0.25 mol F2 needed

\*\*2) canceling units to get the desired units lets you know if you set up the problem correctly

B mole to mass conversions - given mol of substance, calculate mass of other substance needed/made

a. balance eqn.

b. do mol to mol conversion from above

c. do mol to mass conversion - multiply mol desired substance by formula mass/ 1 mol desired substance

ex) If you start with 0.5 mol of K, what mass of F2 is needed to completely react with the K?

0.5 mol K x (1 mol F2/2 mol K) x (38.0 g F2 / 1 mol F2) = 9.5 g F2

C. mass to mass conversions - given mass of one substance, figure the mass of another substance needed/made

a. balance eqn.

b. convert mass of given substance to mol ( multiply given mass by 1 mol/formula mass)

c. do mol to mass converstion from # 2 above

1) mol to mol converstion

2) mole to mass conversion

ex) If you have 19.6 g of K, what mass of F2 is needed to completely react with the K?

19.6 g K x (1 mol K/39.1 g K) x ( 1 mol F2/2 mol K) x ( 38 g F2/1 mol F2) = 9.5 g F2

III. Limiting reactant - reactant that gets used up in rxn when not starting with amounts specified by balanced eqn.

A. Most natural rxns have a limiting reactant

ex) a fire - wood is normally the limiting reactant, other reactant is oxygen from air

B. Excess reactant - the reactant that does not get used up

ex) oxygen from air for a fire

C. Finding which is the limiting reactant

ex) If you have 10 g of K and 10 g of F2, which is the limiting reactant?

1. given starting masses, find mol of each reactant

10 g K x ( 1 mol K/39.1 g K) = 0.226 mol K

10 g F2 x ( 1 mol F2/ 38.0 g F2) = 0.263 mol F2

2. find ratio between moles you just calculated - divide each by smaller amount

K = 0.226/0.226 = 1 mol K F2 = 0.263/0.226 = 1.16 mol F2

a. place in a calculated mol ratio: 1 mol K to 1.16 mol F2

3. compare calculated mole ratio to mol ratio from balanced eqn

balanced eqn. calculated

2 mol K to 1 mol F2 1 mol K to 1.16 mol F2

4. conclusion: K is the limiting reactant because you need twice as many mol of K than F2, but you have less than one mol K for each mol F2, so K will get used up first

IV. Precent Yield - compares amount of product made in the lab to amount predicted by balanced eqn.

A. Reasons for rxns making less than predicted ( rxn does not go to completion)

1. chem. stick to surface of apparatus

2. liquids evaporate

3. products can't be completely separated in purification processes

B. Importance - industry needs to know % yield for profit predictions

C. Calculating % yield:

1. % yield = actual yield (from lab) ÷ theoretical yield (from stoich) x 100-%