HONORS CHEMISTRY UNIT 11 NOTES: STOICHIOMETRY

INFORMATION GIVEN BY CHEMICAL EQUATIONS

Stoichiometry

CO + H2 → CH3OH (unbalanced)

How can we interpret the above equation once it has been balanced?

MOLE –MOLE RELATIONSHIPS

Sample problem 1: What number of moles of O2 will be produced by the decomposition of 5.8 mol of water?

Sample problem 2: Calculate the number of moles of oxygen required to react exactly with 4.30 mol of propane in the reaction shown below.

C3H8 + 5O2 → 3CO2 + 4H2O

Sample problem 3: Ammonia (NH3) is used in huge quantities as a fertilizer. It is manufactured by combining nitrogen and hydrogen according to the following equation:

N2 + 3H2 → 2NH3

Calculate the number of moles of NH3 that can be made from 1.30 mol H2 reacting with excess N2

MASS CALCULATIONS

Using a problem to predict what we need to do

What mass of oxygen will be required to react with exactly 44.1 g of propane?

C3H8 + 5O2 → 3CO2 + 4H2O

What do we need?

What do we know?

What do we want to calculate?

Doing the actual problem

Sample problem 4: Consider the reaction of powdered aluminum metal and finely ground iodine to produce aluminum iodide. The balanced equation for this vigorous chemical reaction is.

2Al + 3I2 → 2AlI3

What mass of I2 is needed to just react with 35.0 g Al?

Sample problem 5: Hydrofluoric acid is used to etch glass according to the following equation: 4 HF + SiO2 → SiF4 + 2H2O

Calculate the mass of hydrofluoric acid needed react with exactly 5.68 g of silicon dioxide.

Sample problem 6: Solid lithium is used in space vehicles to remove exhaled carbon dioxide from the living environment. How many moles of carbon dioxide can be removed from the air by 1000. g of LiOH?

2LiOH + CO2 → Li2CO3 + H2O

Sample problem 7: How many grams of ammonia are produced when 3.00 moles of hydrogen are allowed to react with excess nitrogen?

3H2 + N2 → 2NH3

STOICHIOMETRY USING DENSITY

Sample problem 8: If 25.0 g of hydrogen peroxide decomposes, what volume of oxygen will be produced? Assume the density of oxygen is 1.429 g/L

Sample problem 9: If 1.75 L of oxygen is produced, how many grams of hydrogen peroxide decomposed. The density of oxygen is 1.429 g/L

Sample problem 10: How many liters of NO are produced when 1.50 L of oxygen react with excess ammonia. The density of NO is 1.340 g/L and the density of oxygen is 1.429 g/L.

4NH3 + 5O2 → 4NO + 6H2O

PERCENT YIELD PROBLEMS

What is percent yield?

What is the difference between theoretical yield and actual yield?

Why is there a difference?

Sample problem 11: A 15.0 g sample of magnesium reacts with hydrochloric acid to form magnesium chloride and hydrogen. During the reaction, 46.6 g of magnesium chloride was formed. What is the percent yield of magnesium chloride?

Sample problem 12: When 400. g of hydrogen is added to an excess of nitrogen, 1040 g of ammonia is actually produced. What is the percent yield of ammonia?

Sample problem 13: 2ZnS + 3O2 → 2SO2 + 2ZnO

If the typical yield of sulfur dioxide is 86.78%, what mass of sulfur dioxide should be expected if 4897 g of zinc sulfide is used to start the reaction?

Sample problem 14: 2Al + 3CuSO4 → 3Cu + Al2(SO4)3

If 1.85 g of aluminum reacts with excess of copper (II) sulfate and the percent yield of copper is 56.6%, what mass of copper is produced?

THE CONCEPT OF LIMITING REACTANTS

Using Sandwiches as an example

2 pieces of bread + 3 slices of meat + 1 slice of cheese → 1 sandwich

You have 20 slices of bread, 24 slices of meat, and 12 slices of cheese. Using stoichiometry, how many sandwiches can you make?

What is the limiting ingredient? How much excess is left?

Sample problem 15: CH4 +H2O → CO + 3H2

You begin the reaction with 995 g of methane and 1325 g of water.

1. What is the maximum mass of hydrogen that can be prepared?
2. What is the limiting reactant? The excess reactant?
3. What mass of the excess reactant remains when the reaction is over?

Sample problem 16: 2Al + 3Cl2 → 2AlCl3

You begin the reaction with 2.70 g of Aluminum and 8.20 g of chlorine

1. What mass of aluminum chloride is produced?
2. What is the limiting reactant? The excess reactant?
3. How many moles of excess reactant remain when the reaction is complete?