Chemistry 20	Unit 4
Lesson 2 - Limiting/Excess Reagents and Gravimetric Stoichiometry	84 mins

~~Limiting and Excess Reagents~~

~~What would happen if you only had 10.0 moles of copper and 50.0 moles of silver in silver nitrate… how much silver would you make? 10.0 moles~~	~~Copper is the limiting reagent, less to react~~ ~~Silver is the excess reagent, still some left after reaction.~~ ~~Can only identify with MOLES~~

Gravimetric Stoichiometry

- The act of calculating the masses of reactants and products from a reaction Steps 1) Write a balanced chemical reaction equation, and list the measured mass, the unknown quantity (mass) symbol m, and conversion factors (the molar masses). 2) Convert the mass of measured substance to its chemical amount. (Moles) 3) Calculate the chemical amount of required substance using the mole ratio from the balanced chemical equation. 4) Convert the chemical amount of required substance to its mass.	If you decompose 1.00 g of malachite, what mass of copper(II) oxide would be formed? Step 1) $Cu(OH)_2 \bullet CuCO_{3(s)} \rightarrow 2CuO_{(s)} + CO_{2(g)} + H_2O_{(g)}$ m = 1.00 g m = ?? M = $221.13 g/mol$ M = 79.55 g/mol Step 2) $n_{Cu(OH)2 \bullet CuCO3(s)} = 1.00g \times \frac{1\ mol}{221.13g} = 0.00452\ mol$ Step 3) $n_{CuO(s)} = 0.00452\ mol \times \frac{2\ mol\ of\ 2CuO(s)}{1\ mol\ of Cu(OH)2 \bullet CuCO3(s)}$ $n_{CuO(s)} = 0.00904$ mol Step 4) $m_{CuO(s)} = 0.00904\ mol \times \frac{79.55\ g}{1\ mol} = 0.719\ g$

%Error

- The testing of any scientific method to ensure the occome is valid - %error has to be less than 10% to be valid - Less than 5% is considered high accuracy $\%Error = \left\lvert \frac{Difference\ between\ Lab\ Measurement\ and\ Calculated}{Calculated\ Measure} \right\rvert \times 100\%$	2.13 g of zinc is placed in a beaker with an excess of lead(II) nitrate solution. The lead produced in the reaction is separated by filtration and dried. The mass of the lead is determined. In the beaker, crystals of a shiny black solid were produced, and all the zinc disappeared. mass of filter paper = 0.92 g mass of dried filter paper plus lead = 7.60 g How much do you expect? $Zn_{(s)} + Pb(NO_3)_{2(aq)} \rightarrow Zn(NO_3)_{2(aq)} + Pb_{(s)}$ Net Equation

	$Zn_{(s)} + Pb^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Pb_{(s)}$ m = 2.13 g, M = 65.41 g/mol (Zn); m = ??, M = 207.2g/mol (Pb) $n_{Zn} = 2.13g \times \frac{1\ mol}{65.41g} = 0.0326\ mol$ $m_{Pb} = 0.0326\ mol \times \frac{1\ mol\ of\ Pb}{1\ mol\ of\ Zn} \times \frac{207.2g}{1\ mol} = 6.75\ g$ How much was obtained? $m_{Pb} = 7.60g - 0.92g = 6.68g$ %Error? $\%error = \left\lvert\frac{6.68g - 6.75g}{6.75g}\right\rvert \times 100\% = 1.0\%$

%yield

- A measure of the amount of substance obtained in lab - Depending on lab conditions and skills the %yield can be up to 100% $\%yield = \frac{actual\ yield}{predicted\ yield} \times 100\%$	In a chemical analysis, 3.00 g of silver nitrate in solution was reacted with excess sodium chromate to produce 2.81 g of filtered, dried precipitate. Calculate the percent yield. $2AgNO_{3(aq)} + Na_2CrO_{4(aq)} \longrightarrow Ag_2CrO_{4(s)} + 2NaNO_{3(aq)}$ 3.00g, 169.87g/mol ($AgNO_3$); ???, 331.73g/mol (Ag_2CrO_4) ***When figuring out which product precipitates notice that $NaNO_3$ is aq forsure in our data booklet, and $AgCrO_4$ is not given… normally we would assume aq… BUT the question says ONE MUST precipitate therefore if $NaNO_3$ can't… $AgCrO_4$ MUST.*** $n_{AgNO3} = 3.00g \times \frac{1\ mol}{169.87g} = 0.0177\ mol$ $m_{Ag2CrO4} = 0.0177\ mol \times \frac{1\ mol\ Ag2CrO4(s)}{2\ mol\ AgNO3(aq)} \times \frac{331.73\ g}{1\ mol} = 2.93\ g$ $\%yield = \frac{actual\ yield}{predicted\ yield} \times 100\%$ $\%yield = \frac{2.81\ g}{2.93\ g} \times 100\% = 96.9\%$

Chemistry 20 - Unit 4 - Gravimetric Stoichiometry

Name: ___________________________________

1) If 56.0 grams of iron (III) chloride reacts with 38.8 grams of solid vanadium, what mass of vanadium (V) chloride is theoretically produced? If the percent yield of this reaction is 25.0 %, what is the actual yield of vanadium (V) chloride?

2) If 18.0 mL of 2.50 mol/L cesium sulfide reacts with 42.9 grams of nickel (III) nitride, what mass of cesium nitride is theoretically produced? What is the actual mass of cesium nitride if the percent yield is 45.0 %?

3) Balance each of the following chemical equations using lowest whole numbers.
   a) $NaBr_{(aq)} + NaBrO_{3(aq)} + H_2SO_{4(aq)} \rightarrow Br_{2(l)} + Na_2SO_{4(aq)} + H_2O_{(l)}$

   b) $FeS_{2(s)} + O_{2(g)} \rightarrow Fe_2O_{3(s)} + SO_{2(g)}$

   c) $I_{2(s)} + HNO_{3(aq)} \rightarrow HIO_{3(aq)} + NO_{(g)} + H_2O_{(l)}$

   d) $Sc_2O_{3(s)} + Cl_{2(g)} + S_2Cl_{2(s)} \rightarrow ScCl_{3(s)} + SOCl_{2(s)}$

4) The invention of trinitrotoluene, otherwise known as TNT, revolutionized the mining industry. When TNT detonates, it does so according to the following unbalanced chemical equation:

$$C_7H_5N_3O_{6(s)} \rightarrow N_{2(g)} + H_2O_{(g)} + CO_{(g)} + C_{(s)}$$

If 1.0000×10^{-1} kilograms of TNT detonates, what mass of solid carbon is theoretically produced? If the percent yield of this reaction is 60.0%, what is the actual yield of solid carbon?

5) Nitrocellulose, otherwise known as guncotton, is a highly reactive and explosive gunpowder substitute that can be prepared via the nitration of cellulose. This reaction takes place according to the following unbalanced chemical equation:

$$HNO_{3(aq)} + C_6H_{10}O_{5(s)} \rightarrow C_6H_7(NO_2)_3O_{5(s)} + H_2O_{(l)}$$

3.0 L of 0.100 mol/L nitric acid is mixed with 162.16 g of cellulose, $C_6H_{10}O_{5(s)}$. What is the theoretical yield of nitrocellulose? What is the percent yield of the reaction if the actual yield of nitrocellulose is 5.0 grams?