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Chemistry - Chapter 12 Review

1. What is stoichiometry?

Branch of chemistry dealing with calculations of quantities in chemical reactions

2. Why do we balance a chemical equation? How do we use the information? How does it relate to the Law of Conservation of Mass?

- shows equal #s of atoms on both sides of equation, satisfies law of cons. of mass, = atoms, = mass
- use info to determine amount of product formed, amt of reactant needed

3. What two quantities are conserved in a chemical reaction?

Mass : atoms

4. What are the representative particles of the following:

a. KCl formula units

b. O_2 molecules

c. H_2O molecules

d. Zn atoms

e. Ca^{+2} ions

5. Use the equation below to answer the a, b, and c.

$4K + O_2 \rightarrow 2K_2O$

a. How many moles are there of each reactant and product?

4 mol K + 1 mol O_2 → 2 mol K_2O

b. How many atoms are there of each reactant and product?

4 atoms K + 2 atoms O → 4 atoms K + 2 atoms O

c. Prove that the Law of Conservation of Mass is supported by the reaction.

$4 \times 39.10 + 2 \times 16.00 \rightarrow 4 \times 39.10 + 2 \times 16.00$

$156.4 + 32.00 \rightarrow 156.4 + 32$

$188.4 \rightarrow 188.4$

188.4

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6. What is a mole ratio, and how do we use it in stoichiometry?

2 - conversion factor derived from coefficients of balanced equation
- used to convert between given moles of reactant or product to moles of different react. or prod

7. Define limiting reactant and excess reactant.

2 Lim - 1st substance used up in reaction
Ex - not completely used up

8. Explain the difference between theoretical and actual yield. Which one is usually the greater amount?

larger
2 T - max amount of product that could be formed from given reactants
A - amount of product actually formed in an experiment

9. How do you calculate percent yield?

1 $\frac{Act}{Theo} \times 100 = \%\ yield$

10. Complete the following table:

When converting from –

	Start With	End With
Grams to Moles (example)	Grams of Given	Moles from Balanced Equation
Liters to Grams	L of given	g (molar mass) from per tab
Moles to Molecules	mol of given	6.02×10^{23} molecules
Molecules to Grams	molec. of given	g from per tab
Moles to Liters	mol of given	22.4 L

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Stoichiometry Worksheet #1

1) Balance the chemical equation and use it to solve for the following problems:

$Al(s) + H_2SO_4(aq) \rightarrow$

a. If 58.83 g of Aluminum is completely reacted, how many grams of Hydrogen sulfate are needed?

320.8g H_2SO_4

b. If 45.60 L of Hydrogen gas forms at STP, what mass of Hydrogen sulfate was used?

199.7g H_2SO_4

c. How many grams of Aluminum were needed to produce 3.5 moles of Aluminum sulfate?

190g. Al

d. What volume of hydrogen gas will be produced @ STP from the complete reaction of 2.5 moles of Aluminum?

84L H_2

2) Balance the chemical equation and use it to solve for the following complete combustion:

$C_5H_{11}(s) + O_2(g) \rightarrow$

a. If 180.3 g of C5H11 is burned how many molecules of CO2 are produced?

7.627×10^{24} molec. CO_2

b. If 63.4 Liters of carbon dioxide gas forms at STP, how many Liters of oxygen were used?

98.3L O_2

c. How many moles of oxygen gas were needed to produce 4.5 moles of water vapor?

6.3 mol O_2

d. What mass of C_5H_{11} when burned will produce 74 grams of H2O vapor?

53g C_5H_{11}

3) Balance the chemical equation and use it to solve for the following problems:

$NH_3(g) + O_2(g) \rightarrow NO(g) + H_2O(l)$

a. How many grams of NH_3 were needed to produce 2.5 x 10^{24} molecules of water?

47g NH_3

b. What volume of O2 gas is required to produce 34.0 Liters of NO?

42.5L O_2

c. If 65.3 L of NO were produced at STP, how many grams of Ammonia were used?

49.7g NH_3

d. We want to collect 5 Liters of water, what mass of Ammonia will we need to start with?

3g NH_3

Name Key Period ____

Limiting Reagent Worksheet #2

1) If 15.6 grams of copper (II) chloride, $CuCl_2$ react with 20.2 grams of sodium nitrate, $NaNO_3$, how many grams of sodium chloride, NaCl, can be formed?

$$CuCl_2 + 2\ NaNO_3 \rightarrow Cu(NO_3)_2 + 2\ NaCl$$

$$15.6\text{g } CuCl_2 \times \frac{1\text{mol } CuCl_2}{134.5\text{g } CuCl_2} \times \frac{2\text{mol NaCl}}{1\text{mol } CuCl_2} \times \frac{58.5\text{g NaCl}}{1\text{mol NaCl}} = 13.6\text{g NaCl}$$

$$20.2\text{g } NaNO_3 \times \frac{1\text{mol } NaNO_3}{85.0\text{g } NaNO_3} \times \frac{2\text{mol NaCl}}{2\text{mol } NaNO_3} \times \frac{58.5\text{g NaCl}}{1\text{mol NaCl}} = 13.9\text{g NaCl}$$

Amount of NaCl produced 13.6g NaCl

Limiting reactant $CuCl_2$ Excess reactant $NaNO_3$

2) If 10.4 grams of hydrogen, H_2, and 9.14 grams of oxygen, O_2, are placed together in a container and allowed to react according to the equation how many grams of water, H_2O, would be produced by the reaction?

$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

$$10.4\text{g } H_2 \times \frac{1\text{mol } H_2}{2\text{g } H_2} \times \frac{2\text{mol } H_2O}{2\text{mol } H_2} \times \frac{18\text{g } H_2O}{1\text{mol } H_2O} = 93.6\text{g } H_2O$$

$$9.14\text{g } O_2 \times \frac{1\text{mol } O_2}{32\text{g } O_2} \times \frac{2\text{mol } H_2O}{1\text{mol } O_2} \times \frac{18\text{g } H_2O}{1\text{mol } H_2O} = 10.3\text{g } H_2O$$

Amount of H_2O produced 10.3g H_2O

Limiting reactant O_2 Excess reactant H_2

3) Methyl alcohol (wood alcohol), CH_3OH, is produced via the reaction

$$CO + 2\ H_2 \rightarrow CH_3OH$$

When a mixture of 1.20 g $H_2(g)$ and 7.45 g $CO(g)$ are allowed to react, how many grams of methanol could be produced?

$$1.20\text{g}H_2 \times \frac{1\text{mol}H_2}{2.0\text{g}H_2} \times \frac{1\text{mol}CH_3OH}{2\text{mol}H_2} \times \frac{32.0\text{g}CH_3OH}{1\text{mol}CH_3OH} = 9.60\ \text{g}\ CH_3OH$$

$$7.45\text{g}CO \times \frac{1\text{mol}CO}{28\text{g}CO} \times \frac{1\text{mol}CH_3OH}{1\text{mol}CO} \times \frac{32.0\text{g}CH_3OH}{1\text{mol}CH_3OH} = 8.51\text{g}CH_3OH$$

Amount of CH_3OH produced $8.51\text{g}CH_3OH$

Limiting reactant CO Excess reactant H_2

4) How many grams of NH_3 can be produced from the reaction of 28.0 g of N_2 and 25.0 g of H_2?

$$N_2 + 3\ H_2 \rightarrow 2\ NH_3$$

$$28.0\text{g}N_2 \times \frac{1\text{mol}N_2}{28\text{g}N_2} \times \frac{2\text{mol}NH_3}{1\text{mol}N_2} \times \frac{17\text{g}NH_3}{1\text{mol}NH_3} = 34.0\text{g}NH_3$$

$$25.0\text{g}H_2 \times \frac{1\text{mol}H_2}{2.0\text{g}H_2} \times \frac{2\text{mol}NH_3}{3\text{mol}H_2} \times \frac{17\text{g}NH_3}{1\text{mol}NH_3} = 141\text{g}NH_3$$

Amount of NH_3 produced $34.0\text{g}NH_3$

Limiting reactant N_2 Excess reactant H_2

Percent Yield Worksheet #1

NOTE: % Yield = $\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$

Theoretical Yield = answer to your stoich problem.

Actual Yield = given in the problem or the experimental yield.

1) Balance the equation for the reaction of iron (III) phosphate with sodium sulfate to make iron (III) sulfate and sodium phosphate.

$$FePO_4 + Na_2SO_4 \rightarrow Fe_2(SO_4)_3 + Na_3PO_4$$

a) If I perform this reaction with 25 grams of iron (III) phosphate and an excess of sodium sulfate, how many grams of iron (III) sulfate can I make?

$33\,g\ Fe_2(SO_4)_3$

b) If 18.5 grams of iron (III) sulfate are actually made when I do this reaction, what is my percent yield?

56%

c) Is the answer from problem 1B reasonable? Explain.

d) If I do this reaction with 15 grams of sodium sulfate and get a 65.0% yield, how many grams of sodium phosphate will I make?

$7.8\,g\ Na_3PO_4$

2) $LiOH + KCl \rightarrow LiCl + KOH$

a) I began this reaction with 20 grams of lithium hydroxide. What is my theoretical yield of lithium chloride?

40g LiCl

b) I actually produced 6 grams of lithium chloride. What is my percent yield?

20%

3) $C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$

a) If I start with 5 grams of C_3H_8, what is my theoretical yield of water?

8g H_2O

b) I got a percent yield of 75% How many grams of water did I make?

6g H_2O

4) $Be + 2\,HCl \rightarrow BeCl_2 + H_2$

My theoretical yield of beryllium chloride was 10.7 grams. If my actual yield was 4.5 grams, what was my percent yield?

42%