Key

Date: _____ Class Pd. ____

HONORS CHEMISTRY: Unit 5 Moles & Stoichiometry Test Review

1. $\underline{2}\ C_3H_7OH + \underline{9}\ O_2 \rightarrow \underline{6}\ CO_2 + \underline{8}\ H_2O$

12 + 8 = 20

$\frac{-2}{18}$

a. What is the mole ratio of oxygen to carbon dioxide?

$9 O_2 : 6 CO_2$

b. How many moles of carbon dioxide are produced when 4.6 mol of oxygen react?

Stoichiometry

$$4.6 \text{ mol } O_2 \left| \frac{6 \text{ mol } CO_2}{9 \text{ mol } O_2} \right. = 3.1 \text{ mol } CO_2$$

c. How many molecules of C_3H_7OH will react with 4.6 L of oxygen?

Stoich

$$4.6 \text{ L } O_2 \left| \frac{1 \text{ mol } O_2}{22.4 \text{ L } O_2} \right| \frac{2 \text{ mol } C_3H_7OH}{9 \text{ mol } O_2} \left| \frac{6.022 \times 10^{23} \text{ molecules } C_3H_7OH}{1 \text{ mol } C_3H_7OH} \right. = 2.7 \times 10^{22} \text{ molecules } C_3H_7OH$$

2. Lithium nitride reacts with water to form ammonia (NH_3) and lithium hydroxide.

$Li_3N + 3H_2O \rightarrow NH_3 + 3LiOH$

a. How many grams of lithium nitride will react with 40.0 g of water?

Stoich

$$40.0 \text{ g } H_2O \left| \frac{1 \text{ mol } H_2O}{18.016 \text{ g } H_2O} \right| \frac{1 \text{ mol } Li_3N}{3 \text{ mol } H_2O} \left| \frac{34.833 \text{ g } Li_3N}{1 \text{ mol } Li_3N} \right. = 25.8 \text{ g } Li_3N$$

b. What mass of lithium hydroxide is produced from 6.75 mol of lithium nitride?

Stoich

$$6.75 \text{ mol } Li_3N \left| \frac{3 \text{ mol } LiOH}{1 \text{ mol } Li_3N} \right| \frac{23.949 \text{ g } LiOH}{1 \text{ mol } LiOH} = 485 \text{ g } LiOH$$

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P R

3. A student made 75.94 g of magnesium chloride by reacting 30.00g of Magnesium with 60.00g of hydrochloric acid.

R

Limiting reactant and percent yield

a. Write the balanced equation.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

b. What is the limiting reactant? Excess reactant?

$$30.00\,g\,Mg \left| \frac{1\ mol\ Mg}{24.31\,g\,Mg} \right| \frac{1\ mol\ MgCl_2}{1\ mol\ Mg} \left| \frac{95.24\,g\,MgCl_2}{1\ mol\ MgCl_2} \right| = 117.5\,g\,MgCl_2$$

$$60.00\,g\,HCl \left| \frac{1\ mol\ HCl}{36.458\,g\,HCl} \right| \frac{1\ mol\ MgCl_2}{2\ mol\ HCl} \left| \frac{95.24\,g\,MgCl_2}{1\ mol\ MgCl_2} \right| = 78.37\,g\,MgCl_2$$

LR = HCl

ER = Mg

Theoretical yield = 78.37g $MgCl_2$

c. What is the percent yield?

$$\frac{75.94\,g\,MgCl_2}{78.37\,g\,MgCl_2} \times 100 = 96.90\%$$

d. Determine the amount of excess reactant remaining.

$$78.37\,g\,MgCl_2 \left| \frac{1\ mol\ MgCl_2}{95.24\,g\,MgCl_2} \right| \frac{1\ mol\ Mg}{1\ mol\ MgCl_2} \left| \frac{24.31\,g\,Mg}{1\ mol\ Mg} \right| = 20.00\,g\,Mg$$

↑ used up

$$30.00\,g\,Mg - 20.00\,g\,Mg = 10.00\,g\,Mg$$

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4. A student reacts 2.00g of Lead (II) nitrate with 4.00g of potassium iodide. How much product in grams should she expect to collect? (Write a balanced reaction and determine the precipitate)

solid ↗

$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$

$2.00g\ Pb(NO_3)_2 \left| \frac{1\ mol\ Pb(NO_3)_2}{331.22\ g\ Pb(NO_3)_2} \right| \frac{1\ mol\ PbI_2}{1\ mol\ Pb(NO_3)_2} \left| \frac{461\ g\ PbI_2}{1\ mol\ PbI_2} \right| = 2.78g\ PbI_2$

$4.00g\ KI \left| \frac{1\ mol\ KI}{166\ g\ KI} \right| \frac{1\ mol\ PbI_2}{2\ mol\ KI} \left| \frac{461\ g\ PbI_2}{1\ mol\ PbI_2} \right| = 5.55g\ PbI_2$

LR = $Pb(NO_3)_2$ ER = KI theoretical yield = 2.78g PbI_2

5. Find the percentage of nitrogen in ammonium nitrate, an important source of nitrogen in fertilizers.

NH_4NO_3 ↳ 80.052

$\frac{28.02}{80.052} \times 100 = 35.00\%$

Name the following compounds and give the percent composition of each element.

6. Fe_2O_3 ↳ 159.7 Name: Iron (III) oxide %Fe = 69.94 %O = 30.06

7. Ag_2O ↳ 231.74 Name: Silver oxide %Ag = 93.10%. % O = 6.97.

8. Na_2SO_4 ↳ 142.05 Name: Sodium sulfate %Na = 32.37%. %S = 22.58%. %O = 45.05%.

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9. What is the empirical formula of a compound that contains 53.73 % Fe and 46.27 % S?

$53.73\text{ g Fe} \mid \frac{1\text{ mol Fe}}{55.85\text{ g Fe}} \mid \frac{}{\text{mol Fe}} = .96204 / 0.96204 = 1 \times 2 = 2$

$46.27\text{ g S} \mid \frac{1\text{ mol S}}{32.07\text{ g S}} = 1.443 / 0.96204 = 1.5 \times 2 = 3$

Fe_2S_3

10. What is the empirical formula of a compound that contains 63.1 % Mn and 36.9 % S?

$63.1\text{ g Mn} \mid \frac{1\text{ mol Mn}}{54.94\text{ g Mn}} = 1.1485 / 1.1485 = 1$

$36.9\text{ g S} \mid \frac{1\text{ mol S}}{32.07\text{ g S}} = 1.1506 / 1.1485 = 1$

MnS

11. What is the empirical formula of a compound that contains 26.6 % K, 35.4 % Cr, and 38.0 % O?

$26.6\text{ g K} \mid \frac{1\text{ mol K}}{39.1\text{ g K}} = .68031 / .68031 = 1 \times 2 = 2$

$35.4\text{ g Cr} \mid \frac{1\text{ mol Cr}}{51.99\text{ g Cr}} = .6809 / .68031 = 1 \times 2 = 2$

$38.0\text{ g O} \mid \frac{1\text{ mol O}}{16\text{ g O}} = 2.375 / .68031 = 3.5 \times 2 = 7$

$K_2Cr_2O_7$

12. An organic compound is found to contain 92.25 % carbon and 7.75 % hydrogen. If the molecular mass is 78, calculate:

The empirical formula = CH

$92.25\text{ g C} \mid \frac{1\text{ mol C}}{12.01\text{ g C}} = 7.6811 / 7.681$

$7.75\text{ g H} \mid \frac{1\text{ mol H}}{1.008\text{ g H}} = 7.688 / 7.681$

The empirical formula mass = 13.018 g/mol

CH 12.01 + 1.008

The molecular formula = C_6H_6

$\frac{78}{13.018} = 6$ CH x 6

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13. In an experiment, a student gently heated a hydrated $CuSO_4 \cdot x\ H_2O$ to remove the water. The following data was recorded:

Mass of empty crucible	19.82 g
Mass of crucible & contents before heating	21.54 g.
Mass of crucible & contents after heating	20.94 g

Hydrate = 21.54 - 19.82 = 1.72g

anhydrous salt = 20.94 - 19.82 = 1.12g

water = 1.72 - 1.12 = 0.60g

a. Determine the formula of the hydrate.

$1.12\text{g } CuSO_4 \left| \frac{1 \text{ mol } CuSO_4}{159.62 \text{ g } CuSO_4} \right. = 0.00702 / 0.00702 = 1$

$0.60\text{g } H_2O \left| \frac{1 \text{ mol } H_2O}{18.016 \text{ g } H_2O} \right. = 0.0333 / 0.00702 = \text{about } 5$

b. The formula of the hydrate = $CuSO_4 \cdot 5H_2O$

C. What is the name of the hydrate? copper (II) sulfate pentahydrate

D. What is the percent of water in the hydrate

$CuSO_4 \cdot 5H_2O$

$\frac{90.08}{249.7} \times 100 = 36.08\%$

14. In an experiment, barium chloride ___ hydrate was heated to remove water. The following data was obtained:

Mass of empty crucible	20.286 g
Mass of crucible & contents before heating	21.673 g
Mass of crucible & contents after heating	21.461 g

hydrate = 21.673 - 20.286 = 1.387g

anhydrous salt = 21.461 - 20.286 = 1.175g

water = 1.387 - 1.175 = 0.212g

a. Determine the formula of the hydrate.

$1.175\text{g } BaCl_2 \left| \frac{1 \text{ mol } BaCl_2}{208.28 \text{ g } BaCl_2} \right. = 0.00564 / 0.00564 = 1$ B

$0.212\text{g } H_2O \left| \frac{1 \text{ mol } H_2O}{18.016 \text{ g } H_2O} \right. = 0.01177 / 0.00564 = 2$

b. The formula of the hydrate = $BaCl_2 \cdot 2H_2O$

C. What is the name of the hydrate? Barium chloride dihydrate

D. What is the percent of water in the hydrate

$BaCl_2 \cdot 2H_2O$

$\frac{36.032}{244.312} \times 100 = 14.75\%$