CHEM 160, FALL 2015
EXAM #3 (Chp 6.6-6.8, 7, 9, 10)

NAME ANSWER KEY

115 pt

Use the Scantron for Questions 1-13. Mark only one answer unless instructed otherwise.

CHP 6

1. (6.6) What is the mass percent oxygen in the compound NO?
A) .875% B) 87.5% C) 16.00% D) 46.68 % E) 53.32%

N = 14.01
O = 16.00
30.01

$\%O = \frac{16.00}{30.01} \times 100 = 53.32\%$

2. (6.6) Methane, CH_4, is a molecular compound. Which of the following is the correct value and units of the molar mass of methane?
A. 16.0 g/mol B. 16.0 g/molecule C. 16.0 amu D. 16.0 amu/molecule E. 16.0 g/atom

C = 12 + 4H (4.04) = 16.04 g/mol

3. (6.6) What is the molar mass of sodium phosphate?
A) 226 g B) 119 g C) 354 g D) 308 g E) 164 g

Na_3PO_4

3 x 22.99 = 68.97
1 x 30.97 = 30.97
4 x 16.00 = 64.00
163.94

(6.7) (5 pt) Calculate the mass of silver in a 1.50 g sample of silver sulfide (Ag_2S, molar mass = 247.78 g)

$1.50\text{ g } Ag_2S \times \frac{1\text{ mol}}{247.78\text{ g}} \times \frac{2\text{ mol Ag}}{1\text{ mol } Ag_2S} \times \frac{107.87\text{ g}}{1\text{ mol}} = 1.31\text{ g Ag}$

(6.8)(2 pt) The simplest or smallest whole number ratio of the atoms in a compound formula is known as the

empirical formula

(6.8) (8 pt) An extremely explosive ionic compound is made from the reactions of silver compounds with ammonia. A sample of this compound is found to contain 17.261 g silver and 0.743 g nitrogen. What is the empirical formula for this compound. *Show all work for complete credit.*

	Ag	N
	17.261 g	0.743 g
mol	$17.261\text{ g} / 107.87\frac{\text{g}}{\text{mol}} =$	$0.743\text{ g} / 14.01\frac{\text{g}}{\text{mol}} =$
	0.160 mol Ag	0.0530 mol N
mol ratio	$\frac{0.160\text{ mol Ag}}{0.0530\text{ mol N}} = 3$	$\frac{0.0530\text{ mol N}}{0.0530\text{ mol N}} = 1$

emp formula Ag_3N

21 pt

(6.8) (4 pt) What is the molecular formula of a compound with empirical formula $SNCl_2$ and molecular formula mass = 351 amu?

S = 32.06
N = 14.01
2 Cl = 70.90
E.F. mass = 116.97

$n = \frac{351}{116.97} = 3$

$(SNCl_2)_3 = S_3N_3Cl_6$

CHP 7

Use the following answers to fill in the blanks in Questions 4-7.
A) Changed B) Created C) Coefficients D) Subscript E) There is no answer.

4. When balancing equations we do not change the ___D___ in the formulas.

5. The purpose of the ___C___ placed in front of formulas is to make the number of atoms on the reactant side equal to the number of atoms on the product side.

6. In a chemical reaction atoms are neither created nor destroyed they merely ___A___ partners.

7. When the product of a reaction is ___E___ it is called a precipitate.

(7.1 & 7.3) (6 pt) Balance and name the type of this chemical reaction.

___2___ $HClO_{3\,(aq)}$ + ___1___ $MgSO_{3\,(aq)} \rightarrow$ ___1___ $H_2SO_{3\,(aq)}$ + ___1___ $Mg(ClO_3)_{2\,(aq)}$

Name Double Replacement

(7.1 & 7.3) (8 pt) Complete and balance each of the following reactions. *Hint: Predict if a precipitate will form. If there is no reaction write NR.*

___1___ $KI(aq)$ + ___1___ $NaC_2H_3O_2$ → $1KC_2H_3O_{2\,(aq)} + 1NaI_{(aq)}$ (NR) (No ppt)

___1___ $K_2SO_4(aq)$ + ___1___ $Ba(NO_3)_2$ → $1BaSO_{4\,(s)} + 2KNO_{3\,(aq)}$

CHP 9

8. (9.1) When an atom loses an electron, the resulting particle is
(A) oxidized B) reduced C) neutral D) negatively charged E) positively charged (NOT ALWAYS)

9. (9.1) Identify the oxidation-reduction reactions among the following:

1. $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$
2. $2Na(s) + Cl_2(aq) \rightarrow 2NaCl(s)$
3. $2Mg(s) + O_2(g) \rightarrow 2MgO$

A) 1 and 2 only B) 1 and 3 only C) 2 and 3 only (D) All of 1, 2, and 3 E) None of 1, 2, and 3

10. (9.2) The oxidation numbers of Mg and O in MgO are: A) 0,0 (B) +2,-2 C) +2,0 D) 0,-2
+2 -2

32 pt

11. (9.2) In the following reaction, $\overset{0}{Zn}(s) + \overset{+2}{CuSO4}(aq) \rightarrow \overset{+2}{ZnSO4}(aq) + \overset{0}{Cu}(s)$

(A) Zn is oxidized and Cu^{2+} is reduced.
B) $CuSO_4$ is oxidized and Zn is reduced.
C) $ZnSO_4$ is oxidized and Cu is reduced.
D) $Cu^{2+}$is oxidized and Zn^{2+} is reduced.

Solid calcium reacts with oxygen gas, forming solid calcium oxide.

(9.3) (6 pt) Write the balanced equation for this reaction.

$2\ Ca(s) + 1\ O_2(g) \rightarrow 2\ CaO(s)$

(9.3) (2 pt) What is the name of this reaction? Combination or synthesis

(9.3) (6 pt) When potassium chlorate is heated it produces oxygen and potassium chloride. Write the balanced equation for this reaction.

$2\ KClO_3(s) \rightarrow 3\ O_2(g) + 2\ KCl(s)$

(2 pt) What is the name of this reaction? Decomposition

(9.3) (7 pt) Propane (C_3H_8) is used for heating and cooking in some homes. Write the balanced equation for the combustion of propane.

$1\ C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

CHP 10

12. (10.1) For the reaction $2H_2 + O_2 \rightarrow 2H_2O$ How much water is produced when 2.5 moles of hydrogen react completely?

a. 2.5 grams b. 18.0 grams c. 2.0 moles (d.) 2.5 moles $\frac{2\ mol\ H_2O}{2\ mol\ H_2}$

$?\ H_2O = 2.5\ mol\ H_2 \times \frac{2\ mol\ H_2O}{2\ mol\ H_2} \times \frac{18.02\ g\ H_2O}{1\ mol} = 45.05\ g\ H_2O$

13. (10.1) For the following reaction: $Mg_3N_2 + 6H_2O \rightarrow 3\ Mg(OH)_2 + 2NH_3$
When 2 moles of Mg_3N_2 are allowed to react, how many moles of H_2O also react?

A) 4 moles B) 6 moles C) 8 moles D) 1 mole (E) 12 moles

$2\ mol\ Mg_3N_2 \times \frac{6\ mol\ H_2O}{1\ mol\ Mg_3N_2} = 12\ mol\ H_2O$

(2 pt) The amount of product that a calculation indicates as possible for a chemical reaction is known as the theoretical yield

31 pt

Show all work for full credit in answering questions. Answers must contain correct significant figures for full credit.

(10.2) (7 pt) Using the following equation, if 62.5 grams of hydrogen peroxide produce 0.550 mol of oxygen what is the percent yield?.

$2H_2O_2$ (l) → 2 H_2O (l) + O_2(g)

Molar mass	H_2O_2: 34.02 g	H_2O: 18.02 g	O_2: 32.00 g

$62.5\ g\ H_2O_2 \times \frac{1\ mol\ H_2O_2}{34.02\ g} \times \frac{1\ mol\ O_2}{2\ mol\ H_2O_2} = 0.919\ mol\ O_2$ (theo.)

% yield = $0.550\ mol\ O_2 / 0.919\ mol\ O_2 \times 100 =$ **59.8%**

(10.2 & 10.3) (10 pt) Calculate the grams of aluminum hydroxide obtained from reaction between 105 g sodium hydroxide and 205 g aluminum nitrate according to the following balanced equation:

$Al(NO_3)_3$ (aq) + 3NaOH (aq) → $Al(OH)_3$ (s) + 3$NaNO_3$ (aq)

Molar masses:	213.01 g	40.07 g	78.00 g	85.00 g

A) $105\ g\ NaOH \times \frac{1\ mol}{40.07\ g}\ NaOH = 2.62\ mol\ NaOH$

B) $205\ g\ Al(NO_3)_3 \times \frac{1\ mol}{213.01\ g}\ Al(NO_3)_3 = 0.962\ mol\ Al(NO_3)_3$

$\frac{mol\ NaOH}{mol\ Al(NO_3)_3} = \frac{2.62}{0.962} = \frac{2.7}{1}$

Theo. $\frac{mol\ NaOH}{mol\ Al(NO_3)_3} = \frac{3}{1}$ and this is less than 3 so

NaOH is the limiting reactant.

C) $2.62\ mol\ NaOH \times \frac{1\ mol\ Al(OH)_3}{3\ mol\ NaOH} \times \frac{78.00\ g}{mol}\ Al(OH)_3 =$ **68.12 g**

(2 pt) Which reactant is the limiting reactant? NaOH

(4 pt) How many grams of excess reactant will there be?

$2.62\ mol\ NaOH \times \frac{1\ mol\ Al(NO_3)_3}{3\ mol\ NaOH} = 0.873\ mol\ Al(NO_3)_3$ used.

excess = $0.962\ mol\ Al(NO_3)_3 - 0.873\ mol\ Al(NO_3)_3 = 0.089\ mol$ excess

$0.0890\ mol\ excess \times \frac{213.01\ g}{mol} =$ **18.96 g excess $Al(NO_3)_3$**

23 pt

The following data was obtained from titration of 0.523 g KHP acid with a NaOH solution. Complete the following calculations to determine the molar concentration of the NaOH solution given the following data. The neutralization reaction is NaOH + KHP → KNaP + H_2O. Molar masses are NaOH = 40.00 g and KHP = 204.22 g

	TRIAL 1
Initial NaOH level in buret	0.00 mL
Final NaOH level in buret (End point)	20.55 mL
(2 pt) Volume (mL) of NaOH used ***(Show calculation)***	20.55 − 0.00 = 20.55 mL
(2 pt) Volume in Liters of NaOH used ***(Show calculation)*** $20.55\ mL \times \frac{1\ L}{1000\ mL} =$	0.02055 L

(4 pt) Moles of KHP used in titration 0.00256 mole KHP
(Show calculation)

$0.523\ g\ KHP \times \frac{1\ mol}{204.22\ g\ KHP} = 0.00256\ mol$

(2 pt) Moles of NaOH used in titration 0.00256 mole NaOH
(Show calculation)

$\frac{1\ mol\ NaOH}{1\ mol\ KHP} \times 0.00256\ mol\ KHP = 0.00256\ mol\ NaOH$

(6 pt) Molarity of NaOH solution 0.125 M NaOH
(Show calculation)

$Molarity = \frac{mol\ NaOH}{L\ NaOH} = \frac{0.00256\ mol}{0.02055\ L} = 0.125$ ~~0.1246 M~~

16 pt