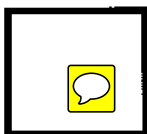


FIRST LETTER OF YOUR LAST NAME



CHEMISTRY 1127

EXAM I

September 27, 2013

Name: KEY

Lab (L) Section ECE

Signature: _____

TA _____

ID # _____

PLEASE READ THE FOLLOWING INSTRUCTIONS

Do NOT begin the exam until asked to do so.

There are 8 numbered pages, a page of equations and a periodic table in this exam. Check to see that they are all here before you begin the exam. Return all these papers when you are finished. Write your name on every page. Use a **pen** with blue or black ink for the entire exam.

Exams done in pencil, erasable ink, or where white-out, liquid paper, etc. have been used are ineligible for regrades.

Be sure to follow the directions in answering all questions. Write your final answers in the blanks provided. In working problems you must **SHOW ALL WORK**. No credit will be given unless all work is clearly shown and the method of solution is logically correct. Use correct units and significant figures.

Do not write below this line

Page	Total	Grader
1	_____ / 14	
2	_____ / 17	
3	_____ / 22	
4	_____ / 33	
5	_____ / 18	
6	_____ / 28	
7	_____ / 6	
8	_____ / 12	

Total Grade _____ /150 Checked by _____

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I. (31 points)

A. (5 points) How many significant figures are there in each of the following measured values?

5 pts each

	# of significant figures
1. 0.007 m	<u>1</u>
2. 12 inches = 1 foot	<u>exact</u>
3. 1.56300×10^{11} m	<u>6</u>
4. 30,800 s	<u>ambiguous</u>
5. 0.000012005 m	<u>5</u>

B. (4 points) Calculate the following to the correct number of significant figures.

$$x = \frac{[(2.68)(1.9) - (0.4)(0.01396)]}{0.7143}$$

$$= \frac{5.092 - 0.00584}{0.7143} = \frac{5.086}{0.7143}$$

$$= 7.1$$

All or nothing

C. (5 points) Ten grams iron pellets ($d = 7.86 \text{ g/cm}^3$) are added to a flask (123.5 g) filled with acetone. The flask and acetone ($d = 0.792 \text{ g/cm}^3$) weigh 211.7 g. How much does the flask weigh after the iron is added and the sides dried from the displaced ~~water?~~ ^{acetone}

$$10.0 \text{ g Fe} \times \frac{1 \text{ cm}^3}{7.86 \text{ g}} = 1.27 \text{ cm}^3 \text{ Fe}$$

All or nothing

$$V_{\text{of the flask}} = (211.7 - 123.5) \times \frac{1 \text{ cm}^3}{0.792 \text{ g}} = 111.4 \text{ cm}^3$$

$$V_{\text{of acetone after iron added}} = 111.4 - 1.27 = 110.09 \text{ cm}^3$$

$$\text{mass of acetone} = 110.09 \times 0.792 = 87.19$$

$$\underline{220.7 \text{ g}}$$

$$\text{total mass} = 87.19 + 123.5 + 10.0$$

5 pts

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D. (8 points) Diamonds are measured in carats and 1 carat = 0.200 g. The density of diamond is 3.51 g/cm³.

1. What is the volume of the Hope diamond (45.52 carats) in cubic inches?

4 pts

$$1 \text{ in} = 2.54 \text{ cm}$$

$$45.52 \text{ carats} \times \frac{0.200 \text{ g}}{1 \text{ carat}} \times \frac{1 \text{ cm}^3}{3.51 \text{ g}} \times \frac{(\text{in})^3}{(2.54 \text{ cm})^3}$$

0.158 in³

1 pt

1 pt

2 pts

2. If someone offered you the mass of the Hope diamond in gold how much would that be worth?

4 pts

1 troy ounce of gold = \$1322

1 troy ounce = 31.10 g

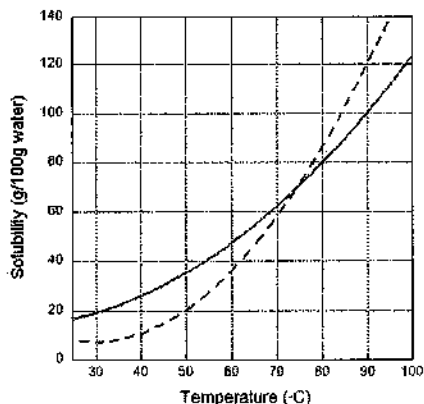
$$45.52 \text{ carats} \times \frac{0.200 \text{ g}}{1 \text{ carat}} \times \frac{1 \text{ troy ounce}}{31.10 \text{ g}} \times \frac{\$1322}{1 \text{ troy ounce}}$$

\$387

2 pts

2 pts

E. (9 points) Answer the following questions using the solubility chart below.



1. Which substance is more soluble at 90°C, Substance X (solid line) or Substance Y (dashed line)?

Y 2 pts

2. You are asked to make a saturated solution of substance X in 75.0 g of water at 30°C. How many grams of substance X do you use?

$$75.0 \text{ g water} \times \frac{20 \text{ g}}{100 \text{ g water}}$$

15 g

3 pts

3. If you take your saturated solution from part 2 and heat it to 90°C how many more grams of substance X could you dissolve?

4 pts

$$75.0 \text{ g water} \times \frac{100 \text{ g}}{100 \text{ g water}}$$

= 75 g × 2 pts

$$75 - 15 = 60 \text{ g}$$

2 pts

60 g

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II. (55 points)

A. (4 points) Consider the isotopes ^{121}Sb and ^{123}Sb

1. How many protons does each isotope have?

51 ^{121}Sb 51 ^{123}Sb

2. How many neutrons does each isotope have?

70 ^{121}Sb 72 ^{123}Sb

1 pt each

B. (4 points) A student saw the following nuclear symbol for an unknown ion: $^{52}_{24}\text{X}$ and knows it has a charge of +2.Cr

1. What is the element?

22

2. How many electrons does this ion possess?

2 pts each

C. (8 points) Classify each of the following as metals, nonmetals, or metalloids

nonmetal

1. Sulfur

metal

2. Lead

metal

3. Magnesium

metalloid

4. Silicon

2 pts each

D. (6 points) Boron has two naturally occurring isotopes. B-10 has an atomic mass of 10.01294 amu and an abundance of 20.00%. What is the atomic mass of the second isotope?

$$10.81 = 10.01294 \times 0.2000 + X(1 - 0.200)$$

$$= 2.0024588 + 0.8000X$$

$$8.8075412 = 0.8000X$$

Set-up 3 pts

answer 2 pts

$$X = 11.01 \text{ amu}$$

11.01 amu -1 if it is not 4 sig. fig

6 pts

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E. (5 points) Calculate the mass of an atom of vanadium in grams.

Spts

$$1 \text{ atom} \times \frac{50.94}{6.022 \times 10^{23} \text{ atoms}} = 8.459 \times 10^{-23} \text{ g}$$

All or nothing

F. (5 points) Determine the number of platinum (Pt) atoms in a typical wedding ring weighing 11.01 g.

Spts

$$11.01 \text{ g} \times \frac{6.022 \times 10^{23} \text{ atoms}}{195.1 \text{ g}} = 3.398 \times 10^{22} \text{ atoms}$$

1 mist. 3 pts

2 mist. 0

3 pts for # of moles

G. (10 points) Write the names the following:

a) P_4O_6 tetraphosphorus hexoxideb) Mg_3N_2 magnesium nitridec) CH_4 methaned) $\text{HNO}_2(\text{aq})$ nitrous acide) $\text{Cr}_2(\text{SO}_3)_3$ chromium (III) sulfite

-1 each mist.

H. (10 points) Write the formulas of the following:

a) Dichlorine monoxide Cl_2O b) Ammonia NH_3 c) Bromic acid $\text{HBrO}_3(\text{aq})$ d) iron(III) carbonate $\text{Fe}_2(\text{CO}_3)_3$ e) nickel(II) iodate $\text{Ni}(\text{IO}_4)_2$

I. (3 points) Write the name of the following

An ionic compound made up of an alkaline earth metal with 56 protons and an anion made up of a chlorine and 3 oxygen atoms. $\text{Ba}(\text{ClO}_3)_2$ barium chlorate

3pts

4
2pts

33

3pts

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III. (64 points)

A. (4 points) What is the mass of 0.485 mol of lead, Pb?

4pts

$$0.485 \text{ mol Pb} \times \frac{207.2 \text{ g}}{1 \text{ mol Pb}}$$

1.00 x 10² g All or nothing

B. (4 points) How many moles are present in 50.0 g of cane sugar C₁₂H₂₂O₁₁?

4pts

(MM C₁₂H₂₂O₁₁ = 342.296 g/mol)

$$50.0 \text{ g C}_{12}\text{H}_{22}\text{O}_{11} \times \frac{1 \text{ mol C}_{12}\text{H}_{22}\text{O}_{11}}{342.296 \text{ g}}$$

0.146 mol

All or nothing

C. (5 points) Citric acid has the formula, C₆H₈O₇. How many carbon atoms are in 1.354 mol of citric acid?

MM C₆H₈O₇ = 192.12 g/mol

$$1.354 \text{ mol C}_6\text{H}_8\text{O}_7 \times \frac{6 \text{ mol C}}{1 \text{ mol C}_6\text{H}_8\text{O}_7} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol C}}$$

5pts

1 pt

↓
4.892 x 10²⁴

↓
2pts

↓
2pts

D. (5 points) Digenite is a copper sulfide mineral with a formula Cu₉S₅ and is an excellent source of copper. How many kilograms of the mineral are required to produce 8.00 kg of copper?

5pts

$$8.00 \text{ kg Cu} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol Cu}}{63.55 \text{ g}} \times \frac{1 \text{ mol Cu}_9\text{S}_5}{9 \text{ mol Cu}} \times \frac{732.3 \text{ g}}{1 \text{ mol Cu}_9\text{S}_5}$$

= 10242 g

1 mist. 3
2 mist. 0

10.2 kg

18

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- E. (6 points) A metal (M) forms an oxide with the formula M_2O_5 . If the oxide contains 43.99% O by mass, what is the molar mass of the metal? What is the identity of the metal?

$$100 - 43.99 = 56.01$$

$$\# \text{ of mol of O} = 43.99 \text{ g} \times \frac{1 \text{ mol O}}{16.00 \text{ g}} = 2.749 \text{ mol} \quad (2 \text{ pts})$$

$$\# \text{ of mol of M} = 2.749 \text{ mol} \times \frac{2 \text{ mol M}}{5 \text{ mol O}} = 1.100 \text{ mol} \quad (2 \text{ pts})$$

$$\underline{50.92 \text{ g/mol}} \quad \checkmark$$

$$1 \text{ mol} \times \frac{56.01 \text{ g}}{1.100 \text{ mol}} \quad (2 \text{ pts})$$

- F. (8 points) When a 0.2754 g sample of manganese is heated in air, 0.3823 g of an oxide is produced. What is the empirical formula of the product of this experiment?

$$\# \text{ of mol of Mn} = 0.2754 \text{ g Mn} \times \frac{1 \text{ mol Mn}}{54.94 \text{ g}} = 0.00501 \text{ mol} \quad (2 \text{ pts})$$

$$\# \text{ of mol of O} = (0.3823 - 0.2754) \times \frac{1 \text{ mol O}}{16.00 \text{ g}} = 0.00668 \text{ mol} \quad (2 \text{ pts})$$



$$\frac{0.00668}{0.00501} = 1.33 \quad (MnO_{1.33})_3 \quad (2 \text{ pts})$$

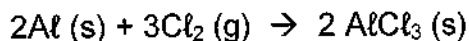
- G. (6 points) Calculate the percent of hydrogen in a sample if combustion of a 1.39 g-sample in excess oxygen yields 3.12 g of H_2O ?

$$3.12 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.016 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{1.008 \text{ g}}{1 \text{ mol H}} = 0.349 \text{ g} \quad (4 \text{ pts})$$

$$\frac{0.349}{1.39} \times 100 = 25.1\% \quad (6 \text{ pts})$$

$$\underline{25.1\%}$$

- H. (8 points) For the reaction



How many grams of $AlCl_3$ can be obtained from 8.00 g of Cl_2 and an excess of Al?

MM ($AlCl_3$) = 133.33 g/mol

$$8.00 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g}} \times \frac{2 \text{ mol AlCl}_3}{3 \text{ mol Cl}_2} \times \frac{133.33 \text{ g}}{1 \text{ mol AlCl}_3}$$

(3 pts)

(3 pts)

(2 pts)

$$\underline{10.0 \text{ g}}$$

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I. (6 points) A reagent bottle is labeled 0.388 M copper(I) sulfate, Cu_2SO_4 .

1. Assuming no volume change, how many grams of Cu_2SO_4 (MM = 223.17 g/mol) needs to be added to 1.50 L of this solution to obtain a 0.750 M solution of Cu_2SO_4 ?

$$\begin{aligned} \# \text{ of mol of } \text{Cu}_2\text{SO}_4 &= 1.50 \text{ L } \text{Cu}_2\text{SO}_4 \times \frac{0.750 \text{ mol}}{1 \text{ L}} = \\ &= 1.125 \text{ mol} \end{aligned}$$

$$\begin{aligned} \# \text{ of mol of } \text{Cu}_2\text{SO}_4 &= 1.50 \text{ L } \text{Cu}_2\text{SO}_4 \times \frac{0.388 \text{ mol}}{1 \text{ L}} = \\ &= 0.582 \text{ mol} \end{aligned}$$

$$\underline{121 \text{ g}} \quad \text{difference} = 0.543 \text{ mol} \times \frac{223.17}{1 \text{ mol}} \quad (2 \text{ pts})$$

2. To what volume should you dilute 50.0 mL of the original solution (0.388 M) to obtain a 0.147 M Cu_2SO_4 solution?

$$50.0 \text{ mL} \times \frac{0.388 \text{ mol}}{1000 \text{ mL}} = 0.0194 \text{ mol } \text{Cu}_2\text{SO}_4$$

$$0.0194 \text{ mol } \text{Cu}_2\text{SO}_4 \times \frac{1 \text{ L}}{0.147 \text{ mol}} = 0.132 \text{ L}$$

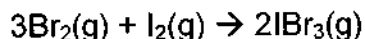
(2 pts)

All or nothing

132 mL or 0.132 L

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J. (12 points) Consider the following balanced equation. Bromine and iodine react to form iodine tribromide. Initially, 1.75 mol of iodine and 3.68 mol of bromine combined.



1. What is the limiting reactant? (WORK MUST BE SHOWN)

Assume Br_2 is the L.R.

$$3.68 \text{ mol Br}_2 \times \frac{2 \text{ mol IBr}_3}{3 \text{ mol Br}_2} = 2.45 \text{ IBr}_3$$

Assume I_2 is the L.R.

$$1.75 \text{ mol I}_2 \times \frac{2 \text{ mol IBr}_3}{1 \text{ mol I}_2} = 3.50 \text{ mol IBr}_3$$

Br_2 is the L.R.

2. What is the theoretical yield of iodine tribromide in moles?

$$\underline{2.45 \text{ mol IBr}_3}$$

3. How many moles of excess reactant remain after reaction is complete?

$$\text{amount of I}_2 \text{ used} = 3.68 \text{ mol Br}_2 \times \frac{1 \text{ mol I}_2}{3 \text{ mol Br}_2} = 1.23 \text{ mol I}_2$$

$$1.75 - 1.23 = 0.52 \text{ mol}$$

$$\underline{0.52 \text{ mol}}$$

4. If 1.50 mol of iodine tribromide was obtained, what is the percent yield?

$$\frac{1.50}{2.45} \times 100 = 61.2 \%$$

$$\underline{61.2\%}$$