

β

Name Key (Please Print)

Student Number _____

Chem 115 - Section 1
Hour Examination I
October 13, 2006

This test consists of five (5) pages, including this cover page. Be sure your copy is complete before beginning your work. If this test packet is defective, ask for another one.

A copy of the periodic table will be distributed with this test.

DO NOT WRITE BELOW THIS LINE

1.

2.

3.

4.

5.

6.

TOTAL

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1. (10 points; 2 points each) Who did what? Match the person with the concept or discovery.

PeopleBecquerel
Lavoisier
NagaokaChadwick
Mendeleev
ProustDalton
Millikan
ThomsonDavy
Moseley
Rutherford**Concepts and Discoveries**

- a. Dalton Predicted and verified the Law of Multiple Proportions
- b. Thomson Determined the charge to mass ratio of the electron
- c. Nagaoka Proposed "Saturnian" model of the atom
- d. Mendeleev Developed periodic table ordered by atomic weight
- e. Becquerel Discovered radioactivity from uranium ore

2. (8 points; 4 points each) Give answers to the following items, which refer to
- $C_5H_4O_3$
- (m.w. = 112.08 u).
- $N_A = 6.022 \times 10^{23}$
- ; at. wt. C = 12.01, H = 1.008, O = 16.00 u.

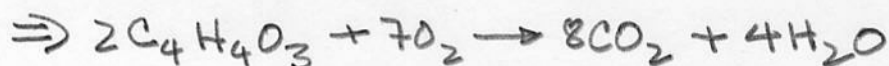
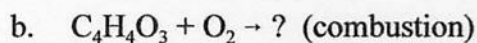
H atoms in 0.4325 g of $C_5H_4O_3$

9.295×10^{21}

weight percent H in $C_5H_4O_3$

3.597%

3. (12 points; 6 points each) In the spaces provided, balance the following skeletal equations, using lowest whole number coefficients.



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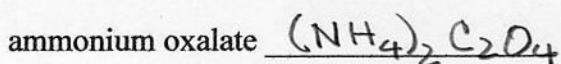
4. (36 points; 6 points each part) Fill in the blanks with the correct answers.

a. Name the following compounds, using I.U.P.A.C. rules of nomenclature.

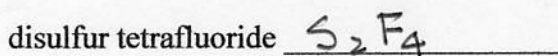
iron(III) hydrogensulfitechlorous acid

b. Give formulas for the following.

ammonium oxalate



disulfur tetrafluoride



c. Indicate the number of protons (p), neutrons (n), and electrons (e).

 ^{73}Ge atomp = 32n = 41e = 32 $^{64}\text{Cu}^{2+}$ ionp = 29n = 35e = 27

d. Give the symbol and name of the following elements:

4th period alkali metal

symbol Kname potassiumtransition element with $Z = 29$ symbol Cuname copper

e. Indicate whether each of the following compounds is ionic or molecular.

molecularionic

f. Answer the following:

(i) The answer to the problem $\frac{(10.530 - 9.5762)}{0.235093}$ should have 3 significant figures.

(ii) For each element, give the expected charge when it forms a monatomic ion:

S 2-Al 3+

(iii) Which one of the following elements forms ionic compounds in which its monatomic ion might have one of two or more possible charges: Tl, I, P, Ba, Cs?

Answer Tl

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5. (16 points) Answer both parts. Show work in the spaces provided to justify your answers.

- a. (12 points) A compound contains 82.657 % carbon and 17.343 % hydrogen. What is the empirical formula of this compound? (at. wts.: C = 12.01 u, H = 1.008 u)

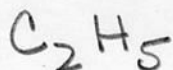
Assume = 100.00g compound.

$$\text{mol C} = (82.657 \text{ g C}) \left(\frac{\text{mol C}}{12.01 \text{ g C}} \right) = 6.882 \text{ mol C}$$

$\Rightarrow 1 \Rightarrow 2$

$$\text{mol H} = (17.343 \text{ g H}) \left(\frac{\text{mol H}}{1.008 \text{ g H}} \right) = 17.20 \text{ mol H}$$

$\Rightarrow 2.5 \Rightarrow 5$



- b. (4 points) If the molecular weight of the compound is 58.12 u, what is its molecular formula?

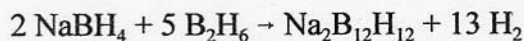
$$\text{f.w. C}_2\text{H}_5 = 29.06$$

$$\frac{\text{m.w.}}{\text{f.w.}} = \frac{58.12}{29.06} = 2 \Rightarrow \text{C}_4\text{H}_{10}$$

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6. (18 points + 5 points bonus) The $B_{12}H_{12}^{2-}$ ion is a cage-like structure of twelve boron atoms. The sodium salt of this anion can be prepared by the following reaction:



How many grams of H_2 gas will be produced when $Na_2B_{12}H_{12}$ is synthesized in the reaction of 0.200 g $NaBH_4$ and 0.420 g B_2H_6 ? **You must identify the limiting reagent, based on appropriate calculations.** Show work in the spaces provided to justify your answers. [f.w. $NaBH_4 = 37.83$ u; m.w. $B_2H_6 = 27.67$ u; f.w. $Na_2B_{12}H_{12} = 187.8$ u; m.w. $H_2 = 2.016$ u.]

$$\text{mol } NaBH_4 = (0.200 \text{ g } NaBH_4) \left(\frac{\text{mol } NaBH_4}{37.83 \text{ g } NaBH_4} \right) = 0.00528_{68} \text{ mol}$$

$$0.00528_{68} / 2 = 0.00264_{34}$$

$$\text{mol } B_2H_6 = (0.420 \text{ g } B_2H_6) \left(\frac{\text{mol } B_2H_6}{27.67 \text{ g } B_2H_6} \right) = 0.0151_{79} \text{ mol}$$

$$0.0151_{79} / 5 = 0.00303_{58}$$

$\Rightarrow NaBH_4$ limits

$$\text{g } H_2 = (0.00528_{68} \text{ mol } NaBH_4) \left(\frac{13 \text{ mol } H_2}{2 \text{ mol } NaBH_4} \right) \left(\frac{2.016 \text{ g } H_2}{\text{mol } H_2} \right)$$

$$= 0.0692_8 \text{ g } H_2 = 0.0693 \text{ g } H_2$$

BONUS (5 points) How many grams of the reactant that is *not* the limiting reagent will be left over after the reaction is complete?

$$\text{g } B_2H_6 \text{ used} = (0.00528_{68} \text{ mol } NaBH_4) \left(\frac{5 \text{ mol } B_2H_6}{2 \text{ mol } NaBH_4} \right) \left(\frac{27.67 \text{ g } B_2H_6}{\text{mol } B_2H_6} \right)$$

$$= 0.365_7 \text{ g } B_2H_6$$

$$\text{g } B_2H_6 \text{ left} = 0.420 \text{ g} - 0.366 = 0.054 \text{ g}$$