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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.

People

Becquerel
Lavoisier
Nagaoka

Chadwick
Mendeleev
Proust

Dalton
Millikan
Thomson

Davy
Moseley
Rutherford

Concepts and Discoveries

- a. Proust His Law of Definite Proportions lead to atomic theory
- b. Millikan Determined the charge of the electron
- c. Thomson Proposed "plum pudding" model of the atom
- d. Chadwick Characterized the neutron from calculations on nuclear reactions
- e. Rutherford Characterized radioactive emissions as α, β, and γ radiation

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.

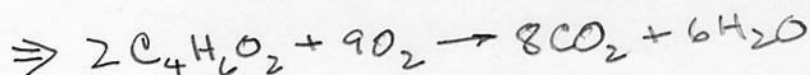
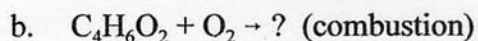
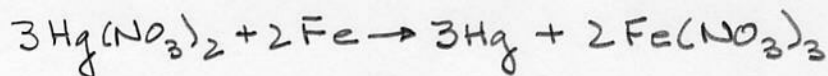
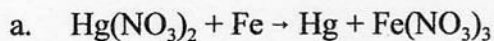
C atoms in 0.4325 g of $C_5H_4O_3$

$$\underline{1.162 \times 10^{22}}$$

weight percent C in $C_5H_4O_3$

$$\underline{53.58\%}$$

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.

 $\text{Fe}(\text{HCO}_3)_2$ iron(II) hydrogen carbonate HClO_4 perchloric acid

b. Give formulas for the following.

ammonium chromate $(\text{NH}_4)_2\text{CrO}_4$ tetraphosphorus decoxide P_4O_{10}

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

 ^{70}Ga atom p = 31 n = 39 e = 31 $^{59}\text{Co}^{3+}$ ion p = 27 n = 32 e = 24

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

3rd period alkali metal symbol Na name sodiumtransition element with $Z = 24$ symbol Cr name chromium

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

 SO_2 molecular CaS ionic

f. Answer the following:

(i) The answer to the problem $\frac{10.53 - 9.5762}{0.235093}$ should have 2 significant figures.

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

Sr 2+ I 1- (or just -)

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

Answer Fe

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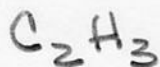
5. (16 points) Answer both parts. Show work in the spaces provided to justify your answers.

a. (12 points) A compound contains 88.818 % carbon and 11.182 % hydrogen. What is the empirical formula of this compound? (at. wts.: C = 12.01 u, H = 1.008 u)

Assume 100.00 g compound.

$$\text{mol C} = (88.818 \text{ g C}) \left(\frac{\text{mol C}}{12.01 \text{ g C}} \right) = 7.395 \text{ mol C} \\ \Rightarrow 1 \Rightarrow 2$$

$$\text{mol H} = (11.182 \text{ g H}) \left(\frac{\text{mol H}}{1.008 \text{ g H}} \right) = 11.09 \text{ mol H} \\ \Rightarrow 1.5 \Rightarrow 3$$



b. (4 points) If the molecular weight of the compound is 54.09 u, what is its molecular formula?

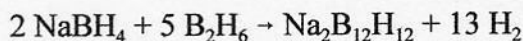
$$\text{f.w. C}_2\text{H}_3 = 27.04$$

$$\frac{\text{m.w.}}{\text{f.w.}} = \frac{54.09}{27.04} = 2 \Rightarrow \text{C}_4\text{H}_6$$

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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 0.250 g $NaBH_4$ and 0.400 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.]

$$mol NaBH_4 = (0.250 g NaBH_4) \left(\frac{mol NaBH_4}{37.83 g NaBH_4} \right) = 0.0066085 mol$$

$$0.0066085 / 2 = 0.0033043$$

$$mol B_2H_6 = (0.400 g B_2H_6) \left(\frac{mol B_2H_6}{27.67 g B_2H_6} \right) = 0.014456 mol$$

$$0.014456 / 5 = 0.0028912 mol$$

$\Rightarrow B_2H_6$ limits

$$g H_2 = (0.014456 mol B_2H_6) \left(\frac{13 mol H_2}{5 mol B_2H_6} \right) \left(\frac{2.016 g H_2}{mol H_2} \right)$$

$$= 0.07577 g H_2 = 0.0758 g H_2$$

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

$$g NaBH_4 \text{ used} = (0.014456 mol B_2H_6) \left(\frac{2 mol NaBH_4}{5 mol B_2H_6} \right) \left(\frac{37.83 g NaBH_4}{mol NaBH_4} \right)$$

$$= 0.2187 g NaBH_4 = 0.219 g NaBH_4$$

$$g NaBH_4 \text{ left} = 0.250 g - 0.219 g = 0.031 g$$