**Exam 2: Chemistry 1984**

**Fall 2013 Alfred State College**

**100 points**

Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ B

**2.1. Electronic Trends and Isotopes (12 pts/ 2 pts each)**

1. Rank these neutral elements in order from smallest to largest in atomic radii:

**I B O F**

**\_F\_\_\_\_\_\_< \_\_\_O\_\_\_\_\_ < \_\_\_B\_\_\_\_\_ < \_\_\_I\_\_\_\_\_**

Smallest largest

1. Ranks these neutral elements in order from smallest to largest first ionization potential:

**F C Li Be**

**\_\_Li\_\_\_\_\_< \_\_\_Be\_\_\_\_\_ < \_\_C\_\_\_\_\_\_ < \_\_\_F\_\_\_\_\_**

Smallest largest

1. Rank these neutral elements in order from smallest to largest electron affinity:

**Te I Sb F**

**\_\_\_Sb\_\_\_\_< \_\_Te\_\_\_\_\_\_ < \_\_\_I\_\_\_\_\_ < \_\_\_F\_\_\_\_\_**

Smallest largest

4.Rank these ions in order from smallest to biggest in size

**Mg2+ S2- Al3+ Na+**

**\_\_Al3+\_\_\_\_\_< \_\_Mg2+\_\_\_\_ < \_Na+\_\_\_\_ < \_\_\_S2-\_\_\_\_\_**

Smallest largest

1. A new trans-uranium element X has three isotopes with masses 500, 505 and 506 amu.

The % abundance of the 500 and 505 isotopes are 25% and 40%. What is the average atomic mass of X to the nearest 0.1 g/mol??

**500\*25 + 505\*40 + 506\*35 =504.1**

**100**

X’s Average atomic mass= 504.1\_\_

1. What is **not** true about nuclear stability? (circle your answer)
2. Stability is favored by nuclei with neutron count/proton count > 1.
3. There is a predicted island of stability past Unobtanium.
4. Higher atomic mass is correlated with lower stability.
5. Stability increases as the neutron/proton count becomes < 1.
6. All of the above

\_\_\_/13

**Chem. 1984 Exam 2b (cont.) p. 2/5**

**2.2. Simple Mole-Mass-Count Conversions (assume 1 mole count = 6\*1023 ) 2 pts each/10 pts total**

1. Compute the molecular mass of crystal meth C10H15N to the nearest g/mol.

(assume atomic masses: C=12 g/mol, H=1 g/mol , N=14 g/mol)

**MW of C10H15N =** \_\_\_\_**149**\_\_\_\_\_\_\_\_\_\_

1. How much does 0.01342 moles of crystal meth weigh to the nearest gram?(show work !)

0.01342 ~~mol~~\*149 g/~~mol~~=2 g

**0.01342 mol crystal meth =** \_\_\_\_\_\_2\_\_\_\_\_\_ g

1. How many molecules of crystal meth are found in 99.332 g of the crystal meth ?

99.332~~g~~/149 ~~g~~ ~~mol~~~~-1~~ \* 6\*1023 molecules/~~mol~~ =4\*1023 molecules

**99.332 g crystal meth** =\_\_\_4\*1023\_\_\_\_\_\_meth molecules

1. How many grams of crystal meth are present in 2.418\*1022 molecules of meth ?

2.418\*1022 ~~molecules~~ \* 1 ~~mol~~/6\*1023 ~~molecule~~s \*149 g/~~mol~~ =6 g

**2.418\*1022 molecules meth**= \_\_\_\_6\_\_\_\_ g meth

1. How many moles of crystal meth are present in 1192 g of the compound ?

1192 ~~g~~ \* 1 mol/149 ~~g~~= 8 mol

**1192 g meth** =\_\_\_\_\_8\_\_\_\_\_\_ mole meth

**2.3. Body Parts (compound element ratio) Mole Calculations (12 pts/ 4 pts each) show work !**

1. You are holding 12.418 g of crystal meth, **C10H15N.** How many grams of **C** are in the sample?

12.418/149 = mol meth=0.08334

Mol C/mol meth= 10/1=x/0.08334=> x= 0.8334 mol= mol C

Mass C = mole C\*12= 0.833\*12=10

**Grams C in 12.418 g crystal meth = \_\_10\_\_\_\_\_\_\_\_\_ g**

1. How many atoms of H are in 0.13333 mol crystal meth ?

Mol H/mol meth = 15/1=x/0.1333=> x= 2= mol H

Atoms H = 6\*1023 molecules/mol \*2 mol =12\*1023

**Atoms of H in 0.13333 mol meth = \_\_\_12\*1023=1.21024\_**

\_\_\_/18

**Chem. 1984 Exam 2b (cont.) p. 3/5**

* 1. **Body Parts (compound element ratio) Mole Calculations (continued)**

1. How many grams of C are combined with 1.75 g hydrogen (H) in crystal meth ?

Mol H= 1.75 g/1 g mol-1

Mol C/mol H=10/15 = x/1.75=> X=10\*1.75/15=1.1666

12 g C/mol\*1.1666 mol C=14

**grams C combined with 1.75 g H in meth=\_\_14\_\_\_\_\_\_\_ g**

* 1. **Percent Composition and Combustion Calculations (12 pts/ 4 pts each)**

1. A compound contains by weight: 52.17 g C, 13.04 g H and 69.56 g O. What is the compound’s empiric formula ? (assume atomic weights: C= 12 g/mol, H =1 g/mol and O=16 g/mol)

Mol C=52.17/12=4.3475 1

Mol H= 13.04 13.04/4.3175=3

**Mol O=69.56/16=4.3475 1**

**\_CH3O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ empiric formula**

1. A binary compound contains 0.2308 g C and 1.54 g O. It has a molecular mass of 460 g/mol.

What is molecular formula for the binary?

0.2308/12=0.0192 = mol C

1.54/16=0.0962=mol O

**C0.0192o0.0962🡪CO5 MW=92**

**460/92=5=> C5O25**

**\_\_\_ C5O25\_\_\_\_\_\_\_\_\_\_ molecular formula**

1. A hydrocarbon (CxHy) is burned in excess O2 to form 0.44 g CO2 and 0.54 g H2O. What is the hydrocarbon’s empiric formula ?

0.44/44=0.01 = mol CO­2

0.54/18=0.030=mol H2O=> mol H=2\*0.030=0.06

**C0.01H0.06**🡪**CH6**

**\_\_\_\_ CH6\_\_\_\_\_\_\_\_\_\_\_ CxHy empiric formula**

**2.5. Reaction Balancing and Reaction Stoichiometry Problems (17 pts)**

1. **Balance us ! ( 7 pts)**

a) \_\_\_4\_\_H3PO3 🡪 \_\_3\_\_H3PO4 + \_1\_\_PH3

b) \_\_2\_\_\_C7H14 + \_\_21\_\_\_O2 🡪 \_\_14\_CO2 + \_14\_\_H2O

1. **Given: C3H8 + 5O2🡪 3CO2 + 4H2O**

**MW 44 32 44 18 g/mol 1 mol count = 6\*1023**

**Show work !**

1. How many grams of O2 are needed to produce 2.4\*1023 molecules of H2O ? ( 5 pts)

**2.4\*1023/6\*1023 = 0.4 mol H2O**

**Mol O2/mol H2O= 5/4= x/0.4=> x=0.5 mol O2 => 0.5\*32=16 g O2**

**\_\_16\_\_Grams O2 to produce 2.4\*1023 H2O molecules**

1. How many grams of CO2 are produced if we burn 6.00 g C3H8? (5 pts)

**6/44= mol C3H8=0.13636 mol**

**Mol CO2/Mol C3H8= 3/1=x/0.13636=> x=0.409 mol CO2**

**0.409 mol \* 44 g/mol=18**

**\_\_18\_\_\_Grams CO2 produced by burning 6 grams C3H8**

**\_\_\_/33**

**Chem. 1984 Exam 2b (cont.) p. 4/5**

* 1. **Limiting Yield and % Yield (15 pts total/5 pts per problem)**

Gasoline (C8H18) burns with O2 stoichiometrically as below:

MW( g/mol) 114 32 44 18

**2C8H18 + 25 O2  🡪 16CO2 + 18 H2O**

1. How many grams of CO2 are formed if we burn 6.4772 g C8H18 and 45.454 g O2 together?

(5 pts)

6.4772/114=mol C8H18=0.0568 => mol CO2 =0.0568\*16/2=0.4545 limits=> 0.4545\*44=20 g

45.454/32=mol O2=1.42 => mol CO2 = 1.42\*16/25=0.909

g CO2 formed = \_\_20\_\_\_\_\_\_\_\_\_

1. How many molecules of H2O are formed if 0.462 mol O2 and 0.148 mol C8H18 are burned together ? ( 5 pts)

0.462 mol O2\*18/25= mol H2O=0.333 limits=> 0.333\*6\*1023 =20\*1023

0.148 \*18/2=mol H2O =1.332

Molecules H2O formed= \_\_20\*1023\_\_\_\_\_\_\_\_

1. A 100 gram sample of C8H18 is burned in an excess of O2. A total of 77.19 g of CO2 results.

What is the % yield of the reaction ? (5 pts)

100 g/114=0.877 mol C8H18 => 0.877\*16/2 mol CO2 max = 7.016 mol CO2 =>308 g CO2

100\*77.19/308 =25%

% Yield = ­­­­­­­­­­\_\_\_25%\_\_\_\_\_\_\_\_\_\_

* 1. **Nomenclature (8 pts/1 pt per answer)**

Provide the correct name for the formulas below

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_hydrosulfuric acid\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    1.  H2S(aq)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_iron(II) chromate\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    2.  FeCrO4

\_\_\_\_\_\_\_\_\_\_\_\_\_dinitrogen pentoxide\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    3.  N2O5

\_\_\_\_\_\_\_\_\_\_\_\_\_magnesium bromide\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    4.  MgBr2

Provide the correct formulas for the names below:

\_\_\_\_\_\_\_HC2H3O2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_          5.  acetic acid

\_\_\_\_\_\_\_\_P4O10\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_          6.  tetraphosphorous decoxide

\_\_\_\_\_\_\_\_\_CuO\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_          7.  cupric oxide

\_\_\_\_\_\_\_Pb(CO3)2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_          8.  lead (IV) carbonate

­\_\_\_/23

**Chem. 1984 Exam 2b (cont.) p. 5/5**

* 1. **Ionic and Covalent Compounds (13 pts)**
     1. **Ionic Compound building 6 pts total (2 pts/answer)**

Predict the likely formulas for binary compounds prepared from:

1. Mg + N = \_\_\_\_\_\_Mg3N2\_\_\_\_\_\_\_\_\_\_\_\_\_
2. K + O \_\_\_\_\_\_\_\_K2O\_\_\_\_\_\_\_\_\_\_\_\_
3. Al + S \_\_\_\_\_\_\_\_Al2S3\_\_\_\_\_\_\_\_\_\_\_\_
   * 1. **Covalent Bonding Using the Lewis Octet Model 6 pts (2 pts/structure) + formal charge question**

Draw the correct Lewis structures for the 3 compounds below, making sure to show all lone pairs.

CO N2 COCl2

:N≡N:

(-):C≡O(+)



Show the formal

charges on C and O

(1 pt)

\_\_\_\_\_/13