**Exam 2: Chemistry 1984**

**Fall 2013 Alfred State College**

**100 points**

Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1 pt A

**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:

**Cl Al P Br**

**~~\_Cl\_\_\_\_< \_\_\_\_Br\_\_ < \_\_P\_\_\_\_\_\_ < \_\_Al\_\_\_~~\_\_ this problem is dropped**

Smallest largest since Br and P are =

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

**F I Li Be**

**\_\_Li\_\_\_\_< \_\_Be\_\_\_\_\_\_ < \_\_\_I\_\_\_ < \_\_\_\_\_F\_\_\_**

Smallest largest

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

**Te I S O**

**\_\_Te\_\_\_\_\_< \_\_\_I\_\_\_\_\_ < \_\_\_\_S\_\_\_\_ < \_\_\_O\_\_\_\_\_**

Smallest largest

1. 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 400, 405 and 406 amu.

The % abundance of the 400 and 405 isotopes are 30% and 40%. What is the average atomic mass of X to the nearest 0.1 g/mol?

**400\*30 + 405\*40 + 406\*30 = 403.8**

**100**

X’s Average atomic mass= \_\_**403.8**\_\_\_\_\_

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 includes name

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**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\_\_\_\_** g/mol

1. How much does 6.711\*10-3 moles of crystal meth weigh to the nearest gram? (show work !)

6.711\*10-3 ~~mol~~\*149 g/~~mol~~=1 g

**6.711\*10-3 mol crystal meth =** \_\_\_\_1\_\_\_\_\_\_\_\_ g

1. How many molecules of crystal meth are found in 49.666 g of the crystal meth ?

49.666~~g~~/149 ~~g~~ ~~mol~~~~-1~~ \* 6\*1023 molecules/~~mol~~ =2\*1023 molecules

**49.666 g crystal meth** =\_\_2\*1023\_\_\_meth molecules

1. How many grams of crystal meth are present in 1.209\*1022 molecules of meth ?

1.209\*1022 ~~molecules~~ \* 1 ~~mol~~/6\*1023 ~~molecule~~s \*149 g/~~mol~~ =3 g

**1.209\*1022 molecules meth**= \_\_\_3\_\_\_\_\_ g meth

1. How many moles of crystal meth are present in 596 g of the compound?

596 ~~g~~ \* 1 mol/149 ~~g~~= 4 mol

**596 g meth** =\_\_\_\_\_4\_\_\_\_\_\_ mole meth

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

1. You are holding 6.209 g of crystal meth, **C10H15N.** How many grams of **C** are in the sample?

6.209/149 = mol meth=0.04167

Mol C/mol meth= 10/1=x/0.04167=> x= 0.4167 mol= mol C

Mass C = mole C\*12= 0.4167\*12=5

**Grams C in 6.208 g crystal meth = \_\_\_\_\_5\_\_\_\_\_\_ g**

1. How many atoms of H are in 0.066666 mol crystal meth ?

Mol H/mol meth = 15/1=x/0.0666=> x= 1= mol H

Atoms H = 6\*1023 molecules/mol \*1 mol =6\*1023

**Atoms of H in 0.06666 mol meth = \_\_\_**6\*1023**\_\_\_\_\_\_\_\_**

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

1. How many grams of C are combined with 0.875 g hydrogen (H) in crystal meth ?

Mol H= 0.875 g/1 g mol-1

Mol C/mol H=10/15 = x/0.875=> X=10\*0.875/15=0.5833 mol C

12 g C/mol\*0.5833 mol C=7

**grams C combined with 0.875 g H in meth=\_\_\_\_7\_\_\_\_ 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 **34.78 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 4.3475/2.1737=2

Mol H= 13.04 13.04/2.1737=6

**Mol O=34.78/16=2.1737 1**

**\_C2H6O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ empiric formula**

1. A binary compound contains 0.2308 g C and 0.770 g O. It has a molecular mass of 520 g/mol.

What is molecular formula for the binary?

**Mol C=0.2308/12=0.0192 => mol O/mol C= 0.048125/0.0192=2.5**

**Mol O=0.770/16=0.04812 empiric formula= C2O5, MW = 2\*12+5\*16=104**

**520/104=5 => molecular formula = C10O25**

**\_\_\_\_\_\_\_ C10O25\_\_\_\_\_\_\_ molecular formula**

1. A hydrocarbon (CxHy) is burned in excess O2 to form 0.44 g CO2 and 0.27 g H2O. What is the hydrocarbon’s empiric formula ?

0.44/44=0.01 = mol CO­2

0.27/18=0.015=mol H2O=> mol H=2\*0.015=0.03

**C0.01H0.03🡪CH3**

**\_\_\_\_\_\_\_CH3\_\_\_\_ CxHy empiric formula**

**2.5. Reaction Balancing and Reaction Stoichiometry Problems (17 Pts total)**

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

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

b) \_\_2\_\_\_C8H18 + \_\_25\_\_\_O2 🡪 \_16\_\_CO2 + \_18\_\_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 1.2\*1023 molecules of H2O? (5 pts)

**1.2\*1023/6\*1023= 0.2 mol H­2O**

**Mol O2/Mol H2O= 5/4=x/0.2=> mol O2 =0.25=> mass O2 =0.25\*32=8**

**\_\_8\_\_\_\_Grams O2 to produce 1.2\*1023 H2O molecules**

1. How many grams of CO2 are produced if we burn 3.00 g C3H8? (5 pts)

Mol C3H8 = 3/44=0.06818

Mol CO2/mol C3H8 = 3/1=x/0.06818=> x= 0.204 mol CO2=> 0.204 mol\*44 g/mol CO2=9

**\_\_\_9\_\_Grams CO2 produced by burning 3 grams C3H8**

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* 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 3.2386 g C8H18 and 22.727 g O2 together?

(5 pts)

3.2386/114=mol C8H18=0.0284 => mol CO2 =0.0284\*16/2=0.272 limits=> CO2 mass=0.272\*44=10 g

22.727/32=mol O2=0.71 => mol CO2 = 0.71\*16/25=0.0.4545

g CO2 formed = \_\_\_\_10\_\_\_\_\_\_\_\_\_\_

1. How many molecules of H2O are formed if 0.231 mol O2 and 0.074 mol C8H18 are burned together ? ( 5 pts)

0.231 mol O2\*18/25= mol H2O=0.1665 limits=> 0.1665\*6\*1023 =10\*1023

0.074 \*18/2=mol H2O =0.666

Molecules H2O formed= \_\_\_\_10\*1023\_\_\_\_\_\_\_\_\_

1. A 50 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)

50 g/114=0.438 mol C8H18 => 0.438\*16/2 mol CO2 max = 3.508 mol CO2 =>154.35 g CO2

100\*77.19/154.35 =50%

% Yield = ­­­­­­­­­­\_\_\_\_50\_\_\_\_\_\_\_\_\_

* 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

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* 1. **Ionic and Covalent Compounds (13 pts)**

**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