**Exam 2 version A: Chemistry 1013**

**Introduction to Chemistry**

Wed 1 April 2015

 \_\_\_\_\_/100 pts

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

**You must show work or no credit will be given !!!**

**2.1. Simple Mole-weight-count conversions (3 points each/15 points total)**

1. The molecular weight of octane is 114 g/mol. How many grams of octane are in 2.6316\*10-2 moles of octane?

multiply down: 0.0263\*10-2 mol\*114 g/mol=3 g

\_3\_\_\_\_\_ g octane

1. How many molecules of octane are in 0.0190 g of octane given that 1 mole count≈6\*1023

divide up to moles: 0.019/114=1.666\*10-4 mol

 multiply down to count: 1.666\*10-4\*6\*1023 =1E20

\_1\*1020\_molecules octane

1. A gallon of gasoline (which is mostly octane) weights 2860 grams. To the nearest whole number, about how many moles of octane are in a gallon of gas?

divide up to moles: 2860/114~ 25 mol

\_25\_\_\_\_moles octane

1. How many grams of octane are in 5.263157\*1022 molecules of octane given that 1 mol

 count=6\*1023 octane molecules?

divide up to moles : 5.263\*1022/6\*1023 =0.0877 mol

multiply down to grams: 0.0877\*114=10 g

 \_10 \_\_\_\_ g octane

1. Given that Si =28 g/mol, O=16 g/mol, how many molecules of SiO2 , the main component of sand,

 are in a grain of sand weighing 0.0060 grams?

MW of SiO2 =28+2\*16=60 g/mol

divide up to moles: 0.006/60 =1\*10-4

multiply down to count: 1\*10-4\*6\*1023=6\*1019 \_6\*1019\_\_\_\_molecules SiO2

**2.2. Mole conversion word problems (4 pts each/8 pts total)**

1. Phosgene gas (COCl2, molecular weight 98 g/mol) was one of the main battlefield chemical weapons used in World War I. It smells like moldy hay and is lethal at a concentration of

1.96 \*10-3 g/liter for rabbits. How many molecules of phosgene must be in a liter of air to kill rabbits? Assume 1 mol count=6\*1023 .

divide up to moles: 1.96\*10-3/98=mol/L=2\*10-5mol/L

multiply down to count: 2\*10-5\*6\*1023 =1.2\*1019

 \_1.2\*1019\_\_\_\_ molecules phosgene

\_\_\_/20 includes name

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1. The manufacture of the microchips found in nearly every modern electronic device requires ultra high vacuum levels to insure the chips don’t fail. Typically this means the molecule count of air particles must be no higher than about 3.21\*1010 molecules/liter during manufacture. Given that the average mass of air particles is about 28.9 g/mol, what is the mass of air per liter in a microchip assembly apparatus? Assume 1 mol count=6\*1023 molecules of air. (Not an even number…)

divide up to moles : 3.21\*1010/6\*1023 =5.35\*10-14 mol/L

multiply down to mass: 5.35\*10-14 \* 28.9=1.546\*10-12 g/L

\_**1.55\*10-1**2 g air/liter (4 pts)

**2.3 Empiric and Molecular Formula Determinations**

1. Which compositions below are correctly expressed as empiric formulas ? (circle choices) 2 pts

 **As5O10 P3Cl7O2 C8H18O Mn5Br15 H2O2**

1. A sample of white crystal with no odor contains 0.1565 g Ca, 0.09375 g C and 0.2500 g O . What is the empiric formula for the compound?

5 pts

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| element | w (g) | g/mol | N=mol | N/Nminempiric formula=\_CaC2O4 |
| Ca | 0.1565 | 40 | 0.00391 | 1 |
| C | 0.09375 | 12 | 0.0078125 | 2 |
| O | 0.25 | 16 | 0.015625 | 4 |

1. A toxic oily exudate collected from a plant is found to contain 0.8372 g C, 1.674 g O and 0.4884 g N.

The molecular weight of the exudate compound is found to be 430 g/mol. What is the actual molecular formula for the compound? 6 pts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| element | w(g) | g/mol | N=mol | N/Nmin | X5 |
| C | 0.8372 | 12 | 0.069766 | 2 | 10 |
| O | 1.674 | 16 | 0.1046 | 3 | 15 |
| N | 0.4884 | 14 | 0.034886 | 1 | 5 |

molecular formula=\_C10O15N5

 C2O3N1 empiric MW=2\*12+3\*16+14=86 430/86=5

**2.4 Combustion problems (5 pts each/10 pts total)**

1. A 14.725 gram sample of pure Co (cobalt) a dark blue metal, is burned with sulfur , a yellow powder to produce 22.725 g of a green compound CoSx. Given that the atomic mass of Co = 59 g/mol and the atomic mass of S=32 g/mol what is the empiric formula for CoSx, e.g., what is x ?

mass of S=22.725-14.725=8 g S=> 8/32 mol =0.25 mol S

mol Co= 14.724/59=0.25 mol Co Co0.25S0.25🡪CoS

\_CoS\_\_ empiric formula for COx

1. An unknown hydrocarbon, CxHy is burned to form 1.1 g CO2 (MW=44 g/mol( and 0.9 g H2O (MW=18

 g/mol). What is the empiric formula for the hydrocarbon?

mol CO2= mol C= 1.1/44=0.025

mol H2O = ½ mol H = 0.9/18=0.05=> mol H=2\*0.05=0.1

C0.025H0.1🡪 CH4

\_\_/27 \_CH4\_\_ empiric formula for CxHy

exam 2A chem 1013 spring 2015: (continued)

**You must show work or no credit will be given !!!**

* 1. **`Body parts’ Stoichiometry (4 pts each/16 pts total)**

Cocaine (‘coke’) has the formula: C17H21NO4 . Its molecular weight is 303 g/mol. Given the

atomic weights C=12 g/mol, H=1 g/mol, N= 14 g/mol and O=16 g/mol and that 1 mol count=6\*1023:

1. How many moles of H are combined in cocaine with 0.19047 mol O?

mol H/mol O=21/4=x/0.19047

 mol H=1

\_1\_\_\_mol H

1. How many grams of C are present in 2.9705 g of coke?

mol coke=2.9705/303 =9.804\*10-3

mol C/mol coke= 17/1=x/9.804\*10-3

x=mol C= 17\*9.804\*10-3=0.1666=> g C=12\*0.1666=2

\_2\_\_\_ g C

1. How many atoms of N are combined with 1.05 mol H in coke? Assume 1 mol count=6\*1023.

mol N/mol H=1/21 =x/1.05 => 1.05/21=x=0.05 mol N

atoms N=0.05\*6\*1023=3\*1022

\_\_3\*1022 atoms N

1. How many grams of H are in a sample containing 1.4286\*1023 molecules of coke ?

mol coke = 1.4286\*1023/6\*1023 =0.2381

mol H/mol coke= 21/1=x/0.2381

x=mol H=5=> 5 g

\_\_\_5\_\_\_\_ grams H

* 1. R**eaction balancing (15 pts)**

Balance these chemical reactions (1 pt per coefficient):

1. **\_2\_H2O + \_1\_\_O2 🡪 \_\_2\_H2O2**
2. **\_\_2\_CH4 + \_3\_\_O2🡪 \_\_2\_CO +\_4\_\_H2O**
3. **2\_\_\_AgNO3 + \_1\_\_CaCl2  🡪 \_\_2\_ AgCl + \_\_\_1\_Ca(NO3)2**
4. **\_\_2\_C4H10 + \_\_13\_O2 🡪 \_\_8\_ CO2 + \_10\_\_\_ H2O**

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exam 2A chem 1013 spring 2015: (continued)

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* 1. **Pie Stoichiometry (6 pts/2 pts per answer)**

A chocolate pie is created with the following (hypothetical) recipe:

**2 cans of chocolate filling+ 4 cups of sugar + 3 cups flour + 1 pint milk = 1 chocolate pie**

1 can filling = 150 g 1 cup sugar = 100 g 1 cup flour = 75 g 1 pint milk=200 g

1. How many pies can be made with 400 g of milk ? \_2\_\_\_ pies
2. **How many grams of filling are combined with 9 cups of flour ? \_900\_\_\_ g filling**
3. **How many cups of sugar must be added to make a round count of pies**

**with 1125 g of flour ? \_20\_\_ cups sugar**

* 1. **Reaction Stoichiometry (13 pts)**

Propane burns according to the balanced reaction:

**C3H8 + 5O2🡪 3CO2 + 4H2O**

 **MW 44 32 44 18 g/mol**

1. How many moles of O2 must react to form 2.4 mol H2O ?

**mol O2/mol H2O= 5/4=x/2.4**

**x=5\*2.4/4=3**

**\_3\_\_mol O2** 3 pts

1. How many grams of CO2 from burning 0.01515 moles C3H8 ? 4 pts

mol CO2/mol C3H8= 3/1=x/0.01515

x=3\*0.01515=0.04545 mol CO2=> 0.04545\*44=2 g

**\_\_2\_\_ g CO2** 4 pts

1. How many molecules of H2O form along with 1.65 grams CO2 ?Assume 1 mol count=6\*1023

1.65/44= mol CO2 =0.0375 mol

mol H2O/mol CO2 =4/3=x/0.0375

x=mol H2O=4\*0.0375/3=0.05

count=0.05\*6\*1023=3\*1022

\_\_\_3\*1022\_\_ molecules H2O 6 pts

* 1. **True/False**
1. Pie stoichiometry is the same as reaction stoichiometry. T F
2. Body parts stoichiometry is named so because you T F

are connecting ‘body’ parts of a individual compound to

its other parts.

1. Winter should pack up and leave, fer criss sakes T T

\_\_\_/22