**Exam 2: Chem 1114 Fall 2014**

**Version A 100 points**

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

1) The compound glucose has the formula: C6H12O6 and a molecular mass of 180 g/mol.

a) How many moles of O are found in 30 g of glucose ? (show work or no credit)

 30 g glucose \* 1 mol glucose/180 g =0.1666 mol glucose

 mol O/mol glucose= 6/1=x/0.1666=>x=1.0 mol

 \_\_\_1.0\_\_\_ mol O 4 pts

b) How many grams of C are in 5.00 grams of glucose ?

5 g glucose\* 1 mol glucose/180 g=0.02777 mol glucose

mol C/mol glucose=6/1=x/0.02777=> x mol C=0.1666 mol C=> 12 g C/mol \* 0.1666 mol C~2.0 g

 \_\_2.0\_\_\_ g C 4 pts

c) A sample of glucose contains 240 grams of H. How many moles of glucose are in the sample?

240 g H= 240 mol H

mol glucose/mol H=1/12=x/240=> x=20 mol

 \_\_20\_\_\_ mol glucose 4 pts

2a) A suspicious, probably illegal white powder contains 80.54% C, 10.07% H and 9.396 % N.

What is the powder’s empiric formula ?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Mass (g)** | **Atomic mass (g/mol)** | **Mass/AW=n=mol** | **n/nmin** |
| **C** | **80.54** | **12** | **80.54/12=6.7116** | **10** |
| **H** | **10.07** | **1** | **10.07/1=10.07** | **15** |
| **N** | **9.396** | **14** | **9.396/14=0.6711** | **1** |

 Empiric formula = C H N 4 pts

 10 15 1 crystal meth

2b) A sugar with the molecular weight 360 g/mol has the following masses of C, H and O in a 10 gram

 sample. What is the molecular formula for the sugar ?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element** | **Mass (g)** | **Atomic mass (g/mol)** | **Mass/AW=n=mol** | **n/n­min** | **x 12** |
| **C** | **4.000** | **12** | **4/12=0.333** | **1** | **12** |
| **H** | **0.667** | **1** | **0.667/1=0.667** | **2** | **24** |
| **O** | **5.333** | **16** | **5.333/16=0.333** | **1** | **12** |

Molecular formula = C H O 4 pts CH2O =>MW=30

 12 24 12 360/30=12

\_\_/21 includes name

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3a)A hydrocarbon with the formula CxHy is burned to form 22 grams CO2 and 9 grams of H2O.

 Given the molecular weights : CO2 = 44 g/mol, H2O=18 g/mol, provide a whole-numbered

 formula for CxHy.

22 g CO2/44 g mol CO2 -1 = mol CO2 = mol C=0.5 mol C

9 g H2O / 18 g mol H2O-1 =0.5 mol H2O=> 2\*0.5=1 mol H

C0.5H1 =CH2

CxHy= CH2 5 pts

3b) A nitrogen oxide (Nx Oy) compound decomposes with H2 to form 1.4 g N2 and 1.8 g H2O . Given that

the atomic masses of N= 14 g/mol and O = 16 g/mol, and the molecular weight of H2O = 18 g/mol, what is the empiric formula for Nx Oy?

1.4 g N2 /28 g mol‑1 N2 = 0.1 mol N2 => 0.2 mol N

 1.8 g H2O/18 g mol-1 H2O= 0.1 mol O =>0.1 mol O

 Nx Oy = N2O 5 pts

4. Balance the reactions below: (1 pt each/12 pts total)

a) \_\_\_2\_H2 + \_\_1\_\_O2 🡪 \_\_2\_\_H2O

b) \_1\_Fe2(SO4)3 + \_6\_NH3 + \_6\_H2O 🡪 \_2\_Fe(OH)3 + \_3\_ (NH4)2SO4

c) \_1\_C7H16 +\_\_11\_\_O2🡪 \_\_7\_\_CO2 + \_\_8\_H2O

5)Octane (C8H18) has a molecular weight of 114 g/mol and burns according to the stoichiometrically balanced reaction below:

2C8H18 +25 O2 🡪 16CO2 + 18H2O

How many moles of water form if we burn 222.22 g O2 (MW=32 g/mol) ?

222.22/32 = mol O2 =6.94375

mol H2O/mol O2 =18/25=x/6.84375=5

 \_\_\_\_5\_\_\_\_ mol water 5 pts

6) Propane (C3H8) burns according to the stoichiometrically balanced reaction below:

C3H8 +5 O2 🡪 3CO2 + 4H2O

 MW (g/mol) 44 32 44 18

 a) How many grams of H2O form when we burn 12.22 grams of C3H8 ? (Show work !)

12.22/44= mol C­3H8=0.277727

mol H2O/mol C3H8 =4/1=x/0.277727 => mol H2O=4\*0.277727=1.1109 mol=> 18 g/mol\*1.1109 mol=20 g

\_\_20\_\_\_ g H2O 5 pts

b)How many grams of H2O form from 2.5\*1023 molecules of O2. (1 mol count = 6\*1023 molecules)

2.5\*1023/6\*1023= 0.416666 mol O2

mol H2O/mol O2 = 4/5= x/0.41666=> x mol H2O= 4\*0.41666/5=0.3333 mol=> 18\*0.333=6 g

 \_\_\_6\_\_\_\_ g H2O 5 pts

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7) Butane burns according to the balanced equation:

 2C4H10 + 13O2 🡪 8CO2 +10H2O

MW 58 32 44 18

a) If we combine 0.6591 g C4H10 and 5.200 g O2 how many grams of CO2 can you form ?

mol C4H10 =0.6591/58=0.01136 => 8/2 \*0.01136 mol CO2 =0.045455 mol

=>butane limits 0.045455\*44=2 g

mol O2 =5.200/32=0.1625=> 8/13 \*0.1625 mol CO2 = 0.1 mol CO2

 \_\_\_2\_\_\_ g CO2 5 pts

b) How many molecules of H2O form by burning 2\*1022 molecules of C4H10 and 0.6933 g O2 ?

(1 mol count=6\*1023 molecules)

0.6933 /32=0.0216656 mol O2  => 10/13 \*0.0216656 mol H2O = mol H2O=0.01666 => O2 limits

=> 0.01666\*6\*1023 =1\*1022 molecules O2

2\*1022/6\*1023 = 0.0333 mol C4H10=> 0.0333\*10/2=0.1665 mol H2O

 \_\_1\*1022\_\_\_\_\_ molecules H2O 5 pts

8. Pentane, C5H12, burns according to the balanced equation:

 C5H12 + 8 O2  🡪 5CO2  + 6H2O

MW 72 g/mol

An 54 g sample of pentane is experimentally burned in excess O2 to produce 1.125 mol H2O.

What is the % yield for the reaction ?

54/72=mol pentane=0.75 mol pentane => 0.75\*6/1= theory moles H­2O=4.5

% yield = 100\*exp mol H2O/theory mol H2O=100\*1.125/4.5=25

 \_25\_\_\_=% yield 5 pts

9. In the Arrhenius acid-base theory:

a) An acid is a(n)\_\_\_\_H+ donor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) A base is a(n)\_\_\_\_\_OH- donor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) acids + bases 🡪 \_\_\_\_\_\_\_salt + water\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. In the Bronsted acid-base theory

a) An acid is a(n)\_\_\_\_proton donor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) A base is a(n)\_\_\_\_proton acceptor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) acids + bases 🡪 \_\_\_\_\_conjugate base + conjugate acid\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) Write out the hydrolysis reaction for CO32- in water:

 CO32- + H2O 🡪 HCO3- + OH-

11. What are the conjugate acid (CA) and conjugate base (CB) in the reaction below:

HPO32- + CO32- 🡪 PO33- + HCO3-

CA=\_\_HCO3-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CB= \_\_\_\_PO33-\_\_\_\_\_\_\_\_\_\_\_\_\_

12. A 25 mL volume of an unknown HCl sample is titrated to a pale pink phenolphthalein endpoint with

 12.5 mL of 0.100 mol/L NaOH. What is the unknown HCl’s concentration ?

 CaVa=CbVb

 Ca\*25=0.1\*12.5=> Ca =0.1\*12.5/25=0.05

\_\_\_/28 \_\_0.05\_\_\_\_ HCl concentration (mol/L) 5 pts

13. What are the oxidation numbers of all the elements in the compounds below: (1 pt each/ 7 pts total)

 a) NO2 N oxidation #=\_\_+4\_\_ O oxidation # = \_-2\_\_\_\_\_

 b) CuCl Cu oxidation #=\_\_+1\_ Cl oxidation #=\_\_\_-1\_\_\_

 c) H2SO4 H oxidation #=\_\_+1\_ O oxidation # =\_-2\_\_ S oxidation #=\_\_+6\_\_

14. Oxidation = \_\_\_losing\_\_\_\_\_\_\_\_electrons

15. Reduction= \_\_\_gaining\_\_\_\_\_\_\_\_ electrons

16. What are elements oxidized and reduced in the reactions below:

 CH4 + 2O2 🡪 CO2 + 2H2O

 \_C\_\_\_\_oxidized \_\_\_O\_\_\_ reduced

 Ag2O + Zn 🡪 ZnO + 2Ag

 Zn \_\_ \_\_ oxidized \_\_Ag\_\_ reduced

17. What feature below is not typical of acid-base reactions:

**a) light created** b) heat generated c) indicator colors change d) protons exchanged

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