**Exam 2: Chem 1114 Fall 2014**

**Version B 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 90 g of glucose ? (show work or no credit)

90 g glucose \* 1 mol glucose/180 g =0.50 mol glucose

mol O/mol glucose= 6/1=x/0.5=>x=3.0 mol

\_\_3\_\_\_\_ mol O 4 pts

b) How many grams of C are in 2.50 grams of glucose ?

2.5 g glucose\* 1 mol glucose/180 g=0.013885 mol glucose

mol C/mol glucose=6/1=x/0.013885=> x mol C=0.08333 mol C=> 12 g C/mol \* 0.08333 mol C~10 g

\_\_1.0\_\_\_\_ g C 4 pts

c) A sample of glucose contains 24 grams of H. How many moles of glucose are in the sample?

24 g H= 24 mol H

mol glucose/mol H=1/12=x/24=> x=2 mol

\_\_\_2\_ mol glucose 4 pts

2a) A suspicious, probably illegal white powder contains 20.135 g C, 2.5175 g H and 2.349 g N.

What is the powder’s empiric formula ?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Mass (g)** | **Atomic mass (g/mol)** | **N=mass/At. mass** | **N=Nmin** |
| **C** | **20.135** | **12** | **20.135/12=1.6779** | **10** |
| **H** | **2.5175** | **1** | **2.5174/1=2.5175** | **15** |
| **N** | **2.349** | **14** | **2.349/14=0.16779** | **1** |

Empiric formula = C H N 4 pts

10 15 1

2b) A sugar with the molecular weight 180 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 6** |
| **C** | **4.000** | **12** | **4/12=0.333** | **1** | **6** |
| **H** | **0.667** | **1** | **0.667/1=0.667** | **2** | **12** |
| **O** | **5.333** | **16** | **5.333/16=0.333** | **1** | **6** |

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

6 12 6 180/30=6

\_\_/21 includes name

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3a)A hydrocarbon with the formula CxHy is burned to form 11 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.

11 g CO2/44 g mol CO2 -1 = 0.25 mol CO2 = mol C=0.25 mol C

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

C0.25H1 =CH+4

CxHy= CH4 5 pts

3b) A nitrogen oxide (Nx Oy) compound decomposes to form 1.4 g N2 and 3.2 g O2. Given that the

atomic masses of N= 14 g/mol and O = 16 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

3.2 g O2/16 g mol-1 O2= 0.2 mol O2 =>0.4 mol O

N0.2O0.4 🡪

Nx Oy = NO2 5 pts

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

b) \_3\_H2O2 + \_1\_Cu 🡪 \_1\_\_Cu(OH)2 + \_\_2\_\_H2O + \_\_1\_\_O2

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

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 133.2 g O2 (MW=32 g/mol) ?

133.2/32 = mol O2 =4.1625

mol H2O/mol O2 =18/25=x/4.1625=3

\_\_\_\_\_**3**\_\_\_ 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 24.44 grams of C3H8 ? (Show work !)

24.44/44= mol C­3H8=0.55545

mol H2O/mol C3H8 =4/1=x/0.55545 => mol H2O=4\*0.55545=2.2218 mol=> 18 g/mol\*2.2218 mol=40 g

\_\_40\_\_ g H2O 5 pts

b)How many grams of H2O form from 1.25\*1023 molecules of O2. (1 mol count = 6\*1023 molecules)

1.25\*1023/6\*1023= 0.20833 mol O2

mol H2O/mol O2 = 4/5= x/0.208333=> x mol H2O= 4\*0.208333/5=0.16666 mol=> 18\*0.1666=3 g

\_\_\_3\_\_\_\_ 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 6.591 g C4H10 and 52.0 g O2 how many grams of CO2 can you form ?

mol C4H10 =6.591/58=0.1136 => 8/2 \*0.1136 mol CO2 =0.45455 mol

=>butane limits 0.45455\*44=20 g

mol O2 =52.00/32=1.625=> 8/13 \*1.625 mol CO2 = 1 mol CO2

\_\_\_20\_\_\_ g CO2 5 pts

b) How many molecules of H2O form by burning 2\*1022 molecules of C4H10 and 1.3866 g O2 ?

(1 mol count=6\*1023 molecules)

1.3866 /32=0.04333 mol O2  => 10/13 \*0.04333 mol H2O = mol H2O=0.03333 => O2 limits

=> 0.03333\*6\*1023 =2\*1022 molecules O2

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

\_\_2\*1022\_\_\_\_\_ molecules H2O 5 pts

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

C5H12 + 8 O2  🡪 5CO2  + 6H2O

MW 72 g/mol

An 108 g sample of pentane is experimentally burned in excess O2 to produce 4.5 mol H2O.

What is the % yield for the reaction ?

108/72=mol pentane=1.5 mol pentane => 1.5\*6/1= theory moles H­2O=9

% yield = 100\*exp mol H2O/theory mol H2O=100\*4.5/9=50

\_50\_\_\_=% yield 5 pts

9. 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\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. 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\_\_\_\_\_\_\_\_\_\_\_

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) NO3 N oxidation #=\_\_6\_\_ O oxidation # = \_\_\_-2\_\_\_

b) CuCl2 Cu oxidation #=\_\_2\_ 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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