# Announcements – Lecture V – Friday, May 24th

a) Add/Drop : Today, May 24th

b) No Class : Monday, May 27th

c) First Lab : Tuesday, May 28th

d) Exam 1 : Friday, May 31st

## Quiz 3

Last Name: _____

**Name:**

a) $Na_2S$ — Sodium sulfide

b) $Mg(NO_3)_2$ — Magnesium nitrate

c) $Cu_3(PO_4)_2$ — Copper(II) phosphate

d) $NH_4Br$ — Ammonium bromide

**Formula:**

e) Calcium hydroxide — $Ca(OH)_3$

f) Aluminum oxide — $Al_2O_3$

g) Chromium(II) sulfide — $CrS$

h) Potassium sulfite — $K_2SO_3$

# 3.1 The Mole and Molar Mass

## b) Molar Mass

$N = 6.023 \times 10^{23}$

### 3.1b Molar Mass – Example_1a

a) How many ATOMS of boron are present in 3.30 moles of boron trifluoride ? $BF_3$

b) How many MOLES of fluorine are present in $3.09 \times 10^{22}$ molecules of boron trifluoride

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$$3.30 \text{ mol } BF_3 \left| \frac{1 \text{ B}}{1 \ BF_3} \right. = 3.30 \text{ mol B}$$

$$3.30 \text{ mol B} \left| \frac{6.023 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \right. = 1.99 \times 10^{24} \text{ atoms B}$$

# 3.1 The Mole and Molar Mass

## b) Molar Mass

$N = 6.023 \times 10^{23}$

### 3.1b Molar Mass – Example_1b

a) How many ATOMS of boron are present in 3.30 moles of boron trifluoride ?

b) How many MOLES of fluorine are present in $3.09 \times 10^{22}$ molecules of boron trifluoride

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$$3.09 \times 10^{22} \text{ molecules } BF_3 \left| \frac{1 \text{ mol}}{6.023 \times 10^{23} \text{ molecules}} \right. = 0.0513 \text{ mol } BF_3$$

$$0.0513 \text{ mol } BF_3 \left| \frac{3 \text{ F}}{1 \ BF_3} \right. = 0.154 \text{ mol F}$$

## 3.1 The Mole and Molar Mass

### b) Molar Mass

### 3.1b Molar Mass – Example_2

How many Grams of bromine are present in 1.02 moles of carbon tetrabromide ? $CBr_4$

$$\frac{1.02 \text{ mol } CBr_4}{1 \ CBr_4} \left| \frac{4 \text{ Br}}{} \right. = 4.08 \text{ mol Br}$$

$$\frac{4.08 \text{ mol Br}}{1 \text{ mol}} \left| \frac{79.90 \text{ g}}{} \right. = 326 \text{ g}$$

Where ? ... Periodic Table

# 3.1 The Mole and Molar Mass

## b) Molar Mass

### 3.1b Molar Mass – Example_3

How many MOLES of water are present in 5.41 grams of this compound ?

a) 0.1 b) 0.2 c) 0.3✓ d) 0.4 e) Help

Molar Mass $H_2O$ : 2(H) + O

$2(1.01) + 16.00 = 18.02\ g.mol^{-1}$

MOLAR MASS

$$5.41\ g\ H_2O \left| \frac{1\ mol}{18.02\ g} \right. = 3.00 \times 10^{-1}\ mol\ H_2O$$

## 3.2 Stoichiometry and Compound Formulas

### b) Percent Composition

**Express the formula $C_4H_{10}$ (butane) in terms of % weight of each component**

$C_4H_{10}$ : $4(C) + 10(H)$

$4(12.01) + 10(1.01)$

$48.04 + 10.10 = 58.14\ g.mol^{-1}$

1 mol of $C_4H_{10}$ weighs 58.14g of which 48.04g is C and 10.10g is H.

C: $\left(\frac{48.04g}{58.14g}\right)100 = 82.63\%$ by weight

H: $\left(\frac{10.10g}{58.14g}\right)100 = 17.37\%$ by weight

} % Composition by weight

## 3.2 Stoichiometry and Compound Formulas

### c) Empirical Formulas from Percent Composition

**Butane is 82.63% C and 17.37% H by weight. Can we determine the formula of Butane from this (can we go back!)**

| | C | H |
|---|---|---|
| a) Assume a 100g sample. | 82.63g | 17.37g |
| b) Convert grams to moles. | $\frac{82.63\,g}{12.01\,g.mol^{-1}}$ | $\frac{17.37\,g}{1.01\,g.mol^{-1}}$ |
| | 6.88 mol | 17.20 mol |
| c) Divide each by smallest mol value. | $\frac{6.88\ mol}{6.88\ mol}$ | $\frac{17.20\ mol}{6.88\ mol}$ |
| | 1.00 | 2.50 |
| d) Convert to whole integer | 2 | 5 |

$C_2H_5$ ∴ What's gone wrong?

## 3.2 Stoichiometry and Compound Formulas

### c) Empirical Formula

$C_2H_5$ ... $C_4H_{10}$ ... $C_6H_{15}$ ... $C_8H_{20}$ ... $C_{10}H_{25}$ ..... etc

All of these are 82.63% C and 17.37% H by weight.

? What is the simplist difference between each of them

% Composition → Formula ... gives the smallest whole number ratio ... called the EMPIRICAL FORMULA

Need one more piece of information to determine the actual formula.

C: 12.01 H: 1.01
O: 16.01

## 3.2d Molecular_Formula – Example_1

An insect repellant, is found to be 62.58% C, 9.63% H and 27.79% O. Using Mass Spectrometry its molar mass is determined to be 230.30 $g.mol^{-1}$. What is the molecular formula of this insect repellant.

| | C | H | O |
|---|---|---|---|
| a) | 62.58 | 9.63 | 27.79 |
| b) | 62.58/12.01 | 9.63/1.01 | 27.79/16.00 |
| | 5.21 mol | 9.53 mol | 1.74 mol |
| c) | 5.21 / 1.74 | 9.53 / 1.74 | 1.74 / 1.74 |
| | 2.99 | 5.48 | 1.00 |
| d) x2 | 5.98 | 10.96 | 2.00 |
| | 6 | 11 | 2 |

$C_6H_{11}O_2$

$C_6H_{11}O_2$:

$6(12.01) + 11(1.01) + 2(16.00)$

$= 115.15\ g.mol^{-1}$

$\frac{230.30}{115.15} = 2$

Empirical Formula: $C_6H_{11}O_2$

Molecular Formula: $C_{12}H_{22}O_4$