

## Announcements – Lecture V – Friday, May 24<sup>th</sup>

a) Add/Drop : Today, MAY 24<sup>th</sup>

b) No Pass : Monday, MAY 27<sup>th</sup>

c) FIRST LAB : Tuesday, MAY 28<sup>th</sup>

d) EXAM I : FRIDAY, MAY 31<sup>ST</sup>



## Quiz 3

Last Name: \_\_\_\_\_

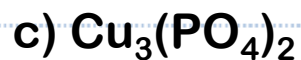
Name: \_\_\_\_\_



Sodium sulfide



Magnesium nitrate



Copper(II) phosphate



Ammonium bromide

Formula:



$\text{Ca}(\text{OH})_2$



$\text{Al}_2\text{O}_3$



$\text{CrS}$



$\text{K}_2\text{SO}_3$



## 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**?  $\text{BF}_3$
- b) How many **MOLES** of fluorine are present in  $3.09 \times 10^{22}$  molecules of boron trifluoride
- 

$$\frac{3.30 \text{ mol } \text{BF}_3}{1 \text{ BF}_3} \times \frac{1 \text{ B}}{1 \text{ BF}_3} = 3.30 \text{ mol B}$$

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

### 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**

$$\frac{3.09 \times 10^{22} \text{ molecules } \text{BF}_3}{6.023 \times 10^{23} \text{ molecules}^{-1}} \times \frac{1 \text{ mol}}{1} = 0.0513 \text{ mol } \text{BF}_3$$

$$\frac{0.0513 \text{ mol } \text{BF}_3}{1 \text{ BF}_3} \times \frac{3 \text{ F}}{1} = 0.154 \text{ mol F}$$

### 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?  $\text{CBr}_4$

$$\frac{1.02 \text{ mol CBr}_4}{1 \text{ CBr}_4} \times \frac{4 \text{ Br}}{1 \text{ CBr}_4} = 4.08 \text{ mol Br}$$

$$\frac{4.08 \text{ mol Br}}{1 \text{ mol}} \times \frac{79.90 \text{ g}}{1 \text{ mol}} = 326 \text{ g}$$

Where? ... Periodic Table

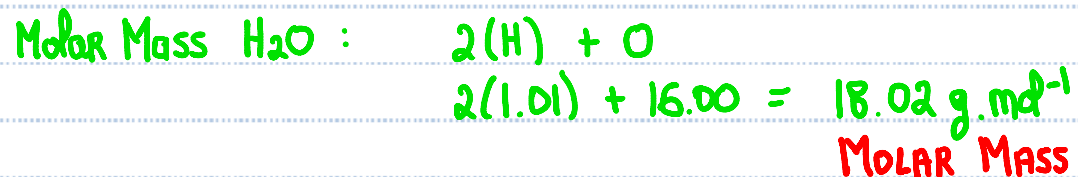
### 3.1 The Mole and Molar Mass

#### 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



$$\frac{5.41 \text{ g H}_2\text{O}}{18.02 \text{ g}} \left| \frac{1 \text{ mol}}{18.02 \text{ g}} \right. = 3.00 \times 10^{-1} \text{ mol H}_2\text{O}$$



## 3.2 Stoichiometry and Compound Formulas

### b) Percent Composition

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

$$\begin{aligned} C_4H_{10} &: 4(C) + 10(H) \\ &4(12.01) + 10(1.01) \\ &48.04 + 10.10 = 58.14 \text{ g.mol}^{-1} \end{aligned}$$

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

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

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

% 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!)

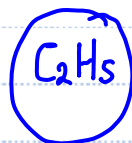
	C	H
a) Assume a 100g sample.	82.63g	17.37g
b) Convert grams to moles.	$\frac{82.63\text{g}}{12.01\text{g}\cdot\text{mol}^{-1}}$	$\frac{17.37\text{g}}{1.01\text{g}\cdot\text{mol}^{-1}}$
	6.88 mol	17.20 mol
c) Divide each by smallest mol value.	$\frac{6.88\text{ mol}}{6.88\text{ mol}}$	$\frac{17.20\text{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

$\text{C}_2\text{H}_5$  ; What's gone wrong?



## 3.2 Stoichiometry and Compound Formulas

### c) Empirical Formula



...  $C_4H_8$  ...  $C_6H_{12}$  ...  $C_8H_{16}$  ...  $C_{10}H_{20}$  ..... etc  
All of these are 82.63% C and 17.37% H by weight.

? What is the simplest difference between each of them

% Composition  $\rightarrow$  Formula ... gives the smallest whole number ratio ...  
called the EMPIRICAL FORMULA

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

## 3.2 Stoichiometry and Compound Formulas

### d) Determining Molecular Formulas

C: 12.01 H: 1.01  
O: 16.01

### 3.2d Molecular Formula – Example\_1

An insect repellent, 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<sup>-1</sup>. What is the molecular formula of this insect repellent.

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



$$C_6H_{11}O_2:$$

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

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

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

Empirical Formula:  $C_6H_{11}O_2$

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