Announcements – Lecture VI – Tuesday, May 26th

1. First Lab: Today, 1:30-4:30, ISB 155
2. Second Lab: Thursday, May 28th, ISB 155 (A-C)
3. Exam I: Friday, May 29th – In Class

Quiz 4 Class #: ____ Last Name: _____

Sr: 87.62 Cu: 63.55 S: 32.07 O: 16.00 $N = 6.023 \times 10^{23}\ mol^{-1}$

a) How many moles of Sr are there in a sample that contains 1.10×10^{22} strontium atoms

$$1.10 \times 10^{22}\ \text{atoms Sr} \left| \frac{1\ \text{mol}}{6.023 \times 10^{23}\ \text{atoms}} \right. = 0.0183\ \text{mol Sr}$$

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b) How many moles of Cu_2SO_4 are present in 1.39 grams of this compound?

Cu_2SO_4: $2(63.55) + 32.07 + 4(16.00)$

$= 223.17\ g.mol^{-1}$

$$1.39\ g\ Cu_2SO_4 \left| \frac{1\ \text{mol}}{223.17\ g} \right. = 6.23 \times 10^{-3}\ \text{mol}\ Cu_2SO_4$$

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

3.3 Stoichiometry and Chemical Reactions

b) Balancing Chemical Equations

3.3b Balancing – Example_1

Balance the following chemical equation:

$$\underline{2}\ Fe_2O_3(s) + \underline{3}\ C(s) = \underline{\cancel{2}\ 4}\ Fe(s) + \underline{3}\ CO_2(g)$$

Reactants					✓
Fe	2	2	4	4	4
O	3	3	6	6	6
C	1	1	1	1	3

Products					✓
Fe	1	2	2	4	4
O	2	2	6	6	6
C	1	1	3	3	3

$2\ Fe_2O_3(s) + 3C(s) = 4\ Fe(s) + 3\ CO_2(g)$

3.3 Stoichiometry and Chemical Reactions

b) Balancing Chemical Equations

3.3b Balancing – Example_2

Balance the following chemical equation:

$$__C_2H_6(g) + \underline{7/2}\ O_2(g) \quad = \quad \underline{2}\ CO_2(g) + \underline{3}\ H_2O(l)$$

Reactants				✓	
C		2	2	2	
H	6	6	6	6	
O	2	2	2	7	

Products				✓	
C	1	2	2	2	
H	2	2	6	6	
O	3	5	7	7	

$C_2H_6(g) + 7/2\ O_2(g) = 2\ CO_2(g) + 3\ H_2O(l)$ ☹

"Convert to the smallest whole integer values"

$2\ C_2H_6(g) + 7\ O_2(g) = 4\ CO_2(g) + 6\ H_2O(l)$ ☺

3.3 Stoichiometry and Chemical Reactions

b) Balancing Chemical Equations

3.3b Balancing – Example_3

Balance the following chemical equation:

$$__AgNO_3(aq) + __K_2CrO_4(aq) = __Ag_2CrO_4(s) + __KNO_3(aq)$$

What is taking you so long?

3.3 Stoichiometry and Chemical Reactions

b) Balancing Chemical Equations

3.3b Balancing – Example_3

Balance the following chemical equation:

$$\underline{2}\ AgNO_3(aq) + \underline{\ \ }\ K_2CrO_4(aq) = \underline{\ \ }\ Ag_2CrO_4(s) + \underline{2}\ KNO_3(aq)$$

Reactants			✓		
Ag	1	2	2		
NO_3	1	2	2		
K	2	2	2		
CrO_4	1	1	1		

Products			✓		
Ag	2	2	2		
NO_3	1	1	2		
K	1	1	2		
CrO_4	1	1	1		

$$2\ AgNO_3(aq) + K_2CrO_4(aq) = Ag_2CrO_4(s) + 2\ KNO_3(aq)$$