Percent Comp., Empirical and Molecular Formula Study Guide

Name: _____

Write the empirical formula:

1. Na_2SO_4 Empirical = Na_2SO_4
2. $C_6H_{12}O_6$ Empirical = CH_2O
3. C_4H_{10} Empirical = C_2H_5
4. KNO_2 Empirical = KNO_2
5. H_2O_2 Empirical = HO

*EMPIRICAL = MOST Reduced Whole # Subscripts

Show all work for the following problems:

6. Propene has an empirical formula of CH_2. What is its molecular formula if it has a molar mass of 42.09 g/mol?

EF MF = ? MM_{MF}

$$\frac{MM_{MF}}{MM_{EF}} = \frac{42.09}{14.03} = 3$$

$$MF = EF \times 3 = (CH_2) \times 3 = \boxed{C_3H_6}$$

7. An unknown compound has 0.3911 g of carbon, 0.0654 g of hydrogen and 1.0437 g of oxygen. What is its empirical formula?

$$\frac{0.3911 \text{ g C}}{} \left| \frac{1 \text{ mol C}}{12.01 \text{ g C}} \right. = 0.03256 \text{ mol C}/0.03256 = 1 \text{ mol C}$$

$$\frac{0.0654 \text{ g H}}{} \left| \frac{1 \text{ mol H}}{1.01 \text{ g H}} \right. = 0.06475 \text{ mol H}/0.03256 = 1.9886 = 2 \text{ mol H}$$

$$\frac{1.0437 \text{ g O}}{} \left| \frac{1 \text{ mol O}}{16 \text{ g O}} \right. = 0.06523 \text{ mol O}/0.03256 = 2 \text{ mol O}$$

$$\boxed{EF = CH_2O_2}$$

8. The molecular mass of the compound in the above question is 276.2 g/mol. What is its molecular formula?

MM_{MF}

$$\frac{MM_{MF}}{MM_{EF}} = \frac{276.2}{46.03} = 6$$

$$MF = EF \times 6 = (CH_2O_2) \times 6 = \boxed{C_6H_{12}O_{12}}$$

9. Calculate the percent composition of H_2SO_4

$$\%H = \frac{\text{mass 2 H}}{\text{mass } H_2SO_4} \times 100 = \frac{2.02}{98.09} \times 100 = 2.06\% \text{ H}$$

$$\%S = \frac{\text{mass S}}{\text{mass } H_2SO_4} \times 100 = \frac{32.07}{98.09} \times 100 = 32.69\% \text{ S}$$

$$\%O = \frac{\text{mass 4 O}}{\text{mass } H_2SO_4} \times 100 = \frac{64}{98.09} \times 100 = 65.25\% \text{ O}$$

*Note: %'s Add up to 100%

10. A compound contains 85.65% Bi, 6.56% O, and 7.79% F. What is the empirical formula of this compound?

$85.65\%\ Bi = \frac{85.65\ g\ Bi}{} \left| \frac{1\ mol\ Bi}{208.98\ g\ Bi} \right. = 0.4098\ mol\ Bi / 0.4098 = 1\ mol\ Bi$

$6.56\%\ O = \frac{6.56\ g\ O}{} \left| \frac{1\ mol\ O}{16\ g\ O} \right. = 0.41\ mol\ O / 0.4098 = 1\ mol\ O$

$7.79\%\ F = \frac{7.79\ g\ F}{} \left| \frac{1\ mol\ F}{19\ g\ F} \right. = 0.41\ mol\ F / 0.4098 = 1\ mol\ F$

$\boxed{EF = BiOF}$

MF = ?

11. Determine the molecular formula of ethylene glycol. It has an atom ratio of one carbon to one oxygen to three hydrogen atoms. The mass of the molecule is 62.06 g/mol.

MM_{MF}

using atom ratio, Empirical formula = COH_3 (1C : 1O : 3H)

$\frac{MM_{MF}}{MM_{EF}} = \frac{62.06}{31.04} = 1.999 \approx 2$

$MF = EF \times 2 = (COH_3) \times 2 = \boxed{C_2O_2H_6}$

12. A compound contains 7.35 grams of chromium and 3.39 grams of oxygen. What is its empirical formula?

$\frac{7.35\ g\ Cr}{} \left| \frac{1\ mol\ Cr}{52\ g\ Cr} \right. = 0.141346\ mol\ Cr / 0.141346 = 1\ mol\ Cr \times 2 = 2\ mol\ Cr$

$\frac{3.39\ g\ O}{} \left| \frac{1\ mol\ O}{16\ g\ O} \right. = 0.211875\ mol\ O / 0.141346 = 1.5\ mol\ O \times 2 = 3\ mol\ O$

$\boxed{EF = Cr_2O_3}$