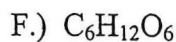
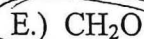


## MOLECULAR FORMULAS

I.) Identify the empirical formula's listed below:



1. The molar mass of acetylene is 26.04 g/mol and the mass of the empirical formula, CH, is 13.02 g/mol. Determine the molecular formula of acetylene.

$$X = \frac{26.04 \text{ g/mol}}{13.02 \text{ g/mol}} = 2 \quad 2(\text{CH}) = \text{C}_2\text{H}_2$$

2. The molar mass of benzene was determined experimentally to be 78.12 g/mol and the empirical formula is CH. Determine the molecular formula.

$$X = \frac{78.12 \text{ g/mol}}{13.02 \text{ g/mol}} = 5.99 \quad 6(\text{CH}) = \text{C}_6\text{H}_6$$

3. Succinic acid is a substance produced by lichens. Chemical analysis indicates it is composed of 40.68% C, 5.08% H, and 52.24% O, and has a molar mass of 118.1 g/mol. Determine succinic acids empirical and molecular formula.

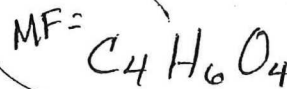
$$\text{A.) C} = \frac{40.68 \text{ g} \left( \frac{1 \text{ mol}}{12.01 \text{ g}} \right)}{3.265 \text{ mol}} = 1.03 \times 2$$

$$\text{EF} = \text{C}_2\text{H}_3\text{O}_2 = 59.0$$

$$\text{B.) H} = \frac{5.08 \text{ g} \left( \frac{1 \text{ mol}}{1.01 \text{ g}} \right)}{3.265 \text{ mol}} = 1.54 \times 2$$

$$\frac{118.1 \text{ g/mol}}{59.05 \text{ g/mol}} = 2$$

$$\text{C.) O} = \frac{52.24 \text{ g} \left( \frac{1 \text{ mol}}{16.0 \text{ g}} \right)}{3.265 \text{ mol}} = 1 \times 2$$



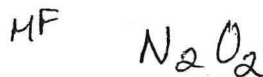
4. A colorless liquid composed of 46.68% N, and 53.32% O has a molar mass of 60.01 g/mol. What is the molecular formula?

$$\text{N} = \frac{46.68 \text{ g} \left( \frac{1 \text{ mol}}{14.01 \text{ g}} \right)}{3.33 \text{ mol}}$$

$$\text{EF NO} = 14.01 + 16 = 30.01 \text{ g}$$

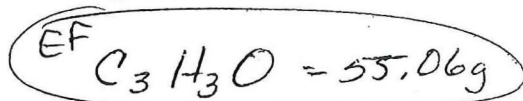
$$\text{O} = \frac{53.32 \text{ g} \left( \frac{1 \text{ mol}}{16 \text{ g}} \right)}{3.33 \text{ mol}}$$

$$\frac{60.01 \text{ g/mol}}{30.01 \text{ g/mol}} = 2$$



5. Analysis of a chemical used in photographic developing fluid indicates a chemical composition of 65.45% C, 5.45% H, and 29.09% O. The molar mass is found to be 110.0 g/mol. Determine the empirical and molecular formula.

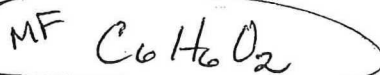
$$A) C = 65.45g \left( \frac{1 \text{ mol}}{12.01g} \right) = \frac{5.449 \text{ mol}}{1.818} = 3$$



$$B) H = 5.45g \left( \frac{1 \text{ mol}}{1.01g} \right) = \frac{5.396 \text{ mol}}{1.818} = 2.97$$

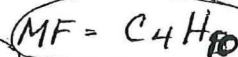
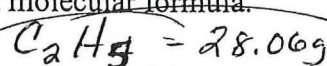
$$\frac{110.0g/\text{mol}}{55.06g/\text{mol}} = 2$$

$$C) O = 29.09g \left( \frac{1 \text{ mol}}{16g} \right) = 1.818 \text{ mol} = 1$$



6. A compound was found to contain 49.98g carbon and 10.47g hydrogen. The molar mass of the compound is 58.12 g/mol. Determine the empirical and molecular formula.

$$C = 49.98g \left( \frac{1 \text{ mol}}{12.01} \right) = 4.16 \text{ mol} = 1 \times 2$$

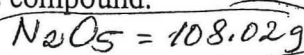


$$H = 10.47g \left( \frac{1 \text{ mol}}{1.01} \right) = \frac{10.366 \text{ mol}}{4.16 \text{ mol}} = 2.49 \times 2$$

$$\frac{58.12g/\text{mol}}{28.06g/\text{mol}} = 2.07$$

7. If 4.04g of nitrogen combine with 11.46g oxygen to produce a compound with a formula mass of 108.00 amu, what is the molecular formula of this compound.

$$N = 4.04g \left( \frac{1 \text{ mol}}{14.01g} \right) = 0.288 = 1 \times 2$$

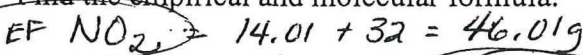


$$\frac{108.00 \text{ amu}}{108.02 \text{ amu}} = 1$$

$$O = 11.46g \left( \frac{1 \text{ mol}}{16g} \right) = \frac{0.716}{0.288} = 2.48 \times 2 = 5$$

8. The molar mass of a compound is 92 g/mol. Analysis of a sample of the compound indicates that it contains 0.606 g nitrogen, and 1.39g oxygen. Find the empirical and molecular formula.

$$N = 0.606g \left( \frac{1 \text{ mol}}{14.01g} \right) = 0.04 = 1$$

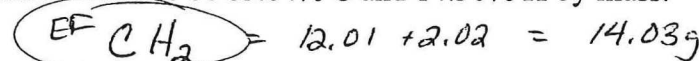


$$O = 1.39g \left( \frac{1 \text{ mol}}{16g} \right) = 0.08 = 2$$

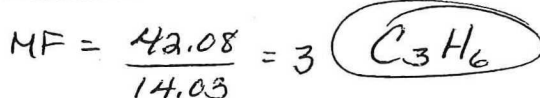


9. A compound with a formula mass of 42.08 amu is found to be 85.64% C and 14.36% H by mass. Find the empirical and molecular formula.

$$C = 85.64g \left( \frac{1 \text{ mol}}{12.01g} \right) = 7.13 = 1$$



$$H = 14.36g \left( \frac{1 \text{ mol}}{1.01g} \right) = 14.21 \times 2$$



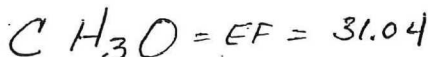
10. Mesitylene, a hydrocarbon that occurs in small amounts in crude oil, has an empirical formula of  $C_3H_4$ . The experimentally determined molecular weight of this substance is 121 amu. What is the molecular formula of mesitylene?

$$3(12.01) + 4(1.01) = 40.07 = EF$$

$$\frac{121}{40.07} = 3 \text{ } C_9 H_{12}$$

11. Ethylene glycol, the substance used in automobile antifreeze, is composed of 38.7% C, 9.7% H, and 51.6% O by mass. Its molar mass is 62.1 g/mol. What is the empirical and molecular formula for ethylene glycol.

$$C = 38.7g \left( \frac{1 \text{ mol}}{12.01} \right) = 3.22 = 1$$



$$H = 9.7g \left( \frac{1 \text{ mol}}{1.01} \right) = \frac{9.60}{3.225} = 3$$

$$X = \frac{62.1}{31.04} = 2$$

$$O = 51.6g \left( \frac{1 \text{ mol}}{16} \right) = 3.225 = 1$$

