

HOMEWORK PROBLEMS:

- 5a. The molecular mass of benzene, an important industrial solvent, is 78.0 g/mol and its empirical formula is CH. What is the molecular formula for benzene?

Answers:

$$CH = 12.01 \text{ g/mol} + 1.008 \text{ g/mol} = 13.018 \text{ g/mol}$$

$$n = \frac{78.0 \frac{\text{g}}{\text{mol}}}{13.018 \frac{\text{g}}{\text{mol}}} = 6$$



- 5b. What is the molecular formula of dichloroacetic acid, if the empirical formula is CHOCl and the molecular mass of the acid is 129 g/mol?

Answers:

$$CHOCl = 12.01 \text{ g/mol} + 1.008 \text{ g/mol} + 16.00 \text{ g/mol} + 35.45 \text{ g/mol} = 64.468 \text{ g/mol}$$

$$n = \frac{129 \frac{\text{g}}{\text{mol}}}{64.468 \frac{\text{g}}{\text{mol}}} = 2$$



- 5c. What is the molecular formula of cyanuric chloride if the empirical formula is CCIN and the molecular mass is 184.5 g/mol?

Answers:

$$CCIN = 12.01 \text{ g/mol} + 35.45 \text{ g/mol} + 14.01 \text{ g/mol} = 61.47 \text{ g/mol}$$

$$n = \frac{184.5 \frac{\text{g}}{\text{mol}}}{61.47 \frac{\text{g}}{\text{mol}}} = 3$$



- 5d. Asorbic acid, vitamin C, has a percentage composition of 40.9% carbon, 4.58% hydrogen, and 54.5% oxygen. Its molecular mass is 176.1 g/mol. What is the molecular formula?

Answers:

$$C : \frac{40.9 \text{ g}}{12.01 \text{ g}} \times \frac{1 \text{ mol C}}{1} = 3.4055 \text{ mol}$$

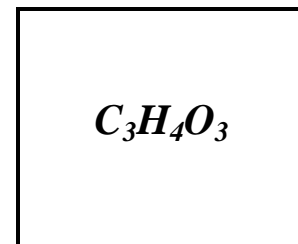
$$H : \frac{4.58 \text{ g}}{1.008 \text{ g}} \times \frac{1 \text{ mol H}}{1} = 4.5437 \text{ mol}$$

$$O : \frac{54.5 \text{ g}}{16.00 \text{ g}} \times \frac{1 \text{ mol O}}{1} = 3.4063 \text{ mol}$$

$$= \frac{3.4055 \text{ mol}}{3.4055 \text{ mol}} = 1 \times 3 = 3$$

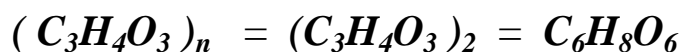
$$= \frac{4.5437 \text{ mol}}{3.4055 \text{ mol}} = 1\frac{1}{3} \times 3 = 4$$

$$= \frac{3.4063 \text{ mol}}{3.4055 \text{ mol}} = 1 \times 3 = 3$$



$$C_3H_4O_3 = 3(12.01 \text{ g/mol}) + 4(1.008 \text{ g/mol}) + 3(16.00 \text{ g/mol}) = 88.062 \text{ g/mol}$$

$$n = \frac{176.1 \frac{\text{g}}{\text{mol}}}{88.062 \frac{\text{g}}{\text{mol}}} = 2$$



- 5e. Aspirin contains 60.0% carbon, 4.48% hydrogen, and 35.5% oxygen. It has a molecular mass of 180 g/mol. What is its empirical and molecular formulas?

Answers:

$$C : \frac{60.0 \text{ g}}{12.01 \text{ g}} \times \frac{1 \text{ mol C}}{1} = 4.9958 \text{ mol}$$

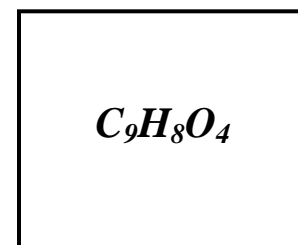
$$H : \frac{4.48 \text{ g}}{1.008 \text{ g}} \times \frac{1 \text{ mol H}}{1} = 4.\bar{4} \text{ mol}$$

$$O : \frac{35.5 \text{ g}}{16.00 \text{ g}} \times \frac{1 \text{ mol O}}{1} = 2.21875 \text{ mol}$$

$$= \frac{4.9958 \text{ mol}}{2.21875 \text{ mol}} = 2\frac{1}{4} \times 4 = 9$$

$$= \frac{4.\bar{4} \text{ mol}}{2.21875 \text{ mol}} = 2 \times 4 = 8$$

$$= \frac{2.21875 \text{ mol}}{2.21875 \text{ mol}} = 1 \times 4 = 4$$



$$C_9H_8O_4 = 9(12.01 \text{ g/mol}) + 8(1.008 \text{ g/mol}) + 4(16.00 \text{ g/mol}) = 180.154 \text{ g/mol}$$

$$n = \frac{180 \frac{\text{g}}{\text{mol}}}{180.154 \frac{\text{g}}{\text{mol}}} = 1$$

