

key

EMPIRICAL AND MOLECULAR FORMULA WORKSHEET

1. An oxide of chromium is found to have the following % composition: 68.4 % Cr and 31.6 % O. Determine this compound's empirical formula.

$$\begin{array}{l} \text{Cr} \quad \frac{68.4 \text{ g} / 1 \text{ mol}}{52 \text{ g}} = \frac{1.315}{1.315} = 1 \\ \text{O} \quad \frac{31.6 \text{ g} / 1 \text{ mol}}{16 \text{ g}} = \frac{1.975}{1.315} = 1.5 \end{array}$$

$\text{Cr}_{1.5}\text{O}_{2.25}$
 Cr_2O_3

2. The percent composition of a compound was found to be 63.5 % silver, 8.2 % nitrogen, and 28.3 % oxygen. Determine the compound's empirical formula.

$$\begin{array}{l} \text{Ag} \quad \frac{63.5 \text{ g} / 1}{107.87} = \frac{0.589}{0.589} = 1 \\ \text{N} \quad \frac{8.2 \text{ g} / 1}{14.01} = \frac{0.585}{0.585} = 1 \\ \text{O} \quad \frac{28.3 \text{ g} / 1}{16 \text{ g}} = \frac{1.769}{0.585} = 3 \end{array}$$

AgNO_3

3. A 170.00 g sample of an unidentified compound contains 29.84 g sodium, 67.49 g chromium, and 72.67 g oxygen. What is the compound's empirical formula?

$$\begin{array}{l} \text{Na:} \quad \frac{29.84}{170.00} = \frac{17.55}{22.99} = \frac{0.76}{0.76} = 1 \\ \text{Cr} \quad \frac{67.49}{170.00} = \frac{39.7}{52} = \frac{0.76}{0.76} = 1 \\ \text{O} \quad \frac{72.67}{170.00} = \frac{42.7}{16} = \frac{2.7}{0.76} = 3.5 \end{array}$$

$\text{NaCrO}_{3.5}$
 $\text{Na}_2\text{Cr}_2\text{O}_7$

4. A 60.00 g sample of tetraethyl lead, a gasoline additive, is found to contain 38.43 g lead, 17.83 g carbon, and 3.74 g hydrogen. Find its empirical formula.

$$\begin{array}{l} \text{Pb} \quad \frac{38.43}{60.00} = \frac{64.05}{207.2} = \frac{0.3}{0.3} = 1 \\ \text{C} \quad \frac{17.83}{60.00} = \frac{29.72}{12.01} = \frac{2.47}{0.3} = 8.2 \\ \text{H} \quad \frac{3.74}{60.00} = \frac{6.23}{1.01} = \frac{6.17}{0.3} = 21 \end{array}$$

$\text{PbC}_8\text{H}_{21}$

5. A compound containing 5.9265 % H and 94.0735 % O has a molar mass of 34.01468 g/mol. Determine the empirical and molecular formula of this compound.

$$\begin{array}{l} \text{H} \quad \frac{5.9265 \text{ g} / 1 \text{ mol}}{1.01 \text{ g}} = \frac{5.87}{5.87} \\ \text{O} \quad \frac{94.0735 \text{ g} / 1 \text{ mol}}{16.00 \text{ g}} = \frac{5.88}{5.87} \end{array}$$

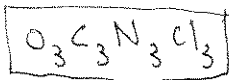
E: HO
M: H₂O₂

EFM = 17.01
 $\frac{34}{17.01} = 2$

6. The empirical formula for trichloroisocyanuric acid, the active ingredient in many household bleaches, is OCNCl . The molar mass of this compound is 232.41 g/mol. What is the molecular formula of trichloroisocyanuric acid?

$$\frac{\text{MM of M.F.}}{\text{MM of E.F.}} = \frac{232.41 \text{ g/mol}}{77.4 \text{ g/mol}} = 3.00$$

$\times 3$

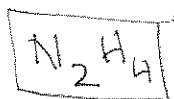


$$\begin{array}{r} 16 \\ 12 \\ 14 \\ \hline + 35.4 \\ \hline 77.4 \text{ g/mol} \end{array}$$

7. Determine the molecular formula of a compound with an empirical formula of NH_2 and a formula mass of 32.06 amu.

$$\frac{\text{MM of M.F.}}{\text{MM of E.F.}} = \frac{32.06}{16} = 2$$

$\times 2$

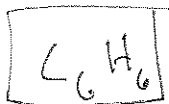


$$\begin{array}{r} 14 \\ 1 \\ \hline 16 \text{ g} \end{array}$$

8. The empirical formula of a hydrocarbon (compound that contains only C and H) is found to be CH . Laboratory procedures have found that the molar mass of the compound is 78 g/mol. What is the molecular formula of this compound?

$$\frac{\text{MM of M.F.}}{\text{MM of E.F.}} = \frac{78}{13} = 6$$

$\times 6$

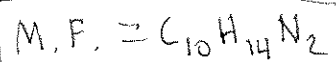
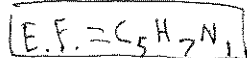


9. The molar mass of nicotine is 162.1 g/mol. It contains 74.0 % carbon, 8.7 % hydrogen, and 17.3 % nitrogen. Determine nicotine's empirical formula and molecular formula.

$$\text{C} = \frac{74}{12} = 6.17 / 1.2 = 5.1$$

$$\text{H} = \frac{8.7}{1} = 8.7 / 1.2 = 7.25$$

$$\text{N} = \frac{17.3}{14} = 1.2 / 1.2 = 1.2$$



$$\frac{\text{MM of M.F.}}{\text{MM of E.F.}} = \frac{162.1}{81} = 2$$

$\times 2$

$$\begin{array}{r} 12(5) \\ 1(7) \\ 14 \\ \hline 81 \text{ g/mol} \end{array}$$

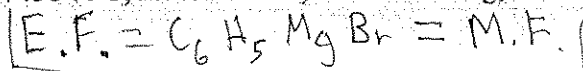
10. Phenyl magnesium bromide is used as a Grignard reagent in organic synthesis. Determine its empirical and molecular formula if its molar mass is 181.313 g/mol and it contains 39.7458 % C, 2.77956 % H, 13.4050 % Mg, and 44.0697 % Br.

$$\text{C} = \frac{39.75}{12} = 3.31 / 1.55 = 6$$

$$\text{H} = \frac{2.78}{1} = 2.78 / 1.55 = 5$$

$$\text{Mg} = \frac{13.40}{24.3} = 0.55 / 1.55 = 1$$

$$\text{Br} = \frac{44.07}{80} = 0.55 / 1.55 = 1$$



$$\frac{\text{MM of M.F.}}{\text{MM of E.F.}} = \frac{181.313}{181.3} = 1$$

$$\begin{array}{r} 12(6) \\ 1(5) \\ 24.3 \\ 80 \\ \hline 181.31 \text{ g/mol} \end{array}$$