

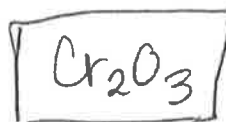
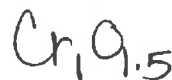
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## EMPIRICAL AND MOLECULAR FORMULA WORKSHEET

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.

$$\text{Cr} \frac{68.4 \text{ g}}{52 \text{ g/mol}} = \frac{1.315}{1.315} = 1$$

$$\text{O} \frac{31.6 \text{ g}}{16 \text{ g/mol}} = \frac{1.975}{1.315} = 1.5$$

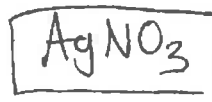


2. The percent composition of a compound was found to be 63.5 % silver, 8.2 % nitrogen, and 28.3 % oxygen. Determine the compound's empirical formula.

$$\text{Ag} \frac{63.5 \text{ g}}{107.87} = \frac{0.589}{0.589} = 1$$

$$\text{N} \frac{8.2 \text{ g}}{14.01} = \frac{0.585}{0.585} = 1$$

$$\text{O} \frac{28.3 \text{ g}}{16 \text{ g/mol}} = \frac{1.769}{0.585} = 3$$

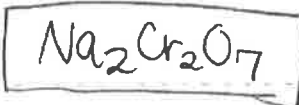


3. A 170.00 g sample of an unidentified compound contains 29.84 g sodium, 67.49 g chromium, and 72.67 g oxygen. What is the compound's empirical formula?

$$\text{Na} \frac{29.84}{170.00} = \frac{17.55}{22.99} = \frac{0.76}{0.76} = 1$$

$$\text{Cr} \frac{67.49}{170.00} = \frac{39.7}{52} = \frac{0.76}{0.76} = 1$$

$$\text{O} \frac{72.67}{170.00} = \frac{42.7}{16} = \frac{2.7}{0.76} = 3.5$$

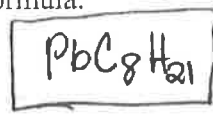


4. A 60.00 g sample of tetraethyl lead, a gasoline additive, is found to contain 38.43 g lead, 17.83 g carbon, and 3.74 g hydrogen. Find its empirical formula.

$$\text{Pb} \frac{38.43}{60.00} = \frac{64.05}{207.2} = \frac{0.3}{0.3} = 1$$

$$\text{C} \frac{17.83}{60.00} = \frac{29.72}{12.01} = \frac{2.47}{0.3} = 8.2$$

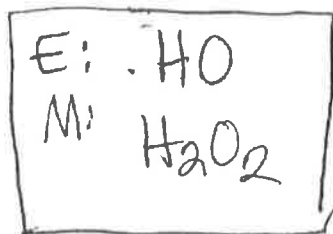
$$\text{H} \frac{3.74}{60.00} = \frac{6.23}{1.01} = \frac{6.17}{0.3} = 21$$



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.

$$\text{H} \frac{5.9265 \text{ g}}{1.01 \text{ g/mol}} = \frac{5.87}{5.87}$$

$$\text{O} \frac{94.0735 \text{ g}}{16.00 \text{ g/mol}} = \frac{5.88}{5.87}$$



EFM = 17.01

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

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

$$E = \text{OCNCl} = 16 + 12 + 14 + 35.5 = 77.5 = \text{empirical mass}$$

$$\frac{\text{molar mass}}{\text{empirical mass}} = \frac{232.41}{77.5} = 3 \quad M = \text{O}_3\text{C}_3\text{N}_3\text{Cl}_3$$

7. Determine the molecular formula of a compound with an empirical formula of  $\text{NH}_2$  and a formula mass of 32.06 amu.

$$\text{NH}_2 = 14 + (1 \times 2) = 16$$

$$\frac{\text{formula mass}}{\text{empirical mass}} = \frac{32.06}{16} = 2$$



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

$$\text{CH} = 12 + 1 = 13$$

$$\frac{78}{13} = 6 \quad \text{C}_6\text{H}_6$$

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.

$$\boxed{\text{C}_5\text{H}_7\text{N}} = E$$

$$(5 \times 12) + (7 \times 1) + 14$$

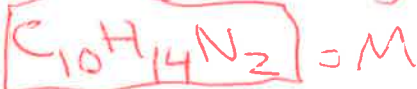
$$60 + 7 + 14 = 81$$

$$74\text{g C} \div 12 = 6.16 / 1.24 = 4.97 \approx 5$$

$$8.7\text{g H} \div 1 = 8.7 / 1.24 = 7$$

$$17.3\text{g N} \div 14 = 1.24 / 1.24 = 1$$

$$\frac{162.1}{81} = 2$$



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.