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.

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.

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?

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.

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

7. Determine the molecular formula of a compound with an empirical formula of NH₂ and a formula mass of 32.06 amu.

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?

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.

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.
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.

\[
\begin{align*}
\text{Cr} & \quad \frac{68.4 \text{ g}}{152 \text{ g}} = \frac{1.315}{1.315} = 1 \quad \text{Cr}_1 \text{O}_{0.5} \\
\text{O} & \quad \frac{31.6 \text{ g}}{16 \text{ g}} = \frac{1.975}{1.315} = 1.5 \quad \text{Cr}_2 \text{O}_3
\end{align*}
\]

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.

\[
\begin{align*}
\text{Ag} & \quad \frac{63.5 \text{ g}}{107.87} = \frac{0.589}{0.589} = 1 \quad \text{AgNO}_3 \\
\text{N} & \quad \frac{82 \text{ g}}{14.01} = \frac{5.85}{5.85} = 1 \\
\text{O} & \quad \frac{26.3 \text{ g}}{16 \text{ g}} = \frac{1.709}{0.585} = 3
\end{align*}
\]

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?

\[
\begin{align*}
\text{Na} & \quad \frac{29.84 \text{ g}}{25.38} = \frac{1.176}{1.176} = 1 \\
\text{Cr} & \quad \frac{67.49 \text{ g}}{52} = \frac{1.297}{1.297} = 1 \\
\text{O} & \quad \frac{72.67 \text{ g}}{16} = \frac{4.542}{4.542} = 3
\end{align*}
\]

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.

\[
\begin{align*}
\text{Pb} & \quad \frac{38.43 \text{ g}}{207.2} = \frac{0.383}{0.383} = 1 \quad \text{PbC}_8 \text{H}_21
\end{align*}
\]

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.

\[
\begin{align*}
\text{H} & \quad \frac{5.9265 \text{ g}}{1.01 \text{ g}} = \frac{5.87}{5.87} = 1 \quad \text{H}_2 \text{O}
\end{align*}
\]

\[
\begin{align*}
\text{O} & \quad \frac{94.0735 \text{ g}}{16 \text{ g}} = \frac{5.87}{5.87} = 1 \quad \text{H}_2 \text{O}_2
\end{align*}
\]

\[
\begin{align*}
\text{EFM} & \quad \frac{34}{27.01} = 2
\end{align*}
\]
Empirical and Molecular Formulas Worksheet

Objectives:
- be able to calculate empirical and molecular formulas

Empirical Formula
1) What is the empirical formula of a compound that contains 0.783g of Carbon, 0.196g of Hydrogen and 0.521g of Oxygen?

2) What is empirical formula of a compound which consists of 89.14% Au and 10.80% of O?

3) What is empirical formula if compound consists of 21.2%N, 6.1%H, 24.2%S and 48.5%O?

Molecular Formula
4) Empirical formula of a substance is CH₂O. Molar mass is 180. What is the molecular formula?

5) Sample (3.585g) contains 1.388g of C, 0.345g of H, 1.850g O and its molar mass is 62g. What is molecular formula of this substance?

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Empirical and Molecular Formulas Worksheet

Objectives:
• be able to calculate empirical and molecular formulas

Empirical Formula
1) What is the empirical formula of a compound that contains 0.783g of Carbon, 0.196g of Hydrogen and 0.521g of Oxygen?

\[
\begin{align*}
\text{C} &: \frac{0.783 \text{g}}{12.01 \text{g/mol}} = 0.065 \approx 1.96 \\
\text{H} &: \frac{0.196 \text{g}}{1.008 \text{g/mol}} = 0.194 \approx 5.88 \\
\text{O} &: \frac{0.521 \text{g}}{16.00 \text{g/mol}} = 0.033 \approx 1
\end{align*}
\]

\[
\text{C}_2\text{H}_6\text{O}
\]

2) What is empirical formula of a compound which consists of 89.14\% Au and 10.80\% of O?

\[
\begin{align*}
\text{Au} &: \frac{89.14 \text{g}}{196.97 \text{g/mol}} = 0.45 \approx 1 \\
\text{O} &: \frac{10.80 \text{g}}{16.00 \text{g/mol}} = 0.675 \approx 1.5
\end{align*}
\]

\[
\text{Au}_2\text{O}_3
\]

3) What is empirical formula if compound consists of 21.2\%N, 6.1\%H, 24.2\%S and 48.5\%O?

\[
\begin{align*}
\text{N} &: \frac{21.2 \text{g}}{14.01 \text{g/mol}} = 1.5 \approx 2 \\
\text{H} &: \frac{6.1 \text{g}}{1.01 \text{g/mol}} = 6.03 \approx 8 \\
\text{S} &: \frac{24.2 \text{g}}{32.06 \text{g/mol}} = 0.75 \approx 1 \\
\text{O} &: \frac{48.5 \text{g}}{16.00 \text{g/mol}} = 3.03 \approx 4
\end{align*}
\]

\[
\text{N}_2\text{H}_8\text{SO}_4
\]

Molecular Formula
4) Empirical formula of a substance is \(\text{CH}_2\text{O}\). Molar mass is 180. What is the molecular formula?

\[
\text{EFM} = (12+2\times0+16) = \frac{180}{30.02} = 6
\]

\[
\text{C}_6\text{H}_12\text{O}_6
\]

5) Sample (3.585g) contains 1.388g of C, 0.345g of H, 1.850g O and its molar mass is 62g. What is molecular formula of this substance?

\[
\begin{align*}
\text{C} &: \frac{1.388 \text{g}}{3.585 \text{g}} \times 12 \times 0.387 = 3.22 \\
\text{H} &: \frac{0.345 \text{g}}{3.585 \text{g}} \times 1.015 = 0.952 \approx 3 \\
\text{O} &: \frac{1.850 \text{g}}{3.585 \text{g}} \times 16 = 3.22 \approx 1
\end{align*}
\]

\[
\text{CH}_3\text{O} = \text{EFM} = (12+3.08+16)
\]

\[
\frac{62}{31.03} \approx 2
\]

\[
\text{C}_2\text{H}_4\text{O}_2
\]

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