

Determining Empirical Formula

1. Can the molecular formula of a compound ever be the same as the empirical formula?
2. Phosphoric acid is found in some soft drinks. A sample of phosphoric acid contains 3.161 g of phosphorous, 0.3086 g of hydrogen, and 6.531 g of oxygen. What is its empirical formula?
3. A sample in the laboratory contains 1.05 grams of nickel and 0.29 grams of oxygen. Determine the empirical formula.
4. A 60.00 g sample of tetraethyllead, a gasoline additive, contains 38.43 g lead, 17.83 g carbon, and 3.74 g hydrogen. Find its empirical formula.
5. What is the empirical formula of a compound with three times as many hydrogen atoms as carbon atoms but only half as many oxygen atoms as carbon atoms?

Name : _____ Date: _____

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Answers

1. Can the molecular formula of a compound ever be the same as the empirical formula?

Yes, if the molar mass matches the mass of the compound's empirical formula mass.

2. Phosphoric acid is found in some soft drinks. A sample of phosphoric acid contains 3.161 g of phosphorous, 0.3086 g of hydrogen, and 6.531 g of oxygen. What is its empirical formula?

$$\text{P: } 3.161 \text{ g} / 30.97 \text{ g mol}^{-1} = 0.102 \text{ mol} / 0.102 \text{ mol} \rightarrow 1$$

$$\text{H: } 0.3086 \text{ g} / 1.01 \text{ g mol}^{-1} = 0.306 \text{ mol} / 0.102 \text{ mol} \rightarrow 3$$

$$\text{O: } 6.531 \text{ g} / 16 \text{ g mol}^{-1} = 0.408 \text{ mol} / 0.102 \text{ mol} \rightarrow 4$$

The empirical formula is H_3PO_4 .

3. A sample in the laboratory contains 1.05 grams of nickel and 0.29 grams of oxygen. Determine the empirical formula.

$$\text{Ni: } 1.05 \text{ g} / 58.7 \text{ g mol}^{-1} = 0.0179 \text{ mol} / 0.0179 \text{ mol} \rightarrow 1$$

$$\text{O: } 0.29 \text{ g} / 16 \text{ g mol}^{-1} = 0.018 \text{ mol} / 0.0179 \text{ mol} \rightarrow 1$$

The empirical formula is NiO .

4. A 60.00 g sample of tetraethyllead, a gasoline additive, contains 38.43 g lead, 17.83 g carbon, and 3.74 g hydrogen. Find its empirical formula.

$$\text{Pb: } 38.43 \text{ g} / 207.2 \text{ g mol}^{-1} = 0.185 \text{ mol} / 0.185 \text{ mol} \rightarrow 1$$

$$\text{C: } 17.83 \text{ g} / 12.01 \text{ g mol}^{-1} = 1.484 \text{ mol} / 0.185 \text{ mol} \rightarrow 8$$

$$\text{H: } 3.74 \text{ g} / 1.01 \text{ g mol}^{-1} = 3.711 \text{ mol} / 0.185 \text{ mol} \rightarrow 20$$

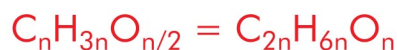
The empirical formula is $\text{C}_8\text{H}_{20}\text{Pb}$.

5. What is the empirical formula of a compound with three times as many hydrogen atoms as carbon atoms but only half as many oxygen atoms as carbon atoms?

Let n be the number of carbon atom

$$\text{No. of H atoms} = 3n$$

$$\text{No. of O atoms} = n/2$$



Putting $n = 1$, the empirical formula is $\text{C}_2\text{H}_6\text{O}$.