

Calculating Empirical Formula

1. A compound consists of 40.0% carbon (C), 6.7% hydrogen (H), and 53.3% nitrogen (N) by mass. Determine its empirical formula.
2. A compound contains 44.9% potassium (K), 18.4% sulfur (S), and 36.7% oxygen (O) by mass. Determine its empirical formula.
3. A compound is composed of 38.71% calcium (Ca), 20.0% phosphorus (P), and 41.29% oxygen (O) by mass. Determine its empirical formula.
4. A compound contains 38.6 grams of potassium (K), 13.9 grams of nitrogen (N), and 47.5 grams of oxygen (O). Determine its empirical formula.

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Calculating Empirical Formula

Answers

1. A compound consists of 40.0% carbon (C), 6.7% hydrogen (H), and 53.3% nitrogen (N) by mass. Determine its empirical formula.

$$\text{Moles of Carbon (C): } 40 \text{ g} / 12.01 \text{ g/mol} = 3.33 \text{ moles} / 3.33 \text{ moles} = 1$$

$$\text{Moles of Hydrogen (H): } 6.7 \text{ g} / 1.01 \text{ g/mol} = 6.63 \text{ moles} / 3.33 \text{ moles} = 2$$

$$\text{Moles of Nitrogen (N): } 53.3 \text{ g} / 14.01 \text{ g/mol} = 3.80 \text{ moles} / 3.33 \text{ moles} = 1$$

The empirical formula is CH_2N

2. A compound contains 44.9% potassium (K), 18.4% sulfur (S), and 36.7% oxygen (O) by mass. Determine its empirical formula.

$$\text{Moles of Potassium (K): } 44.9 \text{ g} / 39.10 \text{ g/mol} = 1.148 \text{ moles} / 0.574 \text{ moles} = 2$$

$$\text{Moles of Sulfur (S): } 18.4 \text{ g} / 32.07 \text{ g/mol} = 0.574 \text{ moles} / 0.574 \text{ moles} = 1$$

$$\text{Moles of Oxygen (O): } 36.7 \text{ g} / 16.00 \text{ g/mol} = 2.294 \text{ moles} / 0.574 \text{ moles} = 4$$

The empirical formula is K_2SO_4 .

3. A compound is composed of 38.71% calcium (Ca), 20.0% phosphorus (P), and 41.29% oxygen (O) by mass. Determine its empirical formula.

$$\text{Moles of Calcium (Ca): } 38.71 \text{ g} / 40.08 \text{ g/mol} = 0.966 \text{ moles} / 0.645 \text{ moles} = 1.497 \times 2 = 3$$

$$\text{Moles of Phosphorus (P): } 20.0 \text{ g} / 30.97 \text{ g/mol} = 0.645 \text{ moles} / 0.645 \text{ moles} = 1 \times 2 = 2$$

$$\text{Moles of Oxygen (O): } 41.29 \text{ g} / 16.00 \text{ g/mol} = 2.581 \text{ moles} / 0.645 \text{ moles} = 4.002 \times 2 = 8$$

The empirical formula is $\text{Ca}_3\text{P}_2\text{O}_8$.

4. A compound contains 38.6 grams of potassium (K), 13.9 grams of nitrogen (N), and 47.5 grams of oxygen (O). Determine its empirical formula.

$$\text{Moles of Potassium (K): } 38.6 \text{ g} / 39.10 \text{ g/mol} = 0.987 \text{ moles} / 0.987 \text{ moles} = 1$$

$$\text{Moles of Nitrogen (N): } 13.9 \text{ g} / 14.01 \text{ g/mol} = 0.992 \text{ moles} / 0.987 \text{ moles} = 1$$

$$\text{Moles of Oxygen (O): } 47.5 \text{ g} / 16.00 \text{ g/mol} = 2.969 \text{ moles} / 0.987 \text{ moles} = 3$$

The empirical formula is KNO_3 .

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