

Types of Formulae



The **empirical formula** of a compound shows the *relative* numbers of atoms of each element present, using the smallest whole numbers of atoms.

For example, the empirical formula of hydrogen peroxide is **HO** – the ratio of hydrogen to oxygen is 1:1.

The **molecular formula** of a compound gives the *actual* numbers of atoms of each element in a molecule.

The molecular formula of hydrogen peroxide is **H₂O₂** – there are two atoms of hydrogen and two atoms of oxygen in each molecule.

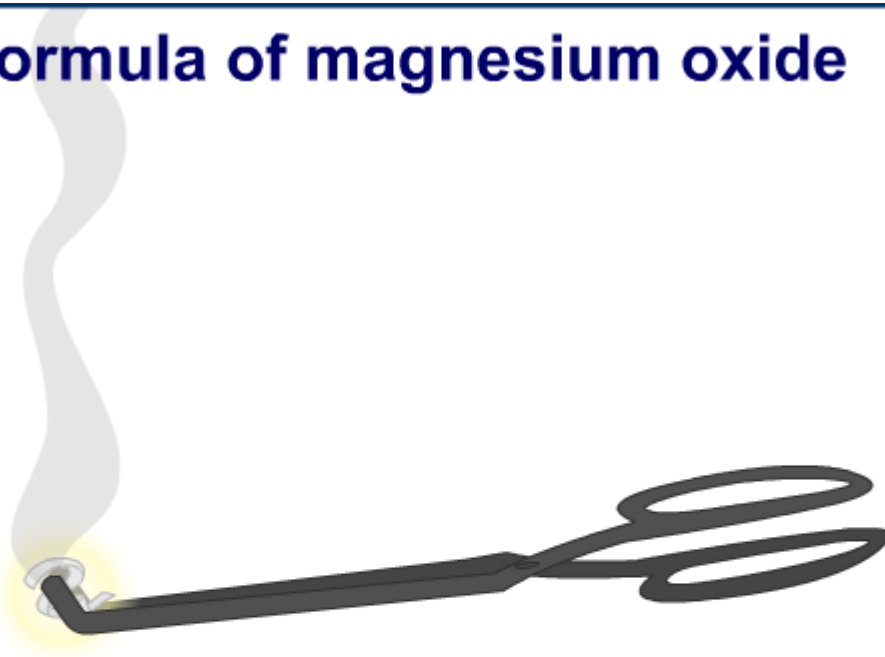




Determining the empirical formula of magnesium oxide

The empirical formula of magnesium oxide can be determined experimentally.

Click "**play**" to find how this is done.



Elemental analysis is an analytical technique used to determine the **percentage by mass** of certain elements present in a compound.

To work out the empirical formula, the total mass of the compound is assumed to be 100 g, and each percentage is turned into a mass in grams.



If necessary, the mass of any elements not given by elemental analysis is calculated. The empirical formula of the compound can then be calculated as normal.

Calculating empirical formulae: examples

Empirical formula of phosphorus oxide

What is the empirical formula of phosphorus(V) oxide given that 1.95g of phosphorus combine with oxygen to form 4.45g of the oxide?

1. Calculate any unknown masses of elements: $\text{mass oxygen} = 4.45 - 1.95 = 2.5\text{g}$

2. Calculate number of moles of each element: $\text{moles phosphorus} = 1.95 / 31.0 = 0.063$

$\text{moles oxygen} = 2.5 / 16.0 = 0.16$

Click the "=" button to show the solution step by step.



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Calculating molecular formulae

The molecular formula can be found by dividing the M_r by the relative mass of the empirical formula.

Example: What is the molecular formula of hydrogen peroxide given that its empirical formula is HO and the M_r is 34?

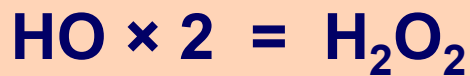
1. Determine relative mass of empirical formula:

$$\text{empirical formula mass} = \text{H} + \text{O} = 1.0 + 16.0 = 17$$

2. Divide M_r by mass of empirical formula to get a multiple:

$$\text{multiple} = \frac{\text{relative molecular mass}}{\text{mass of empirical formula}} = \frac{34}{17} = 2$$

3. Multiply empirical formula by multiple:



Empirical and molecular formulae calculations

Question: 1/6

What is the empirical formula of a sulfur oxide containing 6.42 g of sulfur and 3.20 g of oxygen?

SO

SO₂

SO₃

S₇O₂

