

Put a check mark ✓ if the substance belongs in this group.

Put a cross mark X if the substance does NOT belong in this group.

	atom	molecule	element	compound	ionic compound
oxygen gas (O ₂)		✓	✓		
water (H ₂ O)		✓		✓	
table salt (NaCl)				✓	✓
aluminum foil (Al)	✓		✓		

Distinguishing Amongst Formula, Structural Formula and Empirical Formula

A **formula** states which elements and how many atoms of each element are present (only).

e.g. H₂O (This tells us the molecule has **two** H atoms and **one** O atom.)

H₂O₂ (This tells us the molecule has **two** H atoms and **two** O atoms.)

A **structural formula** tells us, in addition, the **arrangement** of the atoms in a molecule.

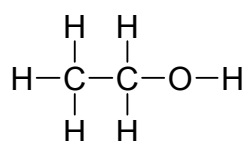
e.g. H₂O structural formula = H–O–H

H₂O₂ structural formula = H–O–O–H

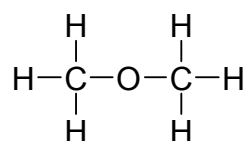
(You will learn how to determine the structural formula later in the semester, in Chapter 7.)

The formula, C₂H₆O, can have more than one **structural formula**:

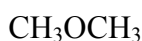
ethyl alcohol



dimethyl ether



A **condensed structural formula** is a shorthand version of the **structural formula**:

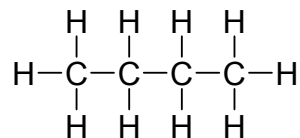


An **empirical formula** is the formula based on **empirical data** and can only give us the **lowest ratio of atoms of each element**. [Make sure you look up the meaning of the word, **empirical**, in a dictionary.]

For a molecular substance, the **formula** is also called a **molecular formula**, giving the actual number of atoms of each element in each molecule. Its subscripts when reduced to the lowest ratio is its **empirical formula**. The **molecular formula** is therefore some multiple of its **empirical formula**.

e.g. Butane gas has the molecular formula C₄H₁₀.

What kind of formula is shown below? Ans: *structural formula*



Its empirical formula is C₂H₅. Its condensed structural formula is CH₃CH₂CH₂CH₃.

For an ionic compound, however, the **formula** always shows the lowest ratio. Thus, its **formula** is also its **empirical formula**. (MgBr₂ is the “formula” as well as the “empirical formula,” but it is not a “molecular formula” because MgBr₂ is not molecular.)