

Elements, compounds, ions

This handout is a guide to allow you to refer to the definitions of elements, compounds, and ions. I do not expect you to remember the individual atomic weights of elements or compounds or their exact definitions, but you do need a basic understanding of these terms to be able to follow the class lectures.

Elements

Elements are the basic chemical unit and are represented by a 1 or 2 letter abbreviation, e.g., phosphorus (P), sodium (Na), oxygen (O), magnesium (Mg). 90 elements are found on Earth. The counting unit for elements is the atom. The atoms of each element weigh a different amount. For example, hydrogen (the lightest atom) has a weight of 1, oxygen that we breathe has a weight of 16, phosphorus has an atomic weight of 31, etc..

Compounds

Compounds are made from combinations of elements. Sodium chloride's abbreviation is NaCl (common table salt) and it is made up of one atom of Na (sodium) and one atom of Cl (chlorine). The counting unit for compounds is a mole, i.e., one mole of NaCl is made from combining one mole of Na and one mole of Cl. The weight of a mole of a compound is simply the sum of the atomic weights of the atoms. For example, the compound H₂O (water) is made from 2 atoms of H (atomic weight = 1) and one atom of oxygen (atomic weight = 16), therefore the molecular weight of water is 2 + 16 = 18. Since all weights in chemistry are in grams (the metric system of weights is described on in your book, Appendix I both editions), a mole is simply the molecular weight in grams, i.e., a mole of water is 18 grams of water.

Ions

Any element or compound that has an electrical charge is an ion. We tend to describe dissolved chemicals in seawater as dissolved ions because we can use the term to describe elements and compounds at the same time and almost everything dissolved in seawater has an electrical charge. Ions are normally written with their charge (+ or -) after the symbol. Na⁺ is the sodium ion because it has a single positive charge. Cl⁻ is the chloride ion since it has a single negative charge. In cases of multiple charges, e.g., Mg²⁺, a number indicates how many charges are associated with the ion (in this case two "plus" charges). Compounds can be ions, too. For example, phosphorous is in the ocean in the form of the phosphate ion (PO₄³⁻), which means that phosphate is a combination of one atom of phosphorus and 4 atoms of oxygen and that the compound is left with three negative charges. In practice, the charges are often left off when we write down the formula for an ion.

Molar units and prefixes

One mole of a substance is the atomic weight (in the case of an element) or molecular weight (in the case of a compound) in grams.

- 1 millimole (1 mmol) = .001 moles (1 x 10⁻³ moles)
- 1 micromole (1 μmol) = .000001 moles (1 x 10⁻⁶ moles)
- 1 nanomole (1 nmol) = .000000001 moles (1 x 10⁻⁹ moles)
- 1 picomole (1 pmol) = .000000000001 moles (1 x 10⁻¹² moles).