



Bonding: ionic and covalent bonds

The interaction¹ of atoms and the forming of bonds involve either transferring or sharing electrons among atoms.

An ionic (or electrovalent) bonding implies the transfer of electrons since it forms when one atom accepts or donates one or more of its valence electrons to another atom. Stable elements (e.g. the noble gases) usually do not lose, gain or share electrons: these are non reactive. Instead other elements lose or acquire electrons. Elements can lose or acquire from one to three electrons, therefore they become ions.

Cations are ions with a positive charge: they are usually smaller than their corresponding atom, because they have lost an entire² energy level due to the loss of electrons.

Anions are ions with a negative charge due to the gain of electrons. Unlike cations, anions are slightly larger than their corresponding atoms because the protons attract one or more extra electrons.

Ions have opposite charges so they attract each other: they come together through an ionic bond, which is a strong attractive force that keeps two chemical elements together. An ionic bond occurs between a metal and a non-metal: the metal becomes a positively charged cation (so it loses electrons) and the non-metal acquires these electrons to become a negatively charged anion.

Compounds with ionic bonds are commonly called salts. Regarding the name to be given to ionic compounds, the name of the metal is written first and then the non-metal by adding the suffix *-ide*.

Some compounds do not gain or lose valence electrons, but they share them: this is the basis of a covalent bond. The shared electrons

belong to both atoms, which feel the effect of more electrons. This is a covalent bond, a chemical bond that comes from the sharing of one or more electron pairs between two atoms. The atoms do not always share the electrons equally, so a polar covalent bond may be the result: a polar covalent bond develops when electrons tend to spend more time with one atom in the bond than with the other. Water (H₂O) is an example.

Ionic and covalent bonding determine compounds with different features; ionic compounds are identified with salts: bonds occur

between a metal and a non-metal, their state at room temperature is usually solid, and they form ions and conduct electricity when dissolved. Covalent compounds derive from bonds between two non-

metals, they can be solid, liquid or gas at room temperature, and they do not form ions or conduct electricity. The melting point of ionic compounds is higher than for covalent compounds. Covalent bonds can be single, double, and/or triple.

The sharing of a single electron pair is called a single bond.

When two pairs of electrons are shared, a double bond results, as in **binary compound** carbon dioxide (CO₂).

There also exist triple bonds: in these cases, three pairs (six electrons total) are shared, as in acetylene gas or nitrogen gas.

GLOSSARY

- 1 influence between bodies
- 2 whole

Binary compound: binary compounds are made of two elements. Their names derive from the number of atoms of each non-metal present, and occur as prefixes (e.g. 2 atoms -di, 4 atoms -tetra, 6 atoms -hexa, and so on). CO₂ is carbon dioxide.

ACTIVITIES

1 Answer the following questions.

- 1 What are bonds?
- 2 What do ionic bonds imply?
- 3 How do stable elements behave?
- 4 What are the differences between cations and anions?
- 5 Why do ions attract each other?

2 In groups discuss the feature of covalent bonding, then write a short summary and present it to the class.