

Covalent Bonding

You will need to understand what covalent bonding is, and to remember some of the properties of molecules that are formed in this way.

A covalent bond forms when two non-metal atoms share a pair of electrons. The electrons involved are in the highest occupied energy levels - or outer shells - of the atoms. An atom that shares one or more of its electrons will complete its highest occupied energy level.

Covalent bonds are strong - a lot of energy is needed to break them. Substances with covalent bonds often form molecules with low melting and boiling points, such as hydrogen and water.

How many bonds?

Atoms may form multiple covalent bonds - that is, share not just one pair of electrons but two or more pairs. Atoms of different elements will form either one, two, three or four covalent bonds with other atoms.

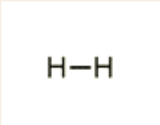
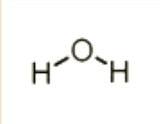
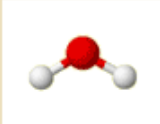
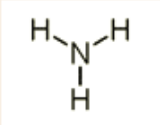
There is a quick way to work out how many covalent bonds an element will form. The number of covalent bonds is equal to eight minus the group number. The table below gives more detail on this rule:

	Group 4	Group 5	Group 6	Group 7
Example	Carbon	Nitrogen	Oxygen	Chlorine
Number of bonds	$8 - 4 = 4$	$8 - 5 = 3$	$8 - 6 = 2$	$8 - 7 = 1$

Hydrogen forms one covalent bond. The noble gases in Group 0 do not form any.

Representing Covalent Bonds

Straight lines are the most common way to represent covalent bonds, with each line representing a shared pair of electrons. 2D or 3D molecular models are especially useful for showing the relationship between atoms in multiple covalent bonds. To the right are some examples of straight lines and images of 3D models.

Element	Formula	Chemical structure	Ball-and-stick model
Hydrogen	H ₂		
Water	H ₂ O		
Ammonia	NH ₃		
Methane	CH ₄	