

Box 1: Keywords

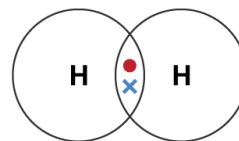
Allotrope	Chemical elements that exist in two or more different forms, in the same physical state e.g. Carbon as diamond or graphite.
Covalent bond	A bond between atoms formed when atoms share electrons to achieve a full outer shell of electrons.
Double bond	A covalent bond resulting from the sharing of four electrons (two pairs) between two atoms.
Intermolecular force	Weak attractive forces between molecules. When a simple molecular substance melts or boils, it is the intermolecular forces that are broken (not the covalent bonds in each molecule).
Molecule	A collection of two or more atoms held together by chemical bonds.

Box 2: Key skills

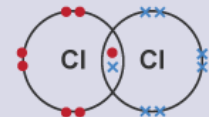
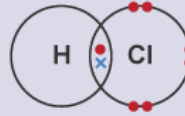
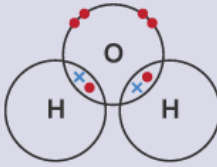
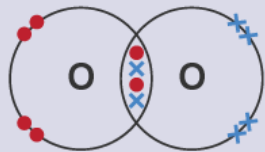
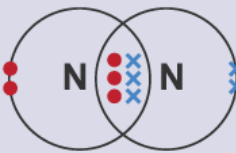
- Recognise substances as small molecules, polymers or giant structures from diagrams showing their bonding.
- Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.

Box 3: Covalent bonding

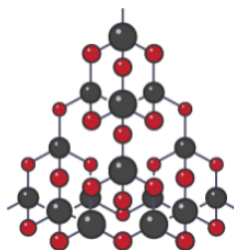
A **covalent bond** is formed when two **atoms** share a pair of **electrons**. Covalent bonding occurs in **elements** and **compounds** containing **non metals** only. E.g. H_2O , O_2 , CO_2



Dot-cross diagrams can be used to show electrons shared, both hydrogens share their one electron to fill outer shell. Below are all **simple covalent molecules**.

Name	Formula	Dot and cross diagram	Structure
Chlorine	Cl_2		$\text{Cl}-\text{Cl}$
Hydrogen chloride	HCl		$\text{H}-\text{Cl}$
Water	H_2O		$\text{H}-\text{O}-\text{H}$
Oxygen	O_2		$\text{O}=\text{O}$
Nitrogen	N_2		$\text{N}\equiv\text{N}$

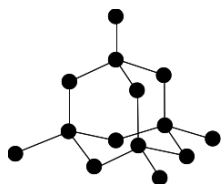
Box 4: Giant Covalent structures



Silicon dioxide (silica) containing silicon atoms (grey) and oxygen atoms (red)

Properties of giant covalent:

- solids at room temperature.
- very high **melting points** and **boiling points** as large amounts of **energy** are needed to overcome their strong covalent bonds.

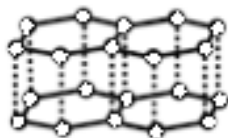


Allotropes of carbon

Diamond

- Forms all 4 bonds in a tetrahedral arrangement so it is very hard and can be used for cutting tools or drills.
- No free delocalised electrons so it cannot conduct electricity.

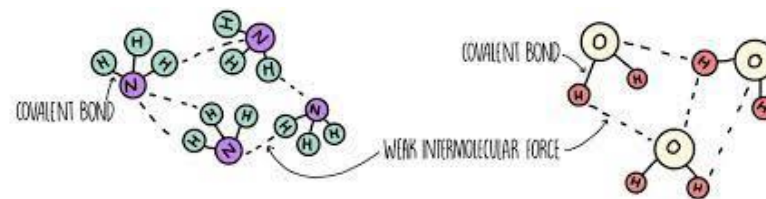
Graphite



- 3 covalent bonds with other carbons forming layers of hexagonal rings. There are no bonds joining layers so layers can slide making graphite soft and slippery (good lubricant).
- As the 4th carbon bond has not been made there is a free delocalised electron. This electron can carry charge so graphite can conduct electricity.

Box 5: Simple molecules - Properties

Examples include: CO_2 , H_2O , O_2 , N_2 , H_2 , CH_4



- **Low melting points and boiling points** - they have strong covalent bonds but weak intermolecular forces so only a small amount of energy needed to overcome these forces.
- **Conduction of electricity** - Small molecules have no overall electric charge, so they cannot conduct electricity, even when liquid or dissolved in water.

Box 6: Pathway

Previous knowledge: Atomic structure

Future links: Organic chemistry

Careers: nanotechnologists, material scientists, researchers, Science editors, Science authors, Science teachers, technicians, Science presenters, engineers, electricians.

Box 7: Cross curricular links