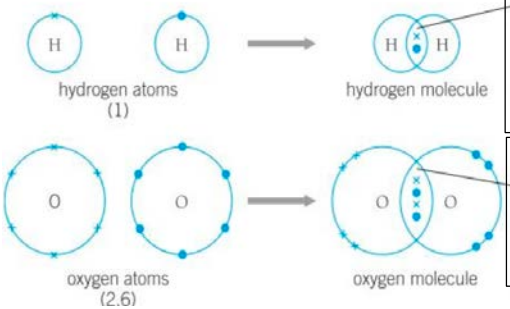
Trilogy C2_3 – Covalent Bonding

Covalent bonding

covalent bond: *a strong bond formed by attraction between atoms that* ***share a pair of electrons.***

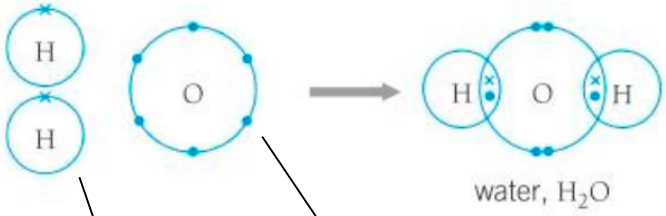
When **non-metal atoms** react with other **non-metal atoms**, electrons are **shared** to form **a covalent bond**.



A shared pair of electrons give both atoms a full outer shell.

This shows 2 pairs of electrons being shared in a **double bond**.

To gain a full outer shell, atoms may need 1 electron or more! Below is the example of H_2O.



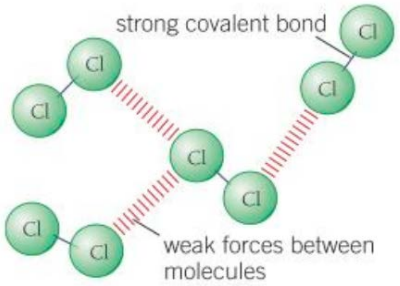
2 hydrogen atoms need to share 1 electron each to gain a full outer shell.

Oxygen has 6 electrons in its outer shell – it needs to gain 2 electrons to gain a full outer shell.

Simple covalent molecules

These are usually gases or liquids that have **low melting points and boiling points**.

Eg: Cl_2 CO_2 H_2O N_2 O_2



They have **strong covalent bonds** between **atoms** but only **weak** forces **between the molecules** (intermolecular forces).

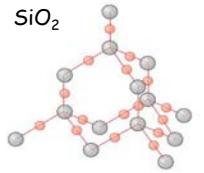
Intermolecular forces are *weak*, so not much energy is needed to break them. Therefore, they have **low melting and boiling points**.

The intermolecular forces **increase** with the size of the molecules, so **larger** molecules have **higher** melting and boiling points. e.g. large polymers

Giant covalent structures

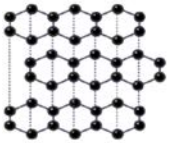
These are solids with **very high melting points**. All of the atoms in these structures are joined by **strong covalent bonds**.

E.g. Carbon can form giant covalent structures as diamond or graphite and silicon dioxide (silica) are examples of giant covalent structures.



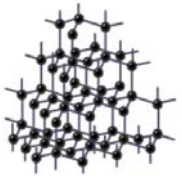
The structure of silicon dioxide (silica).

Graphite



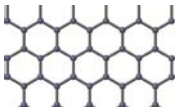
- made of **carbon atoms** forming layers of hexagonal rings.
- Each carbon atom has **3 strong covalent bonds** and one ***delocalised electron***.
- has a **high melting point** because strong covalent bonds take a lot of energy to break.
- can conduct electricity because the delocalised electrons are free to move and carry a charge (like metals!)
- soft because weak forces between layers allow the layers to slide over one another.

Diamond



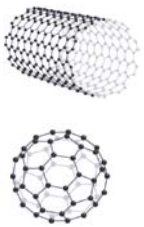
- Like graphite, diamond is also made of **carbon atoms**.
- Each carbon atom has **4 strong covalent bonds**.
- has a **high melting point** because strong covalent bonds take a lot of energy to break.
- **can't conduct electricity** because there are no delocalised electrons free to move and carry a charge.
- **very hard** because each carbon atoms is held strongly in place by 4 covalent bonds.

Graphene



- a single layer of graphite.
- can conduct electricity as delocalised electrons are free to move and carry a charge.
- useful for electronics and composites.
- **very hard** as there are no layers to slide.

Fullerenes



- Graphene can made into hollow shapes called **fullerenes**.
- Buckminster fullerene C_{60} has a spherical shape.
- Carbon nanotubes are cylindrical shapes.
- Their properties make them uses for nanotechnology, electronics and materials.

Nanoscience: study of 1–100 nm structures, of the order of a few hundred atoms.

Includes uses for:

- *Medicine*
- *Electronics*
- *Cosmetics*
- *sun creams*
- *new uses being discovered!*

Limitations of models

- 2D models show which atoms are bonded but not the **shape** of the molecule.
- Dot and cross diagrams show **electrons** in bonds where ball and stick doesn't.
- Giant structures won't show true number of atoms present.