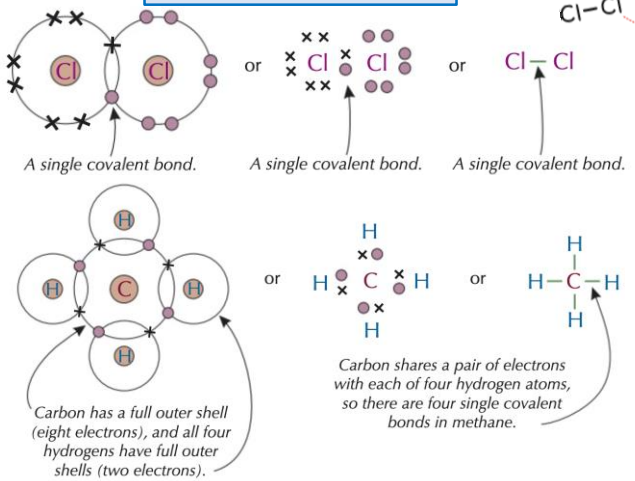
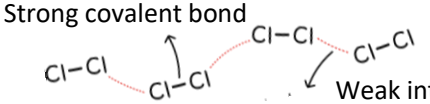
Chemistry: Covalent bonding and properties

Key word	Definition
Covalent bond	A chemical bond when atoms share a pair of electrons.
Molecular formula	A chemical formula showing the actual number of atoms of each element in a compound.
Simple molecule	A molecule made up of only a few atoms joined by covalent bonds.
Displayed formula	A chemical formula that shows the atoms in a covalent compound and all the bonds between them.
Intermolecular force	A force of attraction that exists between molecules.
Polymer	A long chain molecule that is formed by joining lots of smaller molecules (monomers) together.
Monomer	A small molecule that can be joined together with other small molecules to form a polymer.
Giant covalent structure	A large molecule made up of a very large number of atoms held together by covalent bonds.

Simple molecules

Dot and cross diagrams





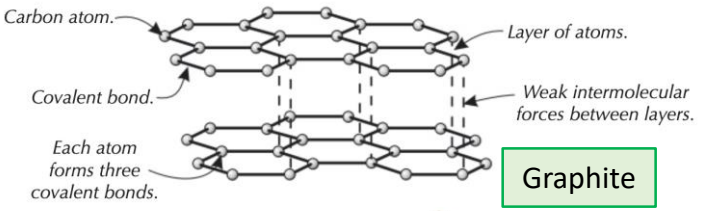
Properties of simple molecules:

- **Low melting and boiling points** – this is because little energy is needed to break the **weak intermolecular forces**.
- **Do not conduct electricity** – this is because they do not have any free **electrons** or an overall electric charge in any state of matter.

Giant covalent structures

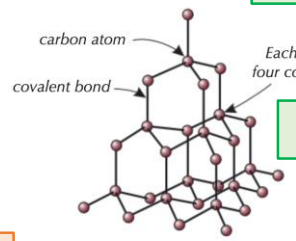
Properties of giant covalent structures:

- **Very high melting points** – this is because a lot of **strong covalent bonds** must be broken. Graphite, for example, has a melting point of more than 3,600°C.



Graphite

- **Variable electrical conductivity** – diamond does not **conduct** electricity, whereas graphite contains free **electrons** so it does conduct electricity. **Silicon** is a semi-conductor – it is midway between non-conductive and conductive.

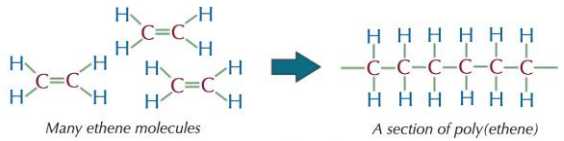


Diamond

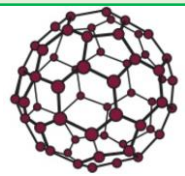
Silicon dioxide

Larger covalent substances

- Polymers are very **large molecules** made when many smaller molecules join together, end to end. The smaller molecules are called **monomers**.
- Polymers have higher melting and boiling points than simple molecules. This is because the intermolecular forces between the larger polymer molecules are **stronger**, so more energy is needed to break them.

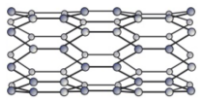


Allotropes of carbon



Bucky ball

Fullerene



Graphene

In all three allotropes, the carbon **atoms** are joined by strong **covalent bonds**, but in such different arrangements that the properties of the allotropes are very different.