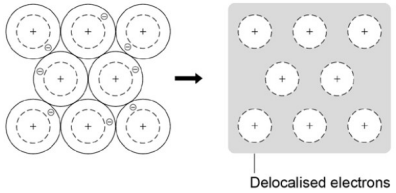
L13 – 19: Structure and Bonding

Metallic bonding

Metals LOSE ELECTRONS to form POSITIVE IONS



GIANT structures of atoms in a REGULAR pattern

Delocalised electrons are free to move.

What is a metallic bond?

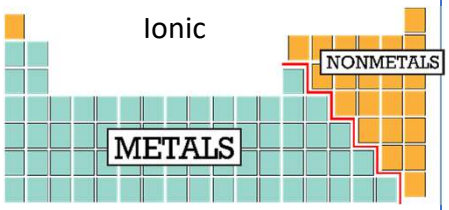
Sharing delocalised electrons – STRONG metallic bonds.

Which type of bonding is it?

M:M
Metallic

M:NM
Ionic

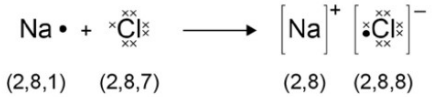
NM:NM
Covalent



Ionic bonding

Metals LOSE ELECTRONS to form POSITIVE IONS
Non-metals GAIN ELECTRONS to form NEGATIVE IONS

Electrons transferred from metal to non-metal



Ions have electronic structure of a noble gas

What is an ionic bond?
STRONG electrostatic force of attraction between **oppositely charged ions**

How do we quickly work out the charges on ions?

Group	Electrons in outer shell	Charge on ion
1	1	1+
2	2	2+
6	6	2-
7	7	1-

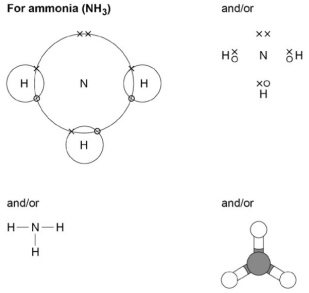
Covalent Bonding

Two **non-metals** will **SHARE** pairs of electrons

STRONG bond formed.

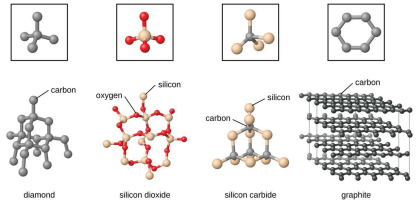
Small **molecules**

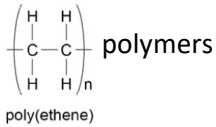
A small group of atoms sharing electrons



Giant Structures

Many atoms sharing electrons





Limitations of these models

Model	Limitations
Dot and cross	Looks like electrons aren't identical Electrons look like they are in fixed positions
Displayed formula	Doesn't show true shape of the molecule
Ball and stick	Can attempt to show 3D shape but doesn't show electrons

Structure and Bonding

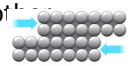
Properties of Metallic Substances

Metals have high melting and boiling points **because…**

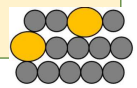
…they are **giant structures** of atoms with **strong metallic bonding**

Can be bent or shaped **because…**

…atoms are arranged in **LAYERS** which can **SLIDE** over each other



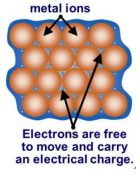
Alloys are harder than pure metals **because…**



Alloys are a mixture of two or more elements, at least one of which is a metal

…the layers are **DISTORTED** so can't slide over each other

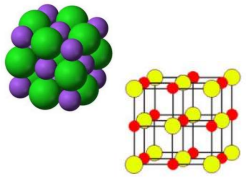
Metals are good conductors of electricity and thermal energy **Because…**



…the **electrons are free** to move and carry thermal energy and charge

Properties of Ionic Substances

Ionic compounds have high melting and boiling points **because…**

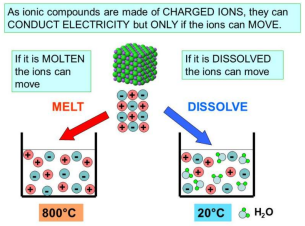


…they are giant structures of atoms (giant ionic lattice) with **strong electrostatic forces** of attraction in **ALL DIRECTIONS** between oppositely charged ions.

A large amount of **energy** is needed to break the many strong bonds.

Only conduct electricity when melted or dissolved in water **because…**

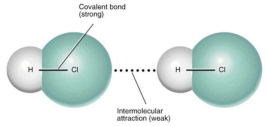
…the **ions are free** to move and so charge can flow.



Properties of Covalent substances

Small molecules

Small molecules have relatively low melting and boiling points **because…**



…**intermolecular forces** are overcome on melting and boiling and these are weak forces.

The bigger the size of the molecule the higher the melting and boiling point **because…**

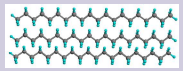
…intermolecular forces increase with the size of the molecules.

Don't conduct electricity **because…**

…the molecules have **no overall electric charge**.

Giant Structures

Polymers are solids at room temperature **because…**

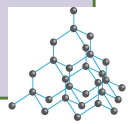


…intermolecular forces increase with the size of the molecules and polymer molecules are **very large**.

Giant covalent compounds have high melting and boiling points **because…**

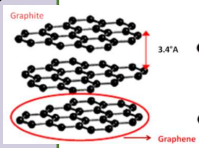
…all of the atoms linked by **strong covalent bonds**.

Diamond is very hard, has a very high melting and boiling point and doesn't conduct electricity **because…**



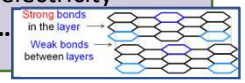
…each carbon is bonded to **4** other carbons by **strong covalent bonds**. There are **no free electrons**.

Graphene is strong, light and an excellent conductor of thermal energy and electricity. **because…**



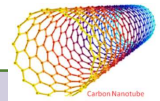
…it is a single layer of graphite so has **free electrons.**

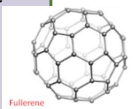
Graphite is very hard, has a very high melting and boiling point and does conduct electricity **because…**



…each carbon is bonded to **3** other carbons by **strong covalent bonds**. It forms **layers** of **hexagonal rings** with no covalent bonds between layers. There are **free electrons**.

Fullerenes (e.g. carbon nanotubes) are extremely strong and are excellent conductors of thermal energy and electricity **because…**





… they have **strong covalent bonds** and **free electrons**.