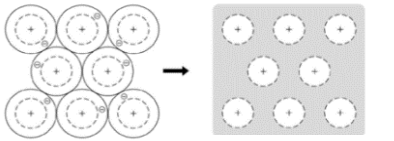
Exmouth Community College
Academy Trust

Metallic Bonding

Metals LOSE ELECTRONS to form POSITIVE IONS



Delocalised electrons

GIANT structures of atoms in a REGULAR pattern

Delocalised electrons are free to move.

What is a metallic bond?

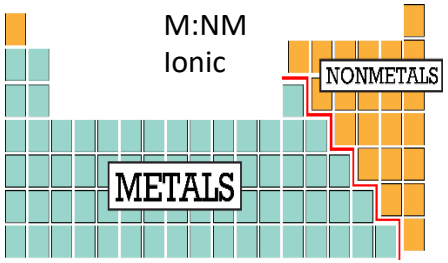
Sharing delocalised electrons – STRONG metallic bonds.

Which type of bonding is it?

M:M
Metallic

NM:NM
Covalent

M:NM
Ionic

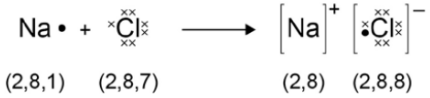


Ionic Bonding

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-

C3 Structure and Bonding

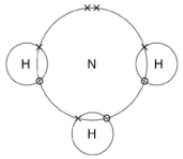
Two **non-metals** will **SHARE** pairs of electrons

STRONG bond formed

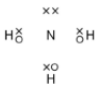
Small molecules

A small group of atoms sharing electrons

For ammonia (NH_3)



and/or

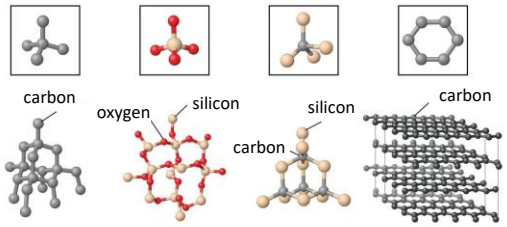


and/or

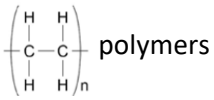
and/or

Giant structures

Many atoms sharing electrons



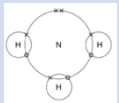
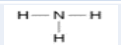
Diamond | Silicon dioxide | Silicon carbide | graphite



polymers

Poly(ethene)

Limitations of these models

Model		Limitations
	Dot and Cross	Looks like electrons aren't identical Electrons look like that 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

Year 9 – Chemistry / Bonding – HT4

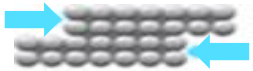
Properties of Metallic Bonding

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

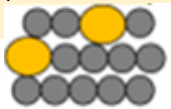
… they are **giant structures** of atoms with **strong metallic bonding**

Can be bent or shaped **because …**

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



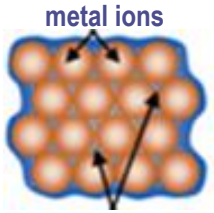
Alloys are harder than pure metals **because …**



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

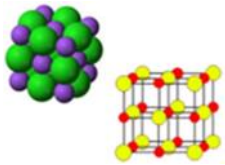
Metals are good conductors of electricity and thermal energy **because …**



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

Properties of Ionic Bonding

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

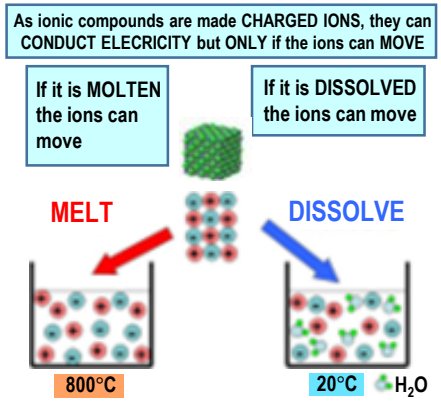


… they are giant structures of atoms (giant ionic lattice) with **strong electrostatic forces** of attraction in **ALL DIRECTIONS** between oppositely charged ions

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

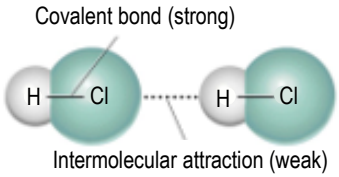


Structure Bonding

Properties of Covalent Bonding

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 …**

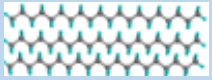
… intermolecular forces increase with the size of the molecules

Don't conduct electricity **because …**

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

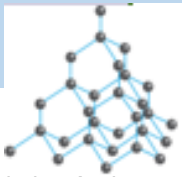
Giant Molecules

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



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

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**

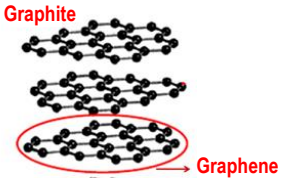
Graphite is very hard, has a very high melting and boiling point and does conduct electricity **because …**

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

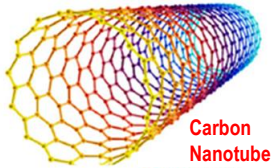
Giant covalent compounds have high melting and boiling points **because …**

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

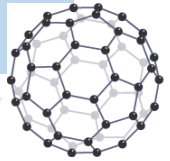
Graphene is strong, light and an excellent conductor of thermal energy and electricity **because …**



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



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

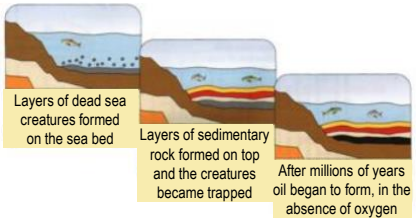


… they have **strong covalent bonds** and **free electrons**

Exmouth Community College
Academy Trust

Hydrocarbons

Crude Oil is made from the remains of living **sea creatures** decayed in mud millions of years ago



It is a **FINITE** resource

It is made from a mixture of Hydrocarbons. Hydrocarbons are made from **Hydrogen and Carbon only**

The main hydrocarbons in Crude Oil are **alkanes**

Alkane	Molecular Formula	Structural Formula
Methane	CH_4	
Ethane	C_2H_6	
Propane	C_3H_8	
Butane	C_4H_{10}	

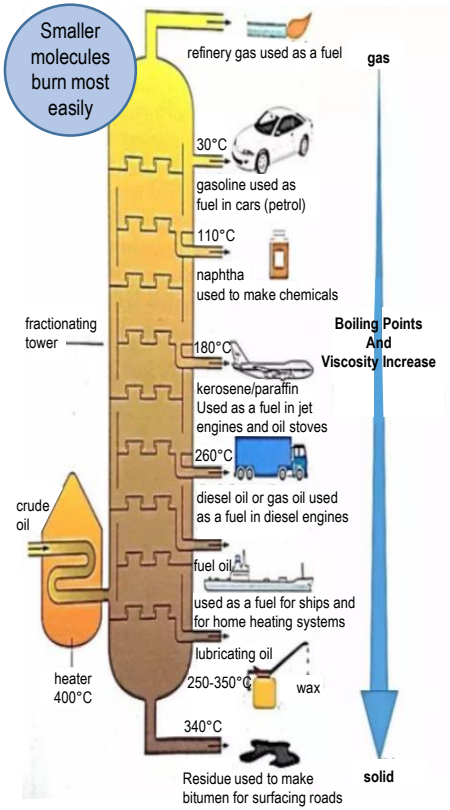
The general formula for an alkane is:

$$C_nH_{2n+2}$$

Fractional Distillation

How do we separate the mixture of hydrocarbons to use them?

Works by **evaporation** and then **condensation**



1. **Heat** the crude oil to **evaporate** it
2. The gases **rise** up the column
3. The different fractions **condense** at **different temperatures**

Combustion

Combustion (burning) is a reaction with **oxygen**

A reaction with oxygen is called **'oxidation'**

When hydrocarbons burn a lot of **energy** is released

Complete combustion of hydrocarbons the only products are **carbon dioxide and water**

Complete combustion only happens if there is plenty of oxygen

General equation

hydrocarbon + oxygen ⟶ carbon dioxide + water

Complete combustion of propane

propane + oxygen ⟶ carbon dioxide + water

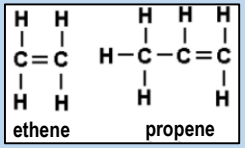
$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

Cracking

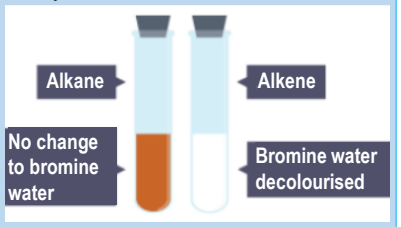
The larger molecules from fractional distillation are less useful. We can break them down into smaller, more useful molecules

Cracking produces a mixture of **alkanes** and **alkenes**

Alkenes have some **double bonds**

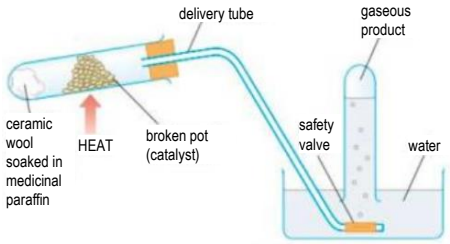


They turn **bromine water colourless**



They are used to make **polymers**

The apparatus for cracking



Catalytic cracking – catalyst and 500°C

Steam cracking – steam and 850°C

Year 9 – Chemistry / Carbon Chemistry – HT4