

### Home learning activities

Subject
Science
Year Group
Year 9
Unit of work / Knowledge organiser
Bonding and Structure
Activities
<ul style="list-style-type: none"> <li>• Read through Sections 1-7a of the 'Bonding and Structure' 'Knowledge Organiser' and make careful and detailed notes on the sections, including details of the properties described in Sections 3, 5b, 6a and 6b.</li> <li>• Read through Sections 7b-12 of the 'Bonding and Structure' 'Knowledge Organiser' and make careful and detailed notes on the sections; complete the 'exam questions' in Section 8.</li> <li>• Watch all 'GCSEPod' clips on the 'Bonding and Structure' Unit.</li> <li>• Complete the 'GCSEPod' Questions assigned for this Unit of work and any additional assignments which have been set by your teacher.</li> </ul>
Where do you complete the work?
Use computer/phone for 'GCSEPod' or 'Seneca' and study materials.
What to do if you finish the work? (Extension activity)
<ul style="list-style-type: none"> <li>• Sign up for 'Seneca Learning' using the 'Sign Up Guide' sheet and the special passcode: <b>j5v9tvzq48</b>. Complete the assignments which have been set.</li> </ul>
These websites might help:
<ul style="list-style-type: none"> <li>• BBC Bitesize -&gt; Secondary -&gt; GCSE -&gt; Combined Science -&gt; AQA Trilogy -&gt; Chemistry -&gt; Bonding, Structure and the Properties of Matter</li> <li>• <a href="http://www.freesciencelessons.co.uk">www.freesciencelessons.co.uk</a> -&gt; GCSE Videos -&gt; Chemistry Paper 1 -&gt; Structure and Bonding</li> </ul>

If you are struggling with your work or if you have finished.

**Please email your classroom teacher directly using the email list found in the Home Learning section of the website.**

# Year 10 — Bonding and Structure

## 1. Formation of ions based on the periodic table

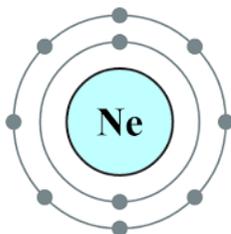
Ions – are charged particles formed from the gaining or losing of outer electrons.

Metal atoms **LOSE** outer electrons they become **POSITIVELY** charged

Non- metal atoms **GAIN** outer electrons they become **NEGATIVELY** charged.

	Group 1 metals LOSE 1 electron BECOME 1+ ion
	Group 2 metals LOSE 2 electrons BECOME 2+ ion
	Group 6 non-metals GAIN 2 electrons Become 2- ions
	Group 7 non-metals GAIN 1 electron Become 1- ions

All atoms do this to gain the electronic configuration of the noble gas (group 0)



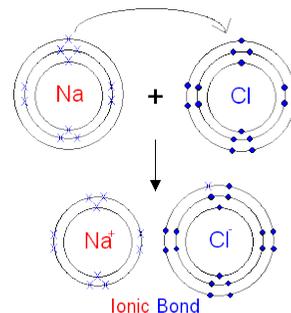
## 2. Ionic Bond

**Metal** – donates outer electrons

**Non-metal** – receives outer electrons to gain a full outer shell.

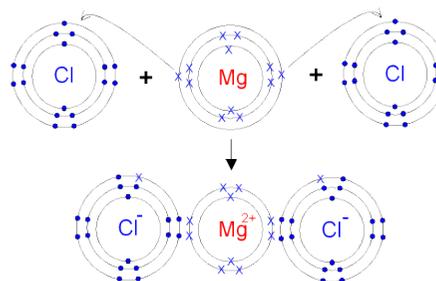
When a metal atom reacts with a non-metal atom electrons in the outer shell of the metal atom are **transferred**.

**Making sodium chloride**



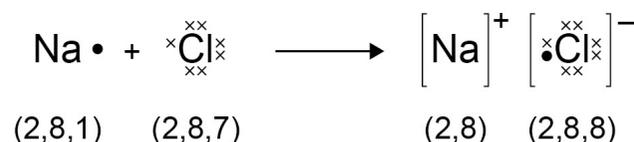
Formula - NaCl

**Making magnesium chloride**



Magnesium needs to lose 2 outer electrons. Each chlorine receives an outer electron to give the Formula  $MgCl_2$

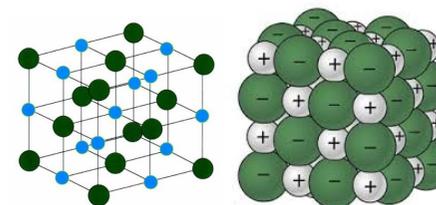
The electron transfer can be represented by simple dot and cross diagrams.



## 3. Properties of ionic compounds

Remember to gain higher marks you need to link the property of the compound to its bonding and structure.

The structure of sodium chloride can be shown as:



**Regular structure (giant ionic) produced by strong electrostatic forces of attraction between oppositely charged ions.**

**They have high melting and boiling points because a high amount of energy is needed to break the many strong ionic bonds.**

**They dissolve in water because water has polarity and attracts the oppositely charged ions.**

**When dissolved in water or molten they conduct electricity because the ions are free to move – allowing charge to flow.**

Working out the empirical formula of ionic compounds from a given model

Empirical formula is the simplest ration of ions in the compound.

Sodium chloride is NaCl (1:1)

Magnesium chloride is  $MgCl_2$  (1:2)

Magnesium oxide MgO (1:1)

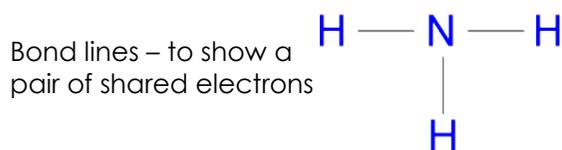
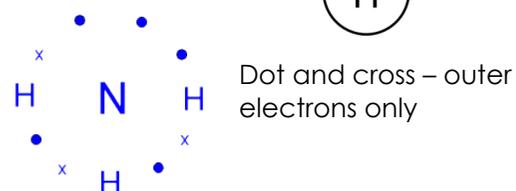
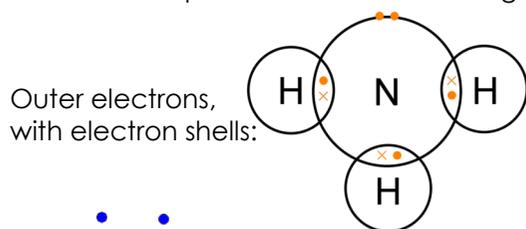
Sodium oxide is  $Na_2O$  (2:1)

## Year 10 — Bonding and Structure

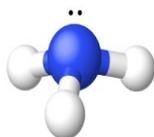
### 4. Covalent Bonding

Formed when 2 or more **non-metals share pairs of electrons** on their outer shells.

The covalent bonds in molecules and giant structures can be represented in the following forms

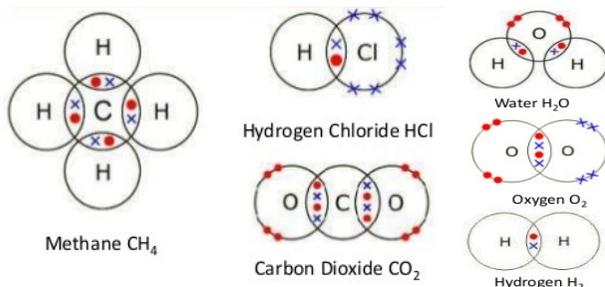


Or as a stick and ball model:



### 5a. Simple Covalent compounds

These are the structures of the common simple covalent compounds.



### 5a. The examiner may ask you to draw different ones.

#### Remember

use the periodic table to find out how many outer electrons each atom has; All electrons need to be paired and shared.

### 5b. Properties of simple covalent compounds

**Low melting and boiling points** - This is because the weak intermolecular forces break down easily. Simple molecular substances are gases, liquids or solids with low melting and boiling points.

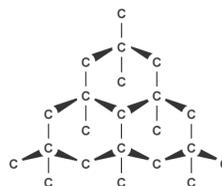
**Non-conductive** - Substances with a simple molecular structure do not conduct electricity. This is because they **do not** have any **free electrons** or an overall electric charge (ions).

Hydrogen, ammonia, methane and water are also simple molecules with covalent bonds. All have **very strong bonds between the atoms**, but much **weaker forces holding the molecules together**. When one of these substances melts or boils, it is these weak 'intermolecular forces' that break, not the strong covalent bonds.

### 6a. Giant covalent compounds and the properties

#### Allotropes of carbon

#### Diamond



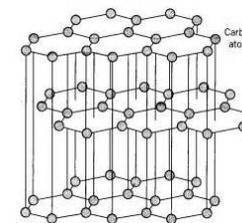
#### Properties

**High melting and boiling point** – all carbons have 4 strong covalent bonds which required extremely high temperatures to break. (NO intermolecular forces)

**Non-conductive** as it does not have free electrons or ions.

**Extremely hard** due to covalent bonds.

### 6b. Graphite



#### Properties

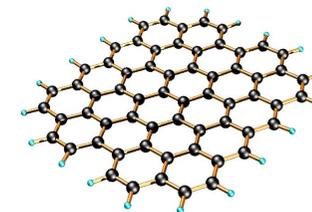
**High melting and boiling point** – all carbons have 3 strong covalent bonds which required extremely high temperatures to break.

**Conducts electricity** – it has delocalised electrons.

**Layers** are weakly attracted meaning they can slide over each other useful as a lubricant.

### 7a. Graphene

Graphene is a smart material, because it is only one atom thick. Graphene is essentially a single layer of carbon in the form of graphite, with its layered structure of hexagonal rings of

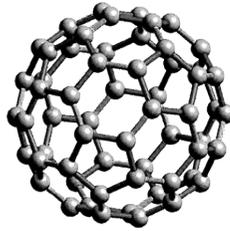


Graphene fibres are strong. Graphene is highly resistant to attack by strong acids or strong alkalis and so can be used to give surfaces an ultra-thin protective layer which is transparent

## Year 10 — Bonding and Structure

### 7b. Buckminster Fullerene

It is actually not a giant covalent structure, but a giant molecule in which the carbon atoms form pentagons and hexagons - in a similar way to a leather football. It is **used** in lubricants



### 8. Exam questions on bonding:

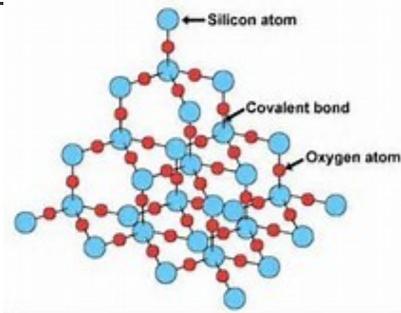
By reference to the detailed structure of sodium chloride explain fully why:

- (i) sodium chloride has a quite high melting point **(1)**
- (ii) solid sodium chloride melts when it is heated strongly, **(2)**
- (iii) molten sodium chloride will conduct electricity **(1)**

**Use** your knowledge of structure and bonding to explain why:

- (i) graphite is very soft **(2)**
- (ii) diamond is very hard **(2)**
- (iii) graphite conducts electricity. **(2)**

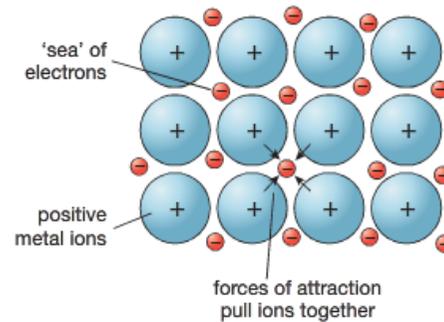
### 9. Silicon dioxide (comparison to diamond)



Silica, which is found in sand, has a similar structure to diamond. It is also hard and has a high melting point, but contains silicon and oxygen atoms, instead of carbon atoms. The fact that it is a **SEMI-CONDUCTOR** makes it useful in the electronic industry.

### 10. Metallic bonding

Metals have giant structures of atoms with strong metallic bonding. The giant structure of metal cations with a 'sea of electrons' moving.

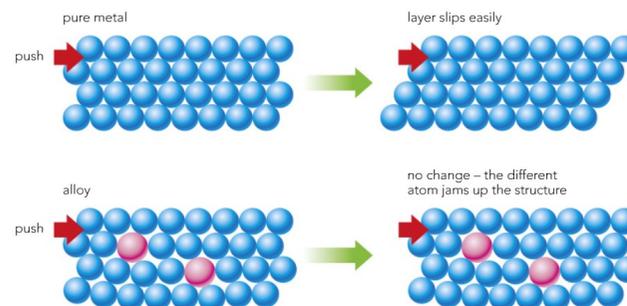


Metals **conduct electricity** as the electrical current is the movement of the delocalised electrons through the lattice of ions.

### 11. Alloys

An alloy is a mixture of fused metals.

Comparing the properties of metals and alloys



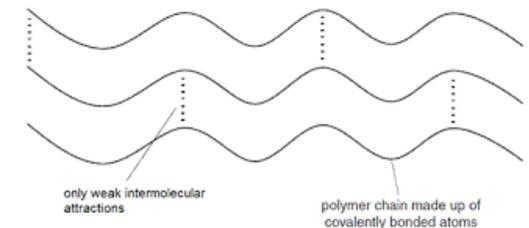
In a pure metal the atoms are in layers which can easily slide over each other. This means metals can be shaped and bent. They are **malleable** (can be hammered into shape) and are **ductile** (drawn into wires).

In an alloy, the **different sized** metal atoms **distort** the layers making it difficult to slide over each other. Alloys are **harder** than pure metals.

### 12. Polymer structure

**Polymers** are large molecules. They are formed from repeating units called **monomers**. They have strong covalent bonds between the atoms in the chain.

Between the polymers weak **intermolecular forces** keep the molecules together. These forces can be broken so polymer chains move over each other. This allows the polymer to be stretched.



As many of these intermolecular forces exist the substance are **solid** at room temperature.

The weaker the intermolecular forces the lower the melting point.

### Types of polymer (HT only)

#### Addition polymerisation

- Monomers are identical
- Monomers have at least one carbon – carbon double bond
- Examples poly(ethene), PVC, PTFE

# 'Seneca Learning' Sign-Up Guide

Passcode: j5v9tvzq48

**Step 1:** Open an internet browser - *Any browser except Internet Explorer will work.*

**Step 2:** Go to [SenecaLearning.com](https://SenecaLearning.com)

**Step 3:** Click on "Get Started" or "Sign Up"

**Step 4:** Create your account - *If you don't know your parent email, then type: N/A.*

**Step 5:** Click on "Classes & Assignments" - *You'll find this in the top menu.*

**Step 6:** Click on "Join Class" - *It's the green button in the top right corner.*

**Step 7:** Type the code from your teacher - *If you received a link instead, then open the link.*