C2.2 Bonding and Structure

Section 1

Properties of metals/non-metals

	Metals	Non-metals
Appearance	Shiny	Dull
State at room temperature	Solid (except mercury, which is a liquid)	About half are solids, about half are gases, and one (bromine) is a liquid
Density	High (they feel heavy for their size)	Low (they feel light for their size)
Strength	Strong	Weak
Malleable or brittle	Malleable (they bend without breaking)	Brittle (they break or shatter when hammered)
Conduction of heat	Good	Poor (they are insulators)
Conduction of electricity	Good	Poor (they are insulators,

Section 2

The **Periodic table** is organized like a big grid. Each **element** is placed in a specific location because of its atomic structure. As with any grid, the periodic table has rows called **Periods** and columns called **Groups** Each row and column has specific characteristics.

History

Dobereiner groups of three elements (**triads**) could be formed in which all the elements shared similar physical and chemical properties.

Newlands Law of octaves states that when elements are arranged in the increasing order of atomic weights, every eighth element has similar properties to the first.

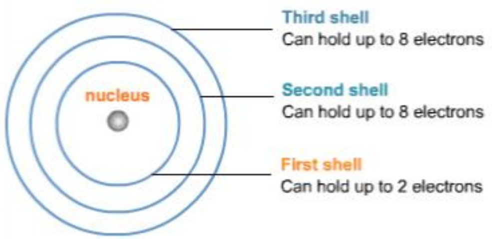
Mendeleev published his first periodic table of the elements in 1869. In it, he arranged the elements in order of increasing atomic weights. He also took into account the **properties** of the elements and their **compounds**. This meant that his table:

•had gaps in it

•showed elements with similar chemical properties lined up in groups. It is the basis of todays Periodic Table

Section 3

Electron structure - electrons are arranged in shells around the nucleus



Section 4

Covalent bonding is between non-metals which share electrons to form full shells

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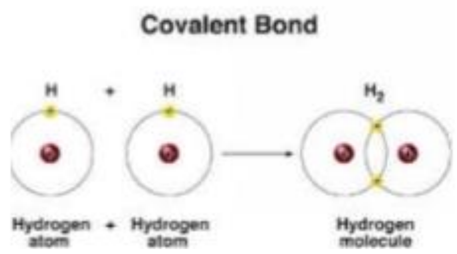
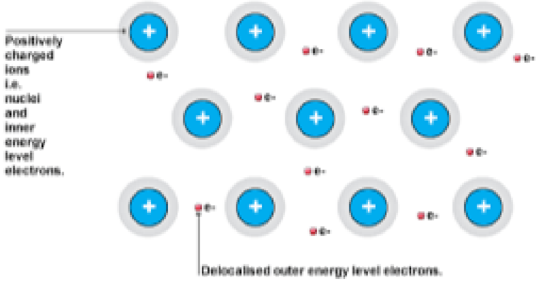
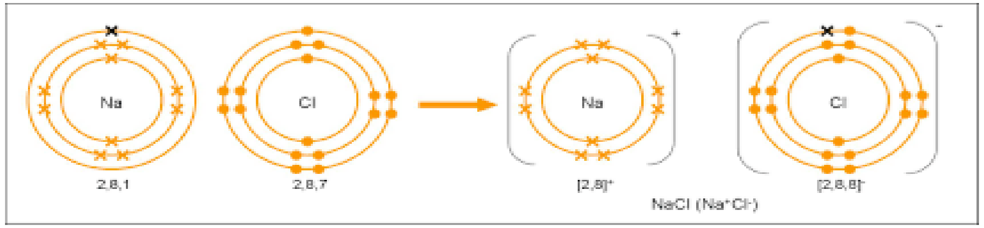


Section 5

Metallic bonding positive nuclei in a 'sea' of electrons



Section 6

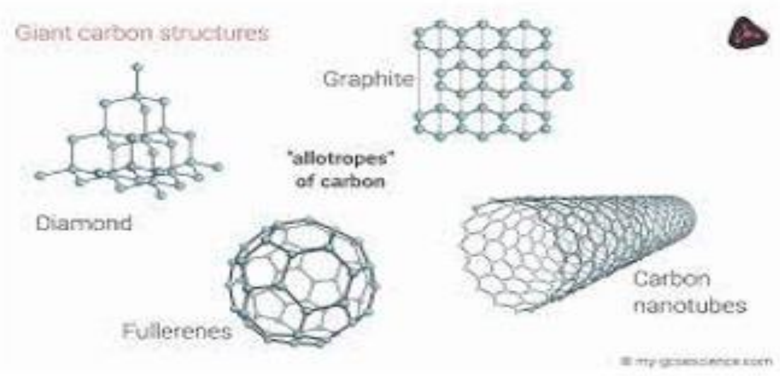


Electrons are transferred so that all atoms have a noble gas configuration (full outer shells).Metal atoms lose electrons and become positively charged ions

Non metals atoms gain electrons to become negatively charged ions

Section 7

Giant Covalent structure are where the atoms share electrons but are interconnected giving different properties to 'simple' covalent structures

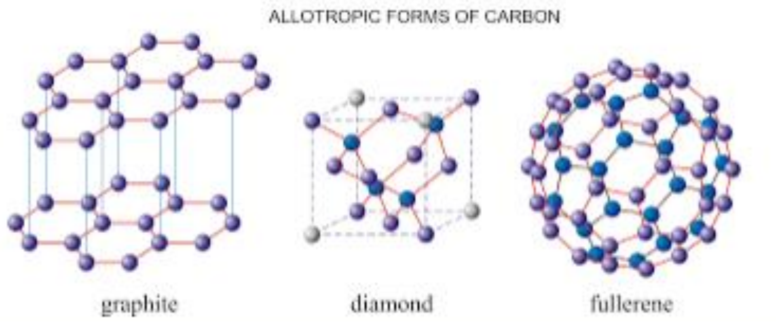


Section 8

A **polymer** is a chemical compound with molecules bonded together in long, repeating chains. Because of their structure, **polymers** have unique properties that can be tailored for different uses. **Polymers** are both man-made and naturally occurring

Section 1

Allotrope refers to one or more forms of a chemical element that occur in the same physical state. The different forms arise from the different ways atoms may be bonded together.



Section 2

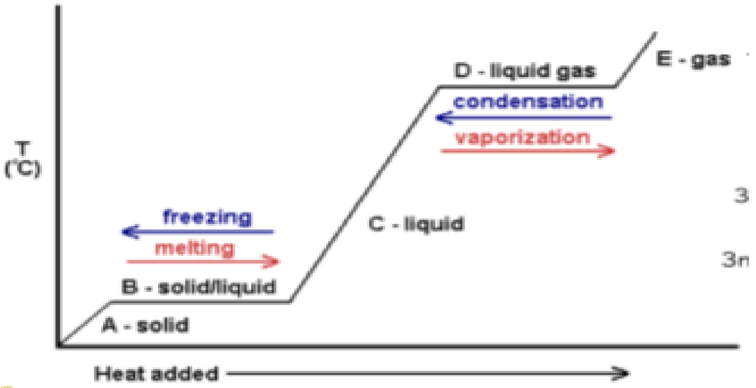
PHYSICAL PROPERTIES OF DIAMOND AND GRAPHITE

Property	Diamond	Graphite
Appearance	Transparent	Black, Shiny
Hardness	Very Hard	Soft, slippery to touch
Thermal Conductivity	Very poor	moderate
Electrical Conductivity	Poor	Good conductor
Uses	Jewellery, drilling	Dry cell, electric arc, lubricant, pencil lead

Section 3

C2.3 Properties of materials

Change of State



Where the graph is a flat line the Temperature is not increasing.This is because the energy is going in to change the state , this means it is used to loosen or break bonds in the diagram above

Section 4

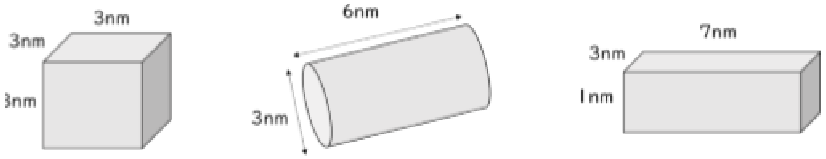
Bulk properties are **properties** due to many atoms, ions or molecules acting together. These are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces, and the ways in which their bonds are arranged. See below

Type of substance	Conducts electricity?	Reason
Simple molecule	No	Simple molecules are not charged
Ionic compound	Only when molten or dissolved	Ions are charged particles, free to move about when the substance is molten or dissolved (not when it is solid)
Giant covalent	No	The individual atoms are not charged
Metal	Yes	Contains delocalised electrons, free to move about

Section 5

C2.3 PROPERTIES

Nanoparticles are really tiny structures, made up of only a few hundred atoms. They are 1-100 nm in diameter (a nm is 10^{-9} metres). As a result they have special properties and uses. This is partly because of their high surface area to volume ratio. We can calculate this -



Cube Surface area = 3 nm x 3 nm x 6 = 54 nm^2

Volume = 3 nm x 3 nm x 3 nm = 27 nm^3

Surface area to volume ratio = 54 nm^2 ÷ 27 nm^3 = **2 nm^{-1}**

Cylinder Surface area = $(2 \times \pi \times 1.5 \times 6) + (2 \times \pi \times 1.5^2)$ = 70.69 nm^2

Volume = $\pi \times 1.5^2 \times 6$ = 42.41 nm^3

Surface area to volume ratio = 70.69 nm^2 ÷ 42.41 nm^3 = **1.67 nm^{-1}**

Cuboid Surface area = 2(1 x 3) + 2(1 x 7) + 2(3 x 7) = 62 nm^2

Volume = 1 nm x 3 nm x 7 nm = 21 nm^3

Surface area to volume ratio = 62 nm^2 ÷ 21 nm^3 = **2.95 nm^{-1}**

Section 6

Nanoparticles are used in sunscreens, sports equipment, drug delivery, deodorants and medicine (see silver below). Future uses include new catalysts, computers, coatings and stronger and lighter building materials.

Some people are **concerned** that the small size of **nanoparticles** makes it possible to breathe them in, or for them to pass into cells. ... Toxic substances could bind to them because of their large surface area to volume ratios, harming health if the **nanoparticles** do get into the body.