Science - Elements, Compounds and Mixtures

Year 9 Term 3

Key Definitions

Soluble	A substance can dissolve
Insoluble	A substance cannot dissolve
Solvent	The liquid solute dissolves in
Solute	The substance that dissolves
Solution	Formed when a solute dissolves in a solvent
Pure substance	Consists of one element or compound
Impure substance	Contains more than one element
Relative atomic mass	The mean mass of an atom of an element compared to 1/12 the mass of a carbon-12 atom
Relative formula mass	The mean mass of a unit of substance compared to 1/12 the mass of a carbon-12 atom
Empirical formula	Shows the simplest whole-number ratio of the atoms of each element in a compound
Molecular formula	Shows the actual number of atoms of each element in a compound

How to determine purity

Method 1: Use melting point data.

An impure substance melts over a range of temperatures or at a point that is lower that the pure substance.

Method 2: Use chromatography data

More than 1 spot or peak shows an impure substance.

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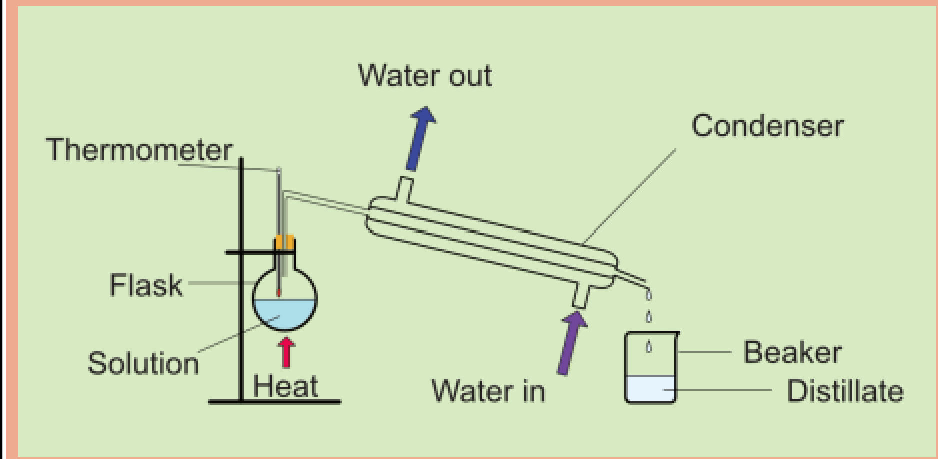
Separation Techniques

Distillation

Heat the solution to evaporate the solvent.

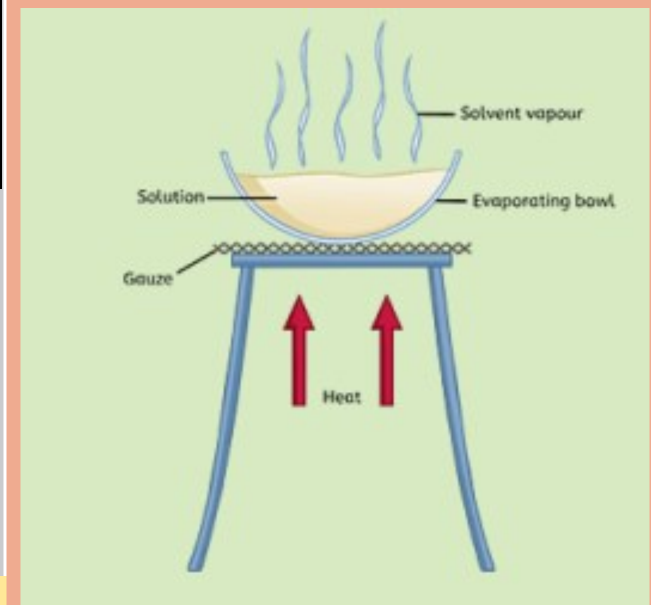
The solvent cools and condenses and is collected.

Will collect and separate both substances



Crystallisation

Separates a soluble substance from a solution. Used when only the salt is required.



Chromatography

Paper Chromatography

The stationary phase is the paper and the mobile phase is the liquid solvent (water)

Thin layer Chromatography

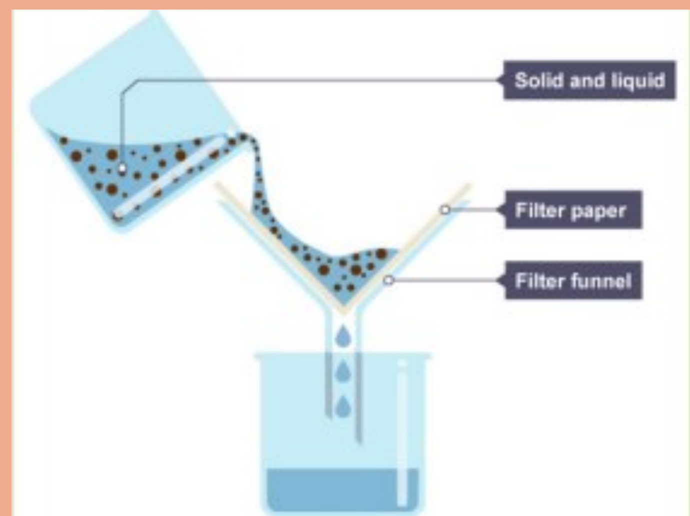
The stationary phase is a thin layer of silica or alumina powder and the mobile phase is the liquid solvent (water or ethanol)

Gas Chromatography

The stationary phase is silica or alumina power or a dense gel. The mobile phase is an unreactive gas.

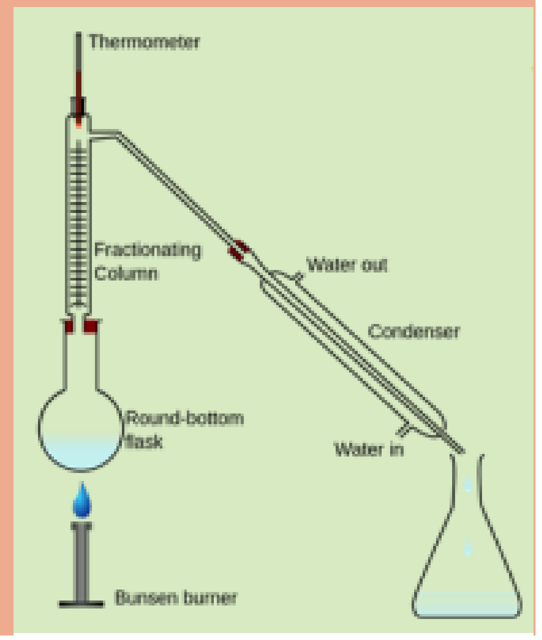
Filtration

Separates an insoluble substance from a liquid.



Fractional Distillation

Separates a mixture of liquids.



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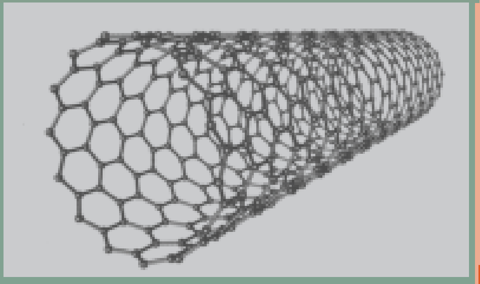
Name	Bonds per carbon	Conduct electricity	Uses
Diamond	**4**	No	Saw blades and drill bits
Graphite	**3**	Yes	Blast furnace linings, pencils
Graphene	**3**	Yes	Anti-corrosion coatings, electronics
Nanotubes	**3**	Yes	Electronics
Buckyball	**3**	No	Lubricant and drug delivery

Fullerenes

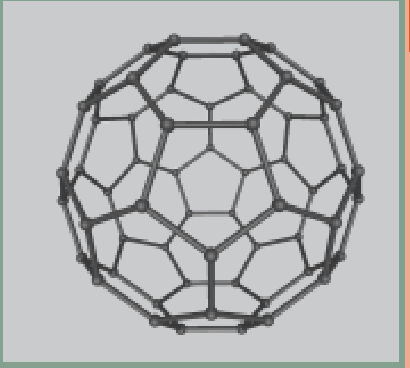
Nanotubes

A sheet of graphene rolled into a tube.



Buckyball

Made of 60 carbon atoms (C60). Used to deliver drugs to cells and as lubricants.

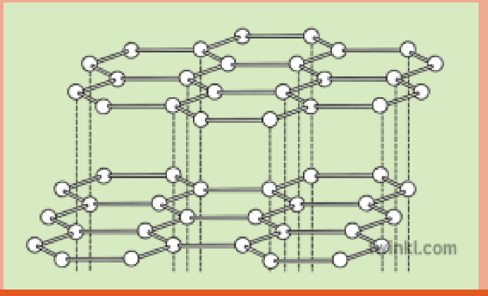


Carbon

Carbon is in group 4 and has 4 electrons in its outer shell. It can form 4 covalent bonds with other elements. There are many allotropes of carbon including diamond, graphite, graphene and fullerenes. Allotropes of different forms of the same element.

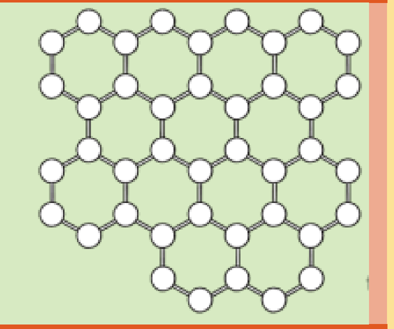
Allotropes of carbon: Graphite

- A giant covalent structure.
- Each carbon is covalently bonded to 3 others.
- Graphite is made up of layers held together by weak intermolecular forces. They can slide over each other.
- There are many strong covalent bonds meaning that graphite has high melting and boiling points.
- There are delocalised electrons meaning graphite can conduct electricity.



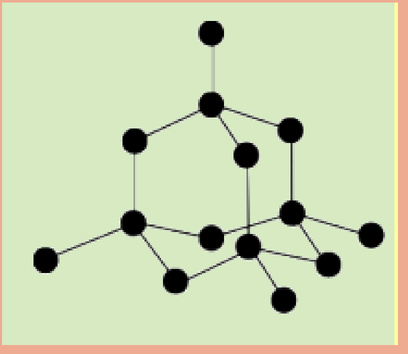
Allotropes of carbon: Graphene

A single layer of graphite. Very strong and can conduct electricity.



Allotropes of carbon: Diamond

- Each carbon is covalently bonded to 4 others.
- There are no weak points making diamond very hard.
- There are no delocalised electrons meaning diamond cannot conduct electricity.
- There are many strong covalent bonds meaning that diamond had high melting and boiling points.



Electrical Conduction

Metals and graphite have delocalised electrons that can move through the structure and carry the charge.

Ionic compounds are made up of charged ions. In a solid they cannot conduct electricity because the ions are not free to move. When molten or dissolved in solution the ions are free to move so can carry the charge and conduct electricity.

Covalent molecules have no charged particles so cannot conduct electricity.

Nanoparticles

Between 1 to 100 nanometres in diameter.

1 nm = 1 x 10-9 m

Very high volume to SA ration giving them unique chemical properties.

Uses: Medicines, sun cream, cosmetics, electronics and catalysts.

Risks: It is possible for nanoparticles to enter our cells and no one knows the long term effect this may have. More research is needed.

Keyword	Explanation
Malleable	Able to be hammered into shape without breaking or cracking. Metals are malleable as the layers slide over each other.
Brittle	Giant covalent structures and giant ionic lattice structures are **brittle** as a force causes the bonds to break.

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Periodic Table

- Mendeleev ordered the periodic table in terms of atomic weight and chemical properties. He left gaps for undiscovered elements. When they were found they had the properties Mendeleev predicted.
- He originally showed the groups as rows but then rotated it so the groups were in columns.
- The modern periodic table is arranged in order of atomic number (proton number).
- Group 0 were discovered and added later.

Rows/Periods	Show the number of
Columns/Groups	Shows the number of electrons in the outer
Metals	Metals (left of periodic table). Shiny, solid at room temperature, malleable, ductile, good conductors
Non-Metals	Dull, usually have low melting and boiling points,

- 1st shell holds 2
- 2nd shell holds 8
- 3rd shell holds 8
- 4th shell holds 18

Key Definitions

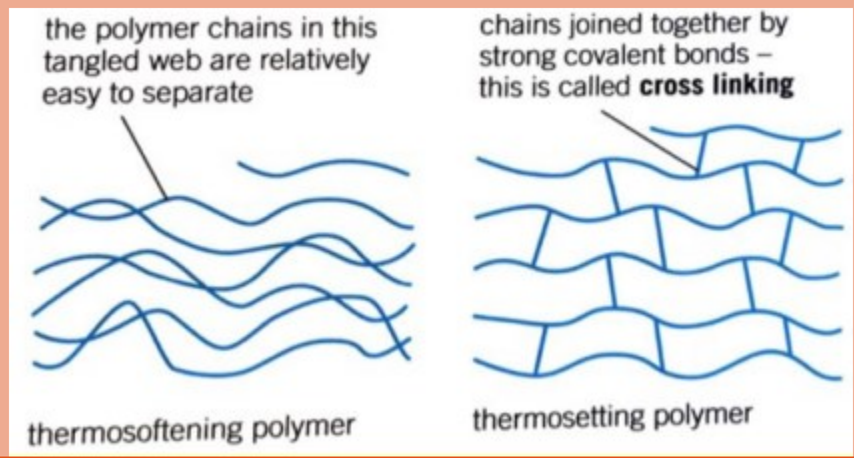
Simple covalent molecules	• Formed when a two non metals react. They share electrons to complete their outer shell. • A covalent bond is a shared pair of electrons. • A double bond is 2 shared pairs of electrons. • Low melting and boiling points due to weak intermolecular forces. • Cannot conduct electricity as there are no charged particles present.
Giant covalent molecules	• Consist or many non metal atoms joined by covalent bonds arranged in a regular repeating pattern. • High melting and boiling points due to lots of strong covalent bonds that need lots of energy to break.
Iconic compounds	• Formed when a metal reacts with a non metal. • Transfer of electrons from the metal atom to the non metal atom. • Forms a giant ionic lattice held together by electrostatic forces between the positive and negative ions. • High melting and boiling points due to strong electrostatic forces. • Can conduct electricity when molten or dissolved as ions are free to move.
Metallic bonding	Electrostatic attraction between positive metal ions in a sea of delocalised electrons.
Metal cations	Metal atoms lose electrons (oxidation) to form positive ions.
Non-Metal anions	Non metal atoms gain electrons (reduction) to form negative ions.

Polymers

Made up or many repeating units called monomers.

Monomer	Polymer
Ethene	Polyethene
Propene	Polypropene
Sugar	Carbohydrate
Amino acids	Protein
Nucleotides	DNA

Thermosetting polymers.
Chains joined by crosslinks.
Stops them sliding over each other making the polymer rigid.
Thermoplastic polymers.
Chains not joined and easy to separate.



Structure of metals