

Bonding – Notes

An element is a **pure substance** that's made up of only **one kind of atom**. It can't be separated into simpler substances.

A compound is a **pure substance** that's made up of **2 or more different elements** chemically combined.

A mixture is an **impure substance** made up of **2 or more pure substances**. Homogenous mixtures have a uniform composition whereas heterogenous mixtures have variable composition.

- Decantation:

Decantation is the pouring off of a liquid from a settled solid. It can be used to separate liquid from undissolved solid. Separation is **possible due to low solubility and density**.

Examples: Sand from water, heavy (dense) precipitate from solution and mercury from nitric acid solution.

- Filtration:

Filtration is the separation of undissolved solids from a liquid or solution using filters. It can be used to separate insoluble solids from soluble ones. Separation is **possible due to differences in solubility**.

Examples: Sand from sea water, charcoal from salt and calcium carbonate from sodium carbonate.

- Evaporation:

Evaporation is the recovery of a dissolved solid from a solution. By evaporating the solvent, we can recover the solute. Separation is **possible because the solute can't evaporate**.

- Crystallisation:

Crystallisation is the recovery of dissolved solids as pure crystals from a saturated solution. It's very useful for separating different soluble salts from solutions. Separation is **possible due to differences in solubility**.

Examples: Pure copper (II) sulfate crystals from solution, potassium nitrate from sodium chloride and table salt from baking soda.

- Simple distillation:

Simple distillation is the recovery of a liquid from solution by means of evaporation and condensation. Separation is **possible since dissolved solids can't evaporate**.

Examples: Pure water from sea water and pure water from ink.

- Fractional distillation:

Fractional distillation is the separation of 2 or more liquids from a mixture. A fractionating column is added to the distilling flask. Separation is **possible due to differences in the boiling point of the liquids**.

Examples: Alcohol from water and alcohol from wine.

Nanoparticles have very high surface area to volume ratios. This **markedly increases the interaction and bonding** which occurs between the atoms and particles in the material.

Metallic bonds:

Metallic bonds form **between metal atoms**. The delocalised valence electrons of these atoms are very mobile. Metallic bonds result from the electrostatic attraction between these delocalised valence electrons and the positively charged metallic ions.

Ionic bonds:

Ionic bonds form **between metal and non-metal atoms**. A transfer of electrons between these atoms creates positive and negative ions, each having an inert gas electron configuration. Ionic bonds result from the strong electrostatic attraction between these oppositely charged ions.

Covalent bonds:

Covalent bonds form **between non-metal atoms**. Electrons are shared in a common bond so that each atom can achieve an inert gas electron configuration. Covalent bonds result from the strong electrostatic attraction between the shared electrons and the protons of adjacent atoms.

Properties of ionic substances:

- High melting and boiling points:

Large amounts of energy are required to melt ionic solids. This energy is required to **overcome the strong electrostatic forces** between the oppositely charged ions.

- Brittleness:

Ionic solids are very hard, brittle and difficult to scratch due to the strong electrostatic forces. They aren't malleable because if layers of ions are forced to slide over each other, **repulsion occurs between like charges**.

- Good conductivity when molten or in aqueous solution:

Ionic solids can't conduct electricity since all the ions are in fixed positions and aren't free to move. When molten, however, the **ions are mobile and will conduct a current**.

Properties of metals:

- High electrical conductivity:

Since the **valence electrons** in metals are highly mobile, any applied voltage will cause a flow of charge.

- High thermal conductivity:

When a substance is heated, the particles vibrate more rapidly. In a metal lattice, the **delocalised valence electrons** readily transfer this energy as they move through the lattice.

- Malleable and ductile:

This is possible since metallic bonds **are non-directional and layers of positive ions can simply slip over each other**. The electrostatic forces between the positive metal ions and valence electrons still operate.

- High melting and boiling points:

The **strong electrostatic attraction** between the **positive metal nuclei** and the **delocalised valence electrons** means that a lot of energy is required to overcome these bonds.

Properties of covalent molecular substances:

- Can't conduct electricity:

This is because the **valence electrons** in covalent molecular substances **aren't mobile** and hence are unable to carry charge.

- Low melting and boiling points:

This is due to the relatively **weak intermolecular forces** between the molecules which don't require a lot of energy to overcome.

Properties of covalent network substances:

- Can't conduct electricity:

This is because the **valence electrons** in covalent network substances **aren't mobile** and hence are unable to carry charge.

- High melting and boiling points:

This is due to the strong electrostatic attraction between the **positive nuclei** and the **shared electrons in multiple bonds** which requires a lot of energy to overcome.

Graphite is made up of carbon atoms which are strongly covalently bonded in 2-dimensional layers. Within each layer there are **delocalised valence electrons** which are able to **conduct electricity**.