Chemical Bonding

Chemistry – Leaving Cert

Quick Notes

Chemical Bonding

A compound is a substance that is made up of two or more different elements chemically combined together. The octet rule states that when bonding occurs, atoms tend to reach an electron arrangement with eight electrons in the outermost shell. There are certain exceptions to this rule, however, for example elements near helium in the Periodic Table will tend to only have two electrons in their outermost shell. The valency of an element is the number of atoms it must lose, gain or share in order to achieve the Octet rule. An ionic bond is the force of attraction between oppositely charged ions on a compound, for example, the bond between sodium and chlorine to form sodium chloride is ionic. In all cases, the total number of electrons lost must be the same as that gained. Ionic compounds form crystal lattices, e.g. washing soda is an example of an ionic compound used to soften hard water. A transition element is one that forms at least one ion with a partially-filled d sub-level. Transition metals have certain properties- they exhibit variable valency, they form coloured compounds and they can behave as catalysts. A covalent bond is formed when two atoms share a pair of electrons e.g. hydrogen and chlorine form a covalent bond in order to produce hydrogen chloride. Covalent bonding can also be viewed in terms of overlap between orbitals. A sigma bond is formed by the head-on overlap of two orbitals. A pi bond is formed when two p orbitals overlap sideways. A pi bond is weaker than a sigma bond. Ionic bonds have high melting and boiling points and are usually solid at room temperature whereas covalent compounds usually have low melting and boiling points and are usually liquids or gases at room temperature. A bond pair is a pair of electrons that make up a covalent bond. A pair of electrons not involved in bonding is a lone pair. The total number of electron pairs around the central atom of the molecule determines the shape of the molecule. This is based on the Valence Shell Electron Pair repulsion Theory. For example, two bond pairs around a central atom will give a linear shape (180O), three bond pairs around the central atom will give a triangular planar shape (120O), four bond pairs – a tetrahedral shape (109.9O). On the other hand, three bond pairs and one lone pair will give a pyramidal shape, two bond pairs and two lone pairs will give a V shape. Electronegativity is the relative attraction that an atom in a molecule has for the shared pair of electrons in a covalent bond. Polar means there is an unequal sharing of electrons between molecules e.g. water is a polar molecule but tetrachloromethane is not a polar molecule. Polar molecules have permanent dipoles. The difference in electronegative values indicates the nature of the bond. A difference of zero indicates the bond is pure covalent, a difference of less than 1.7 indicates a polar covalent

bond and a difference of more than 1.7 indicates an ionic bond. Intramolecular forces are forces within a molecule that hold the molecule together e.g. covalent bonds. Intermolecular forces are forces that attract a molecule to neighbouring molecules (between molecules) e.g. Van Der Waals forces, permanent dipole-dipole interactions, hydrogen bonds. Van der waals forces are weak forces of attraction caused by temporary dipoles. Permanent dipole dipole attractions are relatively weak forces that attract polar molecules to each other. Hydrogen bonds are strong dipole-dipole attractions between molecules in which a hydrogen atom is bonded to oxygen, nitrogen or fluorine. Intermolecular bonding also has an effect on the boiling points of substances – the greater the strength of the forces between molecules the harder it would be to break these forces of attraction thus giving them higher boiling points. Intermolecular forces and polarity also affect why some substances dissolve in some liquids but not in others. 'Like dissolves like' meaning a charged or polar substance such as ammonia will dissolve in a polar liquid such as water.

Recrystallisation is a method used to purify solids where the substance to be purified is dissolved in a hot solvent and this hot solution is filtered to remove insoluble impurities. The melting point of the substance can then be determined by means of a capillary tube and aluminium block. These processes were carried out on benzoic acid.