



Fuels and Heats of Reaction

Chemistry – Leaving Cert

Quick Notes

Fuels and Heats of Reaction

Organic chemistry is the study of compounds of carbon. A hydrocarbon is a compound that contains only hydrogen and carbon e.g. coal, natural gas. A homologous series is a series of compounds of uniform chemical type, showing gradations in physical properties, having a general formula for its members, each member has a similar method of preparation and each member differs from the previous member by a (CH₂) unit. Alkanes are a family of hydrocarbons in which all the atoms are linked by single bonds. Methane is the simplest alkane and is formed by the decomposition of animal waste and vegetation. It is a 'greenhouse gas'. The alkenes are another homologous series of hydrocarbons. The alkenes contain a carbon-carbon double bond between two of the carbon atoms in the molecule, meaning they are unsaturated. Ethene is prepared using ethanol soaked in glass wool and aluminium oxide which acts as a dehydrating agent and a catalyst. Physical properties of ethene are colourless gas, sweetish smell, insoluble in water but soluble in organic solvents. Chemical properties are that it burns with a luminous flame, it turns bromine water from yellow/red to colourless and it turns acidified KMnO₄ from purple to colourless. The alkynes form another homologous series with a carbon-carbon triple bond between two of the carbon atoms in the molecule. Ethyne is an alkyne used in oxyacetylene welding and cutting. Ethyne is prepared using calcium carbide and the impure ethyne is then bubbled through acidified copper sulfate solution to remove gases such as phosphine and ammonia. Physical properties of ethyne are that it is a colourless gas, has a sweetish smell, it is insoluble in water but soluble in organic solvents. Chemical properties are that it burns with a luminous smoky flame, it turns bromine water from yellow/red to colourless and it turns acidified KMnO₄ from purple to colourless. An aliphatic compound is an organic compound that consists of open chains of carbon atoms and closed chain compounds that resemble them in chemical properties. Aromatic compounds contain a benzene ring structure in their molecules e.g. methylbenzene. Fractional distillation is a large-scale, continuous process which separates crude oil into a number of useful mixtures called fractions e.g. refinery gas is a fraction that can be used as a domestic gas. Mercaptans are chemicals added to odourless gases to give them an unpleasant smell so that gas leaks can be detected. Auto-ignition is the early explosion of the petrol-air mixture in an internal combustion engine. This early explosion causes knocking in the engine and loss of power. The octane number is a measure of the tendency of the fuel to resist knocking. 2,2,4-trimethylpentane is assigned an octane number of 100, heptane is assigned an octane number of 0. The shorter

the alkane chain, the more branched the chain and cyclic compounds all lead to higher octane numbers. Four methods commonly used to increase the octane number of petrol are – isomerisation, catalytic cracking, reforming or adding oxygenates. The two ways of manufacturing hydrogen are steam reforming of natural gas and electrolysis of water. An exothermic reaction is one that produces heat indicated by a negative ΔH . An endothermic reaction takes in heat, indicated by a positive ΔH . Heat of reaction is the heat change when the number of moles indicated in the balanced equation for the reaction react completely. The heat of combustion of a substance is the heat change when one mole of the substance is completely burned in excess oxygen, measured using a bomb calorimeter. Whereas the kilogram calorific value of a fuel is the heat change produced when 1kg of the fuel is completely burned in oxygen. Bond energy is the energy required to break one mole of covalent bonds and to separate the neutral atoms completely from each other. To determine the heat of reaction or heat of neutralisation of hydrochloric acid with sodium hydroxide, the following equation is used: $m \times c \times (t_2 - t_1)$ where m is the mass of the solution in kg, c is the specific heat capacity of the solution and $t_2 - t_1$ is the temperature rise. The heat of formation of a compound is the heat change that takes place when one mole of a compound in its standard state is formed from its elements in their standard states. The standard state of an element or compound is its normal form at 25°C and at one atmosphere pressure. Hess's law states that if a chemical reaction takes place in a number of stages, the sum of the heat changes in the separate stages is equal to the heat changes if the reaction is carried out in one stage. This law may be used to calculate the heat of formation of a compound using other heats of formation and one heat of reaction. It may also be used to calculate the heat of reaction using heats of formation of reactants and products.