

Alkanes, alkenes and aromatic compounds

The principal sources of alkanes are *natural gas and petroleum*. Natural gas contains mainly methane, with smaller amounts of the other gaseous alkanes, such as ethane, propane and butane. Petroleum contains a wide range of alkanes.

The uses of petroleum, both *as a fuel and as a source of chemicals*, are of outstanding importance. *Natural gas* is by far the most important source of methane.

Alkanes were once known as the ‘paraffins’, *from the Latin words ‘parum’ (little) and ‘affinitas’ (affinity)*. Hence there are only a few reactions of alkanes, but these are of great importance. The combustion products of alkanes are *carbon dioxide and water*, if the oxygen supply is plentiful. If the oxygen supply is limited, *the products may include carbon monoxide and carbon*.

The combustion of hydrocarbons in general and alkanes in particular is of immense importance, *for it occurs in power stations, furnaces, domestic heaters, candles, gas heaters, internal combustion engines and many other devices essential to a technological society*.

When alkanes are heated to high temperatures, their molecules vibrate strongly enough to break bonds and form smaller molecules, one of which is an alkene. Such reactions are known as ‘cracking’. By using a catalyst, cracking can be made to occur at fairly low temperatures. This is known as ‘catalytic cracking’. Cracking is very important in the petroleum industry. It is used to provide extra gasoline and as a source of alkenes. *Ethene and propene* are the first two members of the homologous series of alkenes. All members of this series contain a double carbon-carbon bond. They therefore have two atoms of hydrogen less than

the corresponding alkane. *Because they contain less than the maximum amount of hydrogen*, they are said to be unsaturated. The melting points and boiling points of the alkenes are very close to those of the alkanes. Ethene, propene and the butanes are gases at room temperature, and the higher members are liquids.

What do PVC raincoats and antifreeze have in common? Or polythene bottles and adhesives? Like many other things in everyday use, they are made from ethene, the simplest alkene and the most versatile organic compound in use today. *Ethene can be used as building block to prepare complex organic molecules*. Propene is used in a similar way. The necessary large quantities of these alkenes are manufactured *by cracking processes*.

The simplest and most important member of the aromatic hydrocarbons is *benzene*. The name ‘aromatic’ was originally used *because some derivatives of these hydrocarbons have pleasant smells*. It is now known that just as many of them smell unpleasant, and in any case many of the aromatic vapours are toxic, so it is unwise to smell them. The name aromatic has been retained to indicate certain chemical characteristics rather than odorous properties.

Benzene is a colourless liquid with a characteristic odour. It is insoluble in water but soluble in all organic solvents, and it is itself a very good solvent for organic compounds. It freezes at 5 °C and boils at 80 °C. *Both the liquid and the vapour are highly poisonous*, so that benzene must be used with care. Detergents, polystyrene, nylon and insecticides can all be made from benzene. In the past, *benzene was produced as a by-product of the destructive distillation of coal*.

1 Ask questions about the phrases in italics in the passage Alkanes, alkenes and aromatic hydrocarbons.

2 Use these words to complete the review of hydrocarbons below: ability, air, bonds, chains, covalent, electrons, ethene, families, fuels, homologous, hydrogen, important, isomers, saturated, unsaturated.

Hydrocarbons are compounds that are made from the elements (1) and carbon. They are all (2) compounds. Carbon has four (3) in its outer shell. A carbon atom always has four covalent (4) linking it with other atoms.

There is a very large number of organic compounds because of the (5) of carbon atoms to form covalent bonds with other carbon atoms and so form (6)

Within the hydrocarbon group, compounds are divided into even smaller groups called (7) series. The simplest of these is called the alkanes, often called (8) compounds. The names of the alkanes are very (9) because the names of all other organic compounds are based on them. Alkanes are useful (10) They burn easily in (11) to form carbon dioxide and water.

There are several other (12) of hydrocarbons, the alkenes being the most important. The simplest member of the alkene family is (13) All the alkenes contain a double bond between two carbon atoms. A hydrocarbon that contains a multiple bond between two carbon atoms is said to be (14) When the length of the carbon chain in the hydrocarbons is greater than three, it is possible to have compounds with the same formula but different structures called (15)