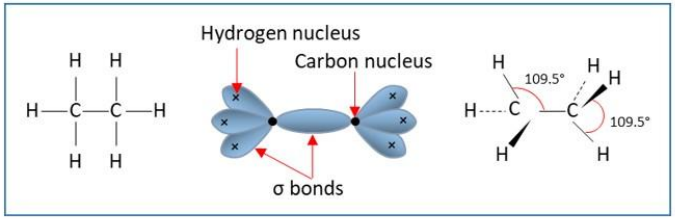
Alkanes



The modified p-orbitals overlap linearly to form covalent bonds called **σ bonds** (C-C) .
H-C-H bond angle is **109.5°**.
A carbon atom and three hydrogen atoms are bonded together to form a **tetrahedral** shape.

The **bond enthalpies** of C—C bonds and C—H bonds are quite **high**, which makes it difficult to break.
C—C bonds are **non-polar**. C—H bonds are very weakly polar. Due to this, the bonds are **difficult to break** and this makes alkanes unreactive except towards **free radicals**.

Bonding in organic molecules

Example: Bonding in ethane

General formulae: $(C_nH_{(2n+2)})$

The boiling point of an alkane homologous series **increases** due to increase in the number of electrons and increase in the size of induced dipole-dipole interactions (London forces) between the molecules.

Reactivity of alkanes

Fractional distillation is the continual evaporation and condensation of a mixture causing the components to separate because of a difference in their boiling points.
Cracking: The process of breaking longer hydrocarbons to smaller hydrocarbons.

Reaction of alkanes with halogens

$$CH_4 + Cl_2 \xrightarrow{sunlight} CH_3Cl + HCl$$

Initiation step:

$$Cl_2 \xrightarrow{sunlight} Cl\cdot + Cl\cdot$$

Propagation steps

$CH_4 + Cl\cdot \rightarrow \cdot CH_3 + HCl$

$\cdot CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\cdot$

Termination step:

$\cdot CH_3 + Cl\cdot \rightarrow CH_3Cl$

$\cdot CH_3 + \cdot CH_3 \rightarrow C_2H_6$

Fractional Distillation of crude oil

Combustion of alkanes and pollutants

Complete combustion: alkane + O_2 → CO_2 + H_2O
Incomplete combustion: alkane + O_2 → CO + H_2O
Pollutants: CO_2 (g), CO(g), C (s), SO_2(g), NOx(g) & unburnt hydrocarbons
CaO neutralises acidic SO_2(g)
Catalytic converters convert pollutants in exhaust to harmless carbon dioxide, nitrogen and water.

	Thermal cracking	Catalytic cracking
Conditions	High pressure (70 atm) and high temperature (1000-1200 K)	Moderate pressure (1-2 atm), temperature of 800-1000 K and zeolite catalyst
Products	Higher percentage of alkenes	Branched and cyclic hydrocarbons
Applications	Ethene is used for making polymers and ethanol	Motor fuels