

## 15 Hydrocarbons

### Alkanes

#### Chemical Reactivity

Alkanes do not react with many reagents.

This is because the C-C bond and the C-H bond are relatively strong and so cannot form stronger bonds with other elements that easily and there are no polar side groups.

Their main reactions are combustion reactions in air although they can react with halogens in the presence of UV light.

#### Combustion

##### Complete Combustion

In excess oxygen alkanes will burn with complete combustion.

The products of **complete** combustion are  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .



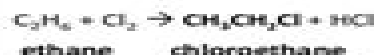
Alkanes readily burn in the presence of oxygen. This combustion of alkanes is highly exothermic, explaining their use as **fuels**.

#### Reaction of alkanes with bromine / chlorine in UV light

##### Synthesis of chloroalkanes

In the presence of **UV light** alkanes react with chlorine to form a mixture of products with the halogens substituting hydrogen atoms.

##### Overall Reaction



*This is the overall reaction, but a more complex mixture of products is actually formed.*

*To understand this reaction fully we must look in detail at how it proceeds step by step. This is called its **mechanism**.*

The **MECHANISM** for this reaction is called a **FREE RADICAL SUBSTITUTION**.

It proceeds via a series of steps:  
**STEP ONE: Initiation**  
**STEP TWO: Propagation**  
**STEP THREE: Termination**

##### STEP ONE Initiation

Essential condition: UV light



The UV light supplies the energy to break the Cl-Cl bond. It is broken in preference to the others as it is the weakest.

The bond has broken in a process called **homolytic fission**.

*each atom gets **one** electron from the covalent bond*

When a bond breaks by homolytic fission it forms **Free Radicals**.

**Free Radicals** do not have a charge and are represented by a



##### DEFINITION

A **Free Radical** is a reactive species which possess an **unpaired electron**.

##### STEP TWO Propagation



The chlorine free radicals are very reactive and remove an H from the methane leaving a methyl free radical

The methyl free radical reacts with a  $\text{Cl}_2$  molecule to produce the main product and another Cl free radical

All propagation steps have a **free radical** in the **reactants** and in the **products**.

As the Cl free radical is regenerated, it can react with several more alkane molecules in a **CHAIN REACTION**.

# Hydrocarbons Chemistry Study Guide Answers

**JS Bruner**



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