

14 Alkanes – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)		
alkanes	_____	_____	_____
complete combustion	_____	_____	_____
incomplete combustion	_____	_____	_____
carbon monoxide	_____	_____	_____
ultraviolet light	_____	_____	_____
free-radical substitution	_____	_____	_____
initiation	_____	_____	_____
propagation	_____	_____	_____
termination	_____	_____	_____
polarity	_____	_____	_____

Recall

At IGCSE you learned that **alkanes** are saturated hydrocarbons that **burn** as fuels. Now we look at their combustion and their one important reaction with halogens.

- Alkanes have only single bonds (general formula C_nH_{2n+2}).
- They are fairly **unreactive** because their bonds are strong and non-polar.

Nothing here is harder than IGCSE – it just adds a mechanism.

New ideas

Read these first, then do the Practice.

■ 1 Combustion

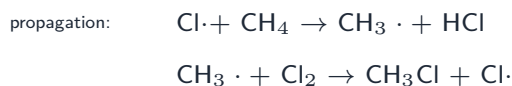
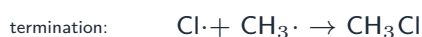
- **complete combustion** (plenty of oxygen) $\rightarrow$ carbon dioxide + water.
- **incomplete combustion** (too little oxygen) $\rightarrow$ water + toxic **carbon monoxide** (CO) + soot.



■ 2 Free-radical substitution

Alkanes react with chlorine (or bromine) in **ultraviolet light** by **free-radical substitution**, in three steps:

- **initiation** – UV splits the halogen into **radicals**: $\text{Cl}_2 \rightarrow 2 \text{Cl}\cdot$
- **propagation** – radicals react and make new radicals: $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{CH}_3\cdot + \text{HCl}$, then $\text{CH}_3\cdot + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$
- **termination** – two radicals join, ending the chain.



■ 3 Why alkanes are unreactive

Their C–H and C–C bonds are strong and have little **polarity**, so there is no charge to attract an attacking species.

Watch out: free-radical substitution needs UV light and gives a *mixture* of products (mono-, di-, tri-substituted). The dot in $\text{Cl}\cdot$ marks an unpaired electron – a radical, not an ion.

Practice

Try these in order.

14.1 Give the general formula of the alkanes. [1]

14.2 Name the products of (a) complete, (b) incomplete combustion of an alkane. [2]

14.3 Why is carbon monoxide dangerous? (one reason) [1]

14.4 Name the three steps of free-radical substitution, in order. [3]

14.5 Write the initiation step for the reaction of chlorine in UV light. [1]

14.6 Explain why alkanes are unreactive towards polar reagents. [2]

14.7 Challenge. When methane reacts with chlorine in UV light, the product is a mixture, not just chloromethane. Explain why. [2]
