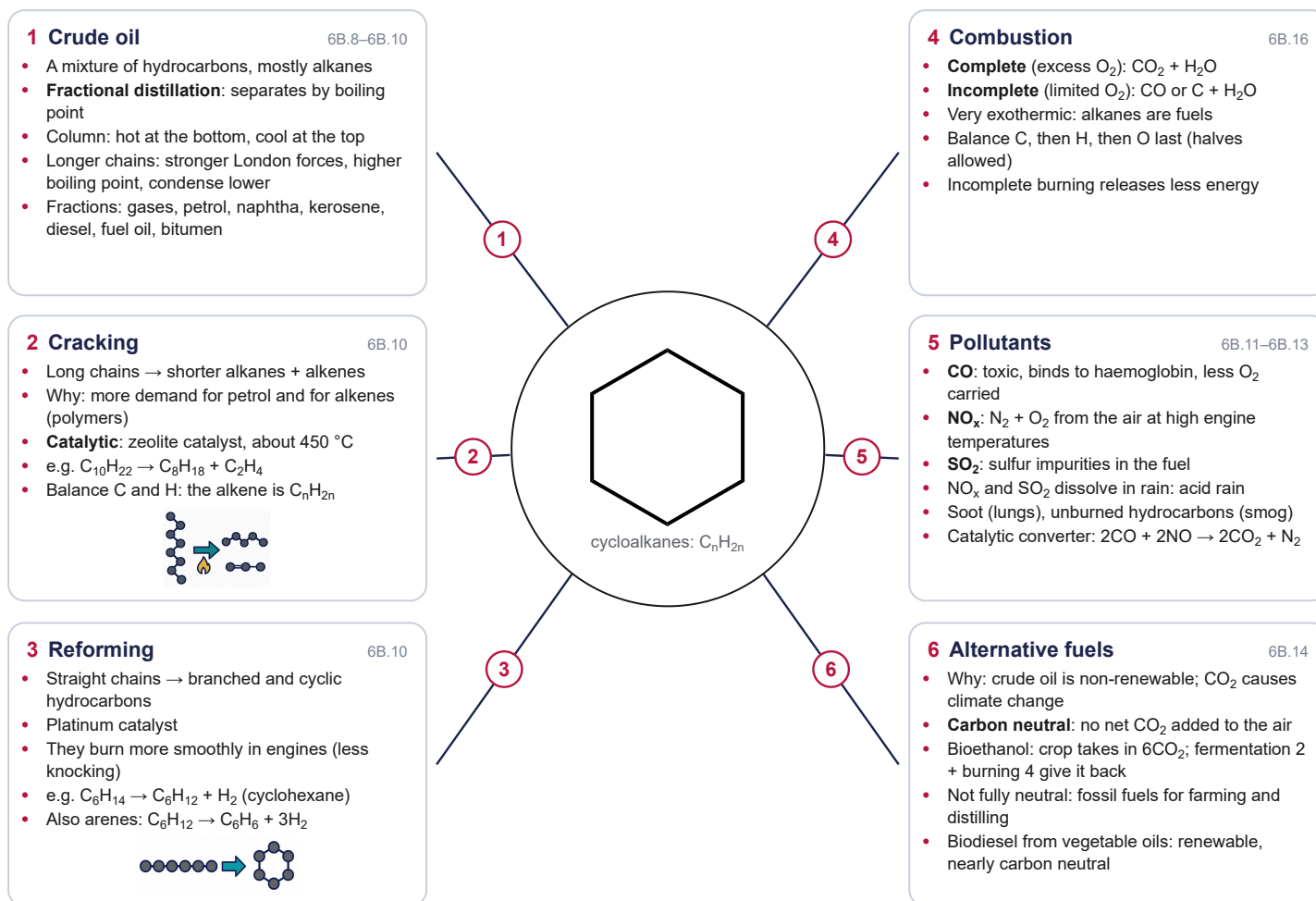


Alkanes Summary Map

Edexcel A Level Chemistry · Topic 6B



Free radical substitution: methane and chlorine

UV light; a dot marks the unpaired electron ($Cl\cdot$, $\cdot CH_3$)

Stage	What happens	Equation
initiation	UV light breaks $Cl-Cl$ (homolytic fission)	$Cl_2 \rightarrow 2Cl\cdot$
propagation 1	$Cl\cdot$ takes an H atom	$Cl\cdot + CH_4 \rightarrow HCl + \cdot CH_3$
propagation 2	$\cdot CH_3$ takes a Cl atom; $Cl\cdot$ is remade	$\cdot CH_3 + Cl_2 \rightarrow CH_3Cl + Cl\cdot$
termination	two radicals pair their electrons	$Cl\cdot + Cl\cdot \rightarrow Cl_2$; $\cdot CH_3 + Cl\cdot \rightarrow CH_3Cl$; $2\cdot CH_3 \rightarrow C_2H_6$
overall	Cl replaces H: substitution	$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
further substitution	the products are attacked too	$CH_3Cl \rightarrow CH_2Cl_2 \rightarrow CHCl_3 \rightarrow CCl_4$

Worked examples

Limited use in synthesis

- Further substitution: a mixture of products
- Larger alkanes: isomers (1- and 2-chloropropane)
- Must be separated; low yield of any one product
- Excess alkane: mostly the monosubstituted product

Balancing: a worked example

- Octane, complete: $C_8H_{18} + O_2 \rightarrow 8CO_2 + 9H_2O$
- O atoms: $16 + 9 = 25$
- $\rightarrow C_8H_{18} + 12\frac{1}{2}O_2 \rightarrow 8CO_2 + 9H_2O$
- To CO: $C_8H_{18} + 8\frac{1}{2}O_2 \rightarrow 8CO + 9H_2O$

Fuels compared

- Petrol:** non-renewable; all its CO_2 is extra
- Bioethanol:** renewable; nearly carbon neutral
- Biodiesel:** renewable; needs farmland
- Always ask where the carbon came from

Ethane among the products of chlorinating methane is evidence for methyl radicals ($2\cdot CH_3 \rightarrow C_2H_6$).

