Hydrocarbons

Q-1) What are alkanes?

→ Alkanes are saturated hydrocarbons (single C-C bonds).

→ As the no. of C increases, the no. of e^- increases, ∴ VVF increases ∴ melting + boiling point increases.

→ As the surface area increases, VVF increases ∴ MP + BP increase; as branching increases (isomers), MP + BP decreases.

→ Alkanes are generally unreactive because they are non-polar and don't have a great difference in electronegativity. (∴ they don't dissolve in water)

Q-2) Combustion / oxidation of alkanes.

alkane + oxygen ⟶ carbon-dioxide + water

↓

incomplete combustion releases carbon-monoxide.

Q-3) Substitution / halogenation of alkanes.

> H-atom in the alkane is replaced by a halogen.

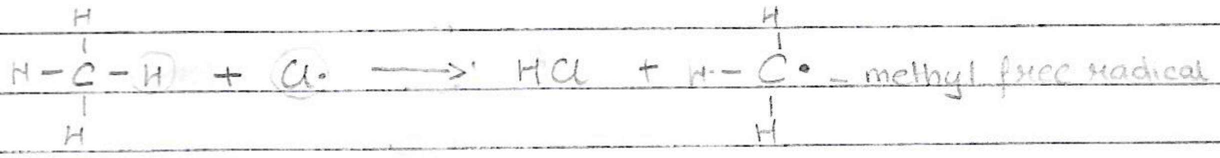
① Initiation.

Breaking of Cl-Cl bond to form free-radicals (in presence of UV-light); homolytic fission.

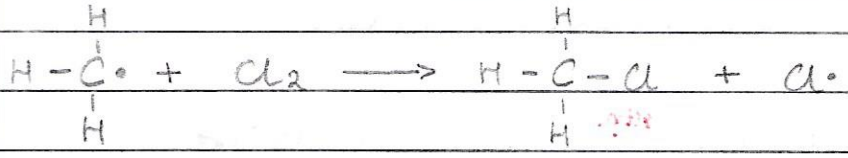
$$Cl-Cl \xrightarrow{\text{U.V. light}} Cl\bullet + Cl\bullet$$

② Propagation

Free radicals are v. reactive + will attack the alkanes.



$$CH_4 + Cl\bullet \longrightarrow HCl + \bullet CH_3$$



$$H_3C\cdot + Cl_2 \longrightarrow H_3C-Cl + Cl\cdot$$

③ Termination

2 free-radicals will react to porm a single product

$Cl\cdot + Cl\cdot \longrightarrow Cl_2$

$CH_3\cdot + CH_3\cdot \longrightarrow C_2H_6$

$CH_3\cdot + Cl\cdot \longrightarrow CH_3Cl$

Q-4) Cracking of alkanes

→ Breaking of high Mr alkane into smaller alkane + alkenes.

Thermal cracking - heat

800 - 900°c

Catalytic cracking

Δ 500 - 600°c , SiO_2 or Al_2O_3 catalyst

eg: $C_8H_{18} \xrightarrow[600°c]{\Delta Al_2O_3} C_6H_{14} + C_2H_4$

Q-5) What are alkenes?

→ Alkenes are unsaturated hydrocarbons (c=c double bonds)

→ They are formed by the cracking of alkanes.

Q-6) Addition of hydrogen / hydrogenation of alkenes.

alkene + hydrogen $\xrightarrow[140°c]{\text{Nickel catalyst}}$ alkane

↳ used to convert fats to margarine.

Q-7) Addition of steam to alkenes.

alkene + steam $\xrightarrow[H_3PO_4 \text{ catalyst}]{6mPa,\ 330°c}$ alcohol

↳ conc. phosphoric acid.

Q-8) Addition of hydrogen halides (Hx) to alkenes.

alkene + Hx $\xrightarrow{rtp.}$ halogenoalkane

The x (halogen) attaches to a C with a double bond.

* When 2 products are formed, the major product is the one which has the halogen atom bonded to a carbon with the least no. of hydrogens.

Q-9) Addition of halogens (x_2) to alkenes.

alkene + ~~hag~~ halogen ⟶ dihaloalkane

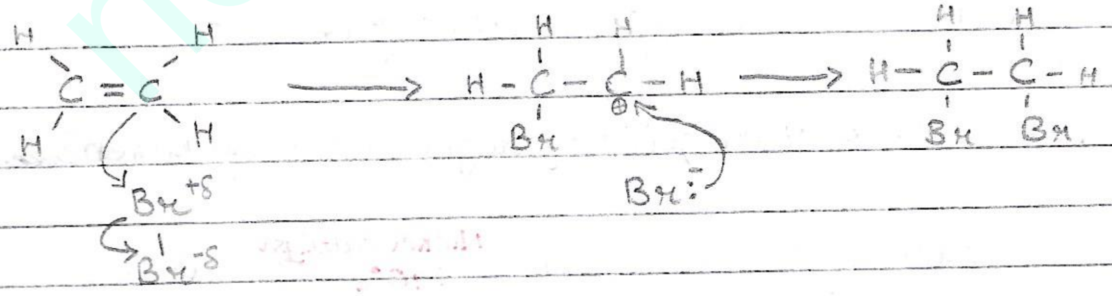
↳ used for test for alkene.

↳ If Br_2 water decolourises, alkene is present.

Mechanism of electrophillic addition.

Electrophiles are e^- loving ; e^- deficient species (+ charged).

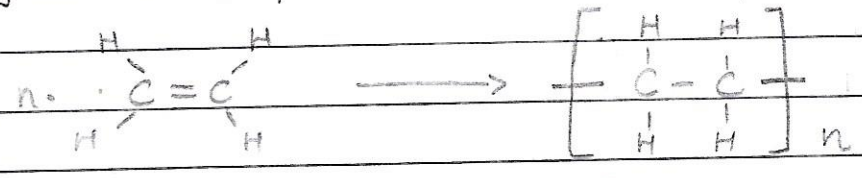
① As the halogen approaches the alkene, high density e^- cloud around the C=C double bond repels a pair of e^- away from the closer halogen, making + * - charged halogen.



② As the new bond between Cx forms, the bond between the x_2 breaks heterolytically.

③ The x^- ion then attacks the carbocation.

Q-10) Polymerisation of alkenes. - addition polymerisation



↳ used to make polyethene / polythene

* LDPE (low density polyethene)

↳ bin bags.

* HDPE (high density polyethene)

↳ detergent bottles, milk jugs.

Q-11) Oxidation of alkenes.

↳ Oxidation with manganate (VII) ions.

~~AA~~ MnO_4^- / $KMnO_4$.

① oxidation with cold dilute acidified MnO_4^-

$\text{alkene} + [O] + H_2O \xrightarrow{MnO_4^-} \text{alkane-}\underset{\text{2-OH groups.}}{\underline{\text{diol}}}$

② oxidation with hot concentrated acidified MnO_4^-

$CH_2=CH_2 + [O] \xrightarrow{MnO_4^-} 2CO_2 + H_2O$ C attached to H, CO_2 & H_2O formed

$CH_3-CH=CH_2 + [O] \xrightarrow{MnO_4^-} CH_3\text{-}COOH + CO_2 + H_2O$

C attached to an alkyl (R) & H, R-COOH formed

$CH_3-CH_2-CH=\underset{CH_3}{\underset{|}{C}}-CH_3 + [O] \xrightarrow{MnO_4^-} CH_3-CH_2-COOH + CH_3-\underset{O}{\underset{||}{C}}-CH_3$

C attached to only R-groups, ketone ($R-\underset{O}{\underset{||}{C}}-R'$) formed.