

Alkane

- General Formula for Alkanes is C_nH_{2n+2}
- **Saturated** hydrocarbon with single bonds
- Alkanes are relatively unreactive as
 - o They are non-polar, they have no point of electron-rich sites or electron-deficient sites
 - o The C-C and C-H single bonds are relatively strong.

Chemical Reactions of Alkanes

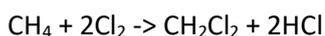
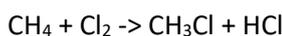
Combustion

- Burn in excess O_2 to produce CO_2 and H_2O
- Note: Incomplete combustion would produce CO and soot
- E.g. $C_2H_6 + 7/2 O_2 \rightarrow 2CO_2 + 3H_2O$
- Note: Do balance the equation properly

Substitution (Free Radical Substitution)

- Reaction where H atom of an organic molecule is replaced by atom of Br or Cl
- Catalysed by UV light/Sunlight
- Chain reaction that leads to a mixture of products

E.g. of reactions



Cracking of Alkanes

Process where hydrocarbons of high molecular mass are broken down into hydrocarbon of lower molecular mass.

Gives mixture of products under different conditions e.g. Temperature and Catalyst

Reagent and Condition: Al_2O_3 catalyst, $600^\circ C$

Importance of Cracking

1. Meet higher demand for shorter hydrocarbons
 - E.g. High grade Octane for motor vehicles
 - o $C_{18}H_{38} \rightarrow C_8H_{18} + C_{10}H_{20}$
2. Short Chain Alkenes e.g. Ethene for making ethanol and plastics
 - a. $C_{18}H_{38} \rightarrow C_6H_{14} + C_2H_4$
3. H_2 gas for the manufacture of Ammonia in the Haber Process
 - a. $C_{18}H_{38} \rightarrow C_8H_{16} + C_{10}H_{20} + H_2$

Alkene

1. General Formula is C_nH_{2n}
2. Unsaturated Hydrocarbon containing C=C double bond
3. More reactive than Alkane as have C=C double bond that is electron-rich, can undergo **addition** reactions

Chemical Reactions of Alkenes

Combustion

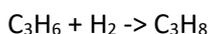
Same reaction as combustion of Alkanes, refer there

Addition Reaction

Reaction where 2 or more molecules join together to form a single molecule, the molecule XY **add across** the C=C or carbon-carbon triple bond

Hydrogenation (Addition of Hydrogen)

Reagent and Condition: H_2 gas, $200^\circ C$, Ni as catalyst



Penta-1,4-diene

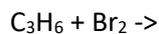
Bromination

- Takes place even in the dark
- **Test for Unsaturation** (used to differentiate btwn alkenes and alkanes)
- Bubble gaseous alkene/shake liquid alkene with liquid bromine in the absence of sunlight/UV light
- Observation: Immediate/Rapid decolourisation of **red-brown** bromine to give a colourless compound.

OR

Bubble gaseous alkene/shake liquid alkene with aqueous Bromine

- Observation: Rapid decolourisation of Bromine water from **orange** to colourless if mixed with alkene
 - a. If mixed with alkane, Bromine water remains orange.



Penta-1,4-diene

Note: Each mole of double bond in alkene absorbs one mole of Hydrogen during hydrogenation. Hence, the no. of moles of H_2 absorbed indicates the no. of C=C in alkene.

Hydration (Addition of Water)

Reagent and Condition: Steam, 300°C, 60 atm,
concentrated H_3PO_4 as catalyst

Hydration of Propene:

Addition Polymerisation

Reagent and Condition: High Pressure

Ethene polymerises to form poly(ethene) which is
used as plastic bags/films