Alkane

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

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

$CH_4 + 2Cl_2 \rightarrow CH_2Cl_2 + 2HCl$

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

<u>Reagent and Condition</u>: Al_2O_3 catalyst, 600°C

Importance of Cracking

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

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^oC, Ni as catalyst

$C_3H_6 + H_2 \rightarrow C_3H_8$

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.

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.

$C_3H_6 + Br_2 \rightarrow$

Penta-1,4-diene

Hydration (Addition of Water)

Reagent and Condition: Steam, 300^{o}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