WJEC AS Organic Chem

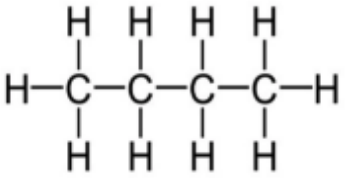
SYNOPTIC 2.4-2.8

IGC HK Exam

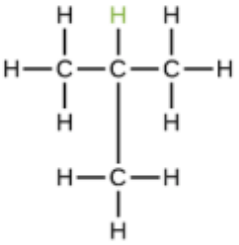
Isomers

Structural Isomer

Chain: Straight / Branch

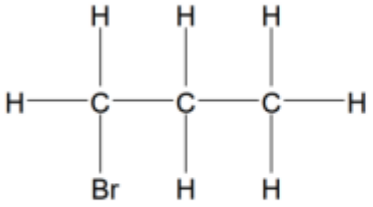


butane

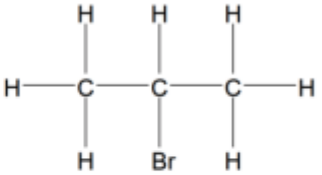


methylpropane

Positional: Functional Group is in different position

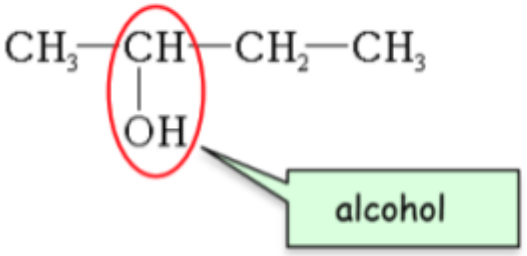


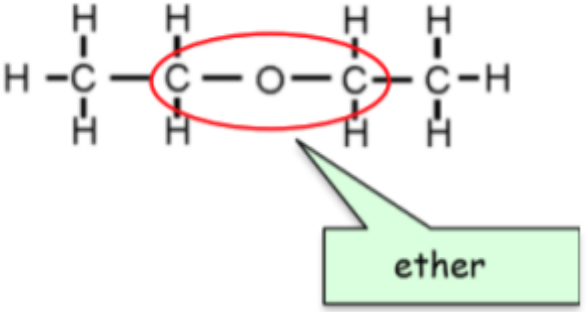
1-bromopropane



2-bromopropane

Functional Group: Different functional groups (eg: alcohol and ether)



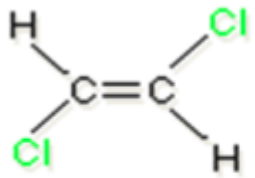


Geometric Isomer

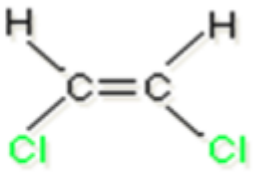
"These are two different groups attached to each carbon atom on either side of the double bond. **There is no rotation around a double bond**"

Cis-Trans Notation

Cis - Adjacent
Trans - Across



trans-1,2-dichloroethene



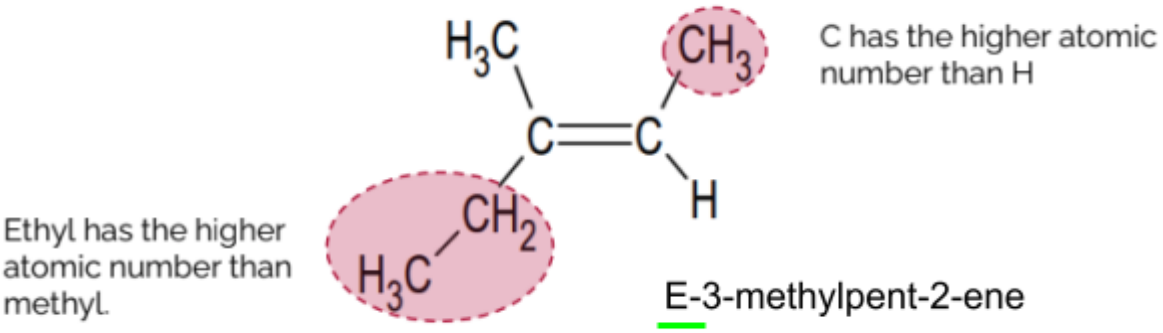
cis-1,2-dichloroethene

E-Z Notation

Higher atomic number higher priority, look at highest atomic number when it is same
Z - (Z)ame Side
E - Opposite Side

Z 1-bromo-2-chloro-1-fluoroethene

E 1-bromo-2-chloro-1-fluoroethene



E-3-methylpent-2-ene

Alkane

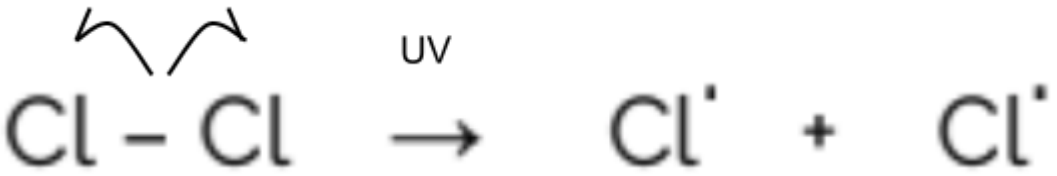
Free Radical Substitution

Initiation

Condition

- UV Light
- Vapour Phase Reaction

Homolytic Fission



Propagation

A radical attacking alkane forming another radical

1. $CH_4 + Cl\cdot \rightarrow \cdot CH_3 + HCl$

2. $\cdot CH_3 + Cl_2 \rightarrow CH_3Cl + \cdot Cl$

Termination

Two free radicals collide which brings to an end of reaction.

$Cl\cdot + Cl\cdot \rightarrow Cl_2$

$\cdot CH_3 + Cl\cdot \rightarrow CH_3Cl$

$\cdot CH_3 + \cdot CH_3 \rightarrow CH_3CH_3$

Alkene

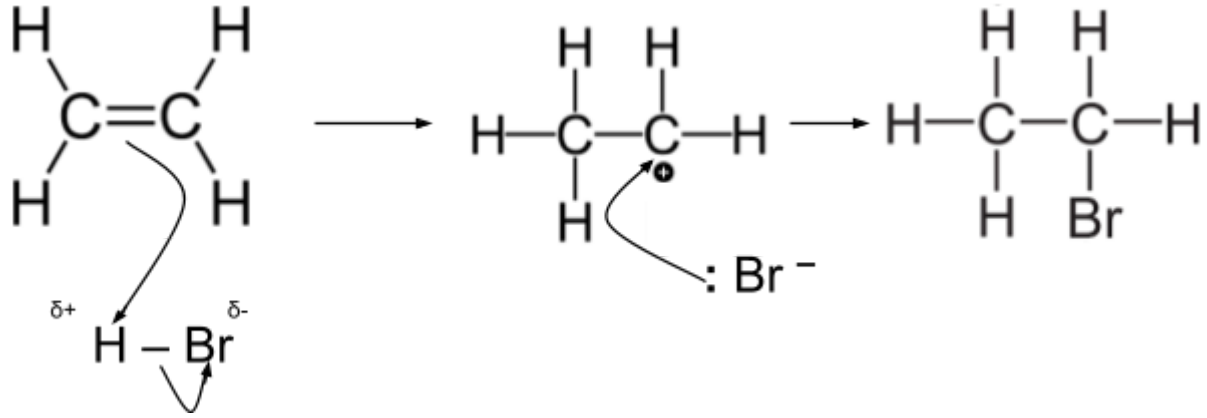
Electrophilic Addition

Electrophile Example

- Br_2
- H-Br

Condition

- Room temperature
- <u>Bromine in a nonpolar solvent</u>



Hydrogenation

Adds H_2 to the C=C double bond

Condition

- Catalyst: Nickel
- Temperature: 100^{o}C
- Pressure: 3-5 atm

Margarine

Hydrogenation of fats

Halogenoalkane

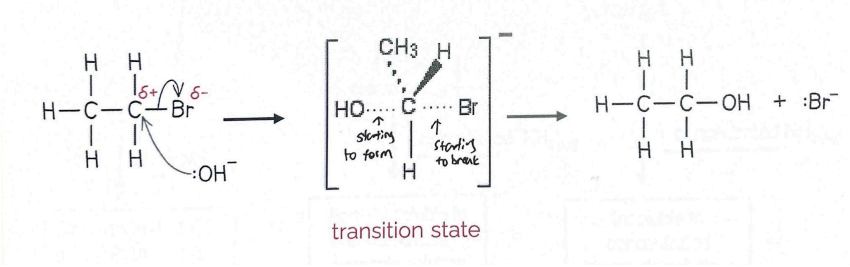
(S_{N2}) Nucleophilic Substitution

Nucleophiles: $:OH^-$ (most common) $:NH_3$ $:CN^-$

Reaction with NaOH

Conditions

- Aqueous NaOH solution
- Reflux
- Propanone as a mutual solvent

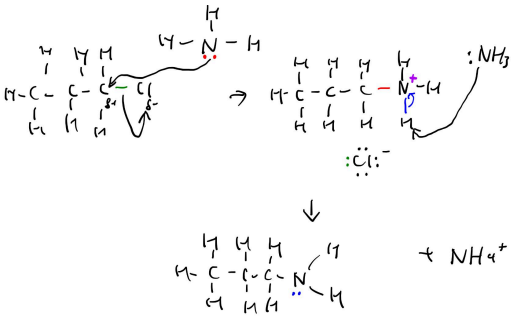


Reaction with KCN

Conditions

- Alcoholic KCN solution
- Reflux

Reaction with Ammonia



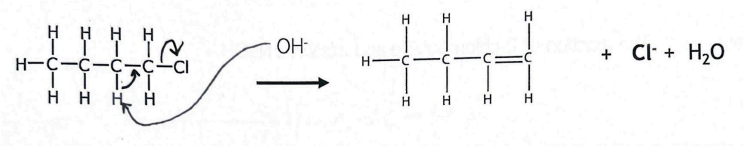
Conditions

- Concentrated alcoholic ammonia solution
- Heated under pressure in a sealed tube

(E_2) Elimination Reaction

Conditions

- **NaOH in ethanol solvent**
- Reflux (Heat)



OH^- ion act as a base not a nucleophile

The C adjacent to the C-X must have a H attached for the H-X to be eliminated

Alcohol

Preparation of Alcohols

Direct Hydration (From Alkene to Alcohol)

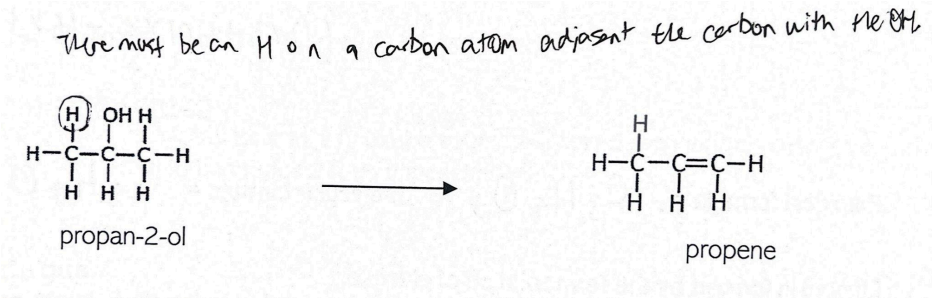
Condition

- Phosphoric acid on silica gel catalyst
- 300°C
- 60-70 atm

Dehydration Alcohol to Alkenes (Elimination)

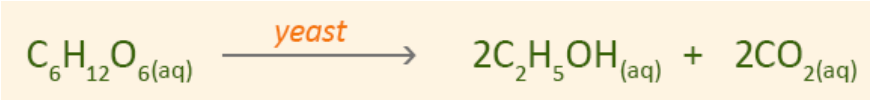
Condition

- Concentrated H_2SO_4 (dehydration agent + catalyst)
- Heat to 180°C

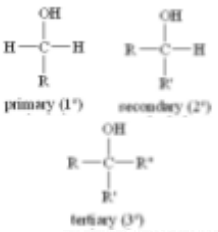


Manufacture of Ethanol from Ethene by Fermentation (Batch Process)

- No air (anaerobic condition)
- Kept under body temperature (25-40°C)
- Catalyst: Yeast / Zymase



Oxidation of Alcohols

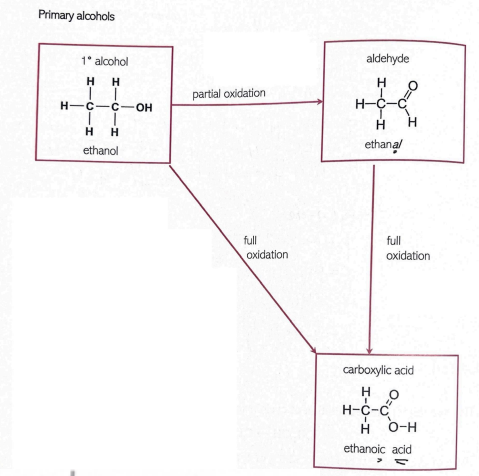


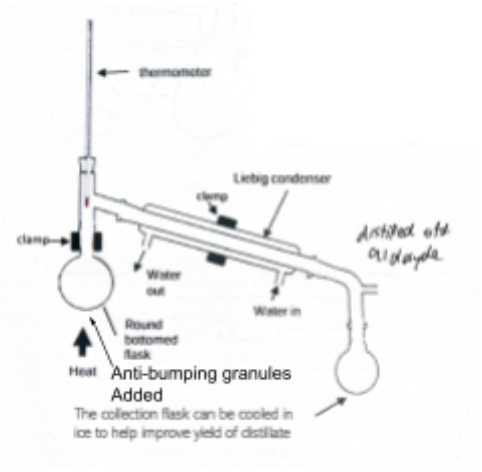
Condition

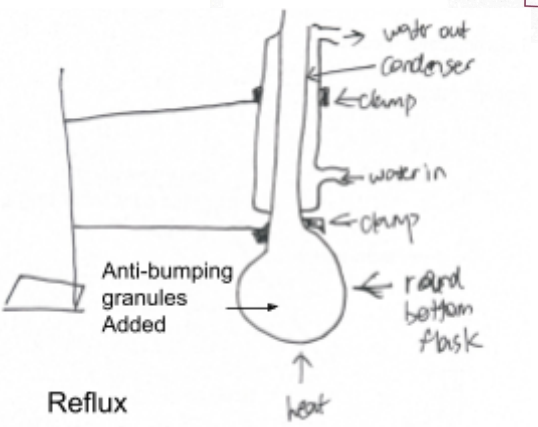
- Acidified Potassium Dichromate
- Concentrated Sulphuric Acid (Dehydrating Agent)

Primary Alcohol

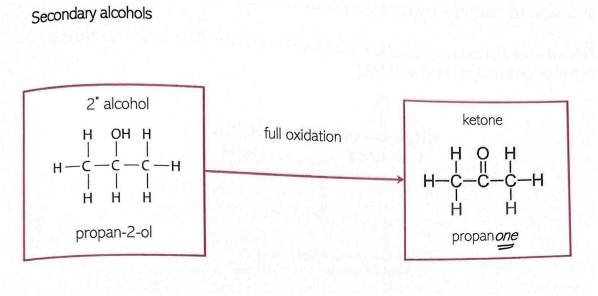
1. Partial Oxidation
- Distill out the aldehyde as it forms to prevent further oxidation to carboxylic acid
- Excess alcohol
2. Full oxidation
- Reflux
- Excess oxidising agent to ensure maximum yield of carboxylic acid







Secondary Alcohol



Condition

- Potassium Dichromate
- Conc Sulphuric Acid
- Reflux

Tertiary Alcohol

NO Reaction
As it would require breaking of C-C bond

Reaction of Carboxylic Acid

With Magnesium

$2CH_3COOH_{(aq)} + Mg_{(s)} \rightarrow (CH_3COO^-)_2Mg^{2+} + H_{2(g)}$

With Sodium Hydroxide

$CH_3COOH_{(aq)} + NaOH_{(aq)} \rightarrow CH_3COO^-Na^+_{(aq)} + H_2O_{(i)}$

With Carbonates and Hydgoencarbonates

$CH_3COOH_{(aq)} + NaHCO_{3\ (aq)} \rightarrow CH_3COO^-Na^+_{(aq)} + H_2O_{(l)} + CO_{2\ (g)}$

Conversion to Esters (Carboxylic Acid -> Esters)

Conditions

- **H_2SO_4 catalyst** (dehydrating agent = removing water)
- Reflux
- <u>Anhydrous</u> $ZnCl_2$ (absorbs water and push the position of equilibrium to right)

Naming: [*Alcohol*]+**yl** [*Carboxylic Acid*]+**oate**

Summary

Alkanes

- Free Radical Substitution

Alkenes

- Electrophilic Substitution
- Hydrogenation

Halogenoalkane

- Nucleophilic Substitution
- Elimination

Alcohol

- Direct hydration
- Fermentation
- Dehydration
- Oxidation
- Esterification
- Elimination