

8. Introduction to Organic Chemistry

- Diastereomer are stereoisomers which are not mirror images of each other
- Meso compound check for line of symmetry, note that carbons can be rotated, only cannot when it's a double bond. So rotate it if necessary to find the line of symmetry

9. Alkanes

- Free radical substitution **CANNOT** occur for the H atom attached to C in an aldehyde as the covalent bond is between sp^3 and sp^2 (C is sp^2) and is hence stronger and cannot be broken easily by a radical.

10. Alkenes

- Cis-trans isomerism; cis isomers generally less stable due to steric strain between 2 alkyl groups
- Cis isomers have a higher boiling point due to increased polarity, however trans isomers have higher melting point as their molecules pack better in a crystal lattice
- Undergo **ELIMINATION** and **ELECTROPHILIC ADDITION** reactions
- More reactive than alkanes due to the high electron density of the carbon-carbon double bond
- **OXIDATION** in alkenes; $KMnO_4$ (aq) and H_2SO_4 (aq), cold conditions for mild oxidation (OH added to carbon-carbon double bond) and heat under reflux for strong oxidation (cleavage of the carbon-carbon double bond)

Saytzeff's Rule: If more than one alkene can be formed by an elimination reaction, the more stable alkene is the major product. An alkene with more alkyl substituent groups is generally more stable.

Markovnikov's Rule: When an asymmetrical alkene undergoes electrophilic addition, the more stable carbocation intermediate is formed.

11. Arenes

- The delocalisation of the 6 pi electrons confers extra stability on benzene and gives benzene its aromatic character
- Undergo **ELECTROPHILIC SUBSTITUTION** and **OXIDATION** reactions
- Side chains are oxidised down to the ring, with only a carboxylic acid group remaining
 - The alkyl side chain must have at least one H atom bonded to it in order to undergo oxidation when heated with $KMnO_4$ (aq) and H_2SO_4 (aq)
- Benzoic acid is soluble in hot water but has poor solubility in cold water due to the large hydrophobic benzene ring (appears as a white ppt.)
- An activating group is **electron releasing** which increases the electron density in the benzene ring and makes the ring more attractive for electrophiles as it helps to **disperse the positive charge** of the intermediate carbocation and thus leads to the **stabilisation of the carbocation**. **Activation energy** required is reduced and the **reaction proceeds faster**. Thus an activating group makes the ring more reactive.
- F.R.S CAN actually occur in benzene
- Br_2 is usually preferred to Cl_2 as a test gas as Cl_2 is faint in colour, gaseous and hazardous
- Note that major product does not mean ONLY product

- Electrophilic substitution of benzene ring using $\text{Br}_2(\text{l})$ and anhydrous FeBr_3 , requires the lewis acid because benzene not polarising enough to generate Br^+ from Br_2 due to delocalisation of pi-electrons into the ring, therefore, lewis acid required to generate Br^+ .

Questions

1. Why must reaction occur under anhydrous conditions?

Ans: In the presence of H_2O , FeCl_3 hydrolyses and will thus be unable to accept a lone pair from Cl so the Cl^+ electrophile cannot be generated.

2. Describe and explain the shape of benzene in relation to sigma and pi bonds.

Ans: Each C atom is sp^2 hybridised, thus each C atom has 3 sp^2 hybridised orbitals that are arranged in a trigonal planar manner, forming three sigma bonds with 2 carbon atoms and 1 hydrogen atom. Each C atom also has an unhybridized p-orbital occupied by a single electron. Each singly-filled p-orbital overlaps sideways with the adjacent p-orbital on either side. This gives the overall effect of having a cloud of cyclic delocalised pi electrons above and below the plane of the ring.

The carbon atoms, being sp^2 hybridised, have their bond angles at 120 degrees and thus they are arranged in the form of a regular hexagon. The benzene molecule is flat and symmetrical with all the carbon and hydrogen atoms lying in the same plane.

3. Can Al_2Cl_6 act as a Lewis Acid catalyst too?

Ans: No, Al_2Cl_6 is not electron-deficient and is thus not able to accept an electron lone pair from Cl to form a dative covalent bond.