

HL Answers to Synthetic routes questions

- Step 1:** React with chlorine in ultra violet light and separate 1-chloro-2-methylpropane from any other chlorinated products.

$$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3 + \text{Cl}_2 \rightarrow \text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$$

Step 2: React 1-chloro-2-methylpropane with warm dilute aqueous sodium hydroxide solution to give 2-methylpropan-1-ol.

$$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl} + \text{NaOH} \rightarrow \text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH} + \text{NaCl}$$

Step 3: Oxidize 2-methylpropan-1-ol by refluxing with acidified potassium dichromate(VI) solution to give the required product (via 2-methylpropanal).

$$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{OH} + \text{H}_2\text{O} + \rightarrow \text{CH}_3\text{CH}(\text{CH}_3)\text{COOH} + 4\text{H}^+ + 4\text{e}^-$$
- Step 1:** React but-1-ene with hydrogen bromide to form 2-bromobutane (formed in preference to 1-bromobutane according to Markovnikov's rule). *Mechanism:* Electrophilic addition.

Step 2: React 2-bromobutane with warm dilute aqueous sodium hydroxide solution to give butan-2-ol. *Mechanism:* a mixture of $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$.

Step 3: Oxidize butan-2-ol by refluxing with acidified potassium dichromate(VI) solution to give butanone.
- Step 1:** Oxidize some of the ethanal by refluxing with acidified potassium dichromate(VI) solution to give ethanoic acid.

Step 2: Reduce the rest of the ethanal with sodium borohydride (or lithium aluminium hydride) to give ethanol.

Step 3: Warm the ethanol and the ethanoic acid formed in Steps 1 and 2 in the presence of concentrated sulfuric acid to produce the desired ester.
- Step 1:** Covert benzene into nitrobenzene by warming (keep below 50 °C) with a mixture of concentrated nitric acid and concentrated sulfuric acid.

Step 2: Reduce nitrobenzene to phenylamine by using tin and concentrated hydrochloric acid then react the phenylammonium chloride intermediate with sodium hydroxide solution.
- Step 1:** React 1-chloropropane with warm dilute aqueous sodium hydroxide solution to give propan-1-ol.

Step 2: React chloroethane with warm dilute aqueous sodium hydroxide solution to give ethanol.

Step 3: Oxidize the ethanol obtained in Step 2 by refluxing with acidified potassium dichromate(VI) solution to ethanoic acid.

Step 4: React the ethanoic acid with the propan-1-ol obtained from Step 1 by warming in the presence of concentrated sulfuric acid to give the ester.

