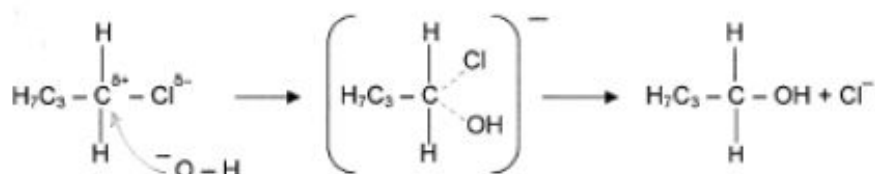


Mark Scheme - AS 2.6 Halogenoalkanes

- 1 (a) e.g. damages liver/ damages pancreas/causes cancer/causes skin disorders/
short-term effects (1)

e.g. more traffic accidents/violent behaviour/criminal behaviour (1) [2]

- (b) (i) Nucleophilic substitution / hydrolysis (1)



Reactants: Intermediate (1)
Polarisation (1) (accept curly arrow to show
curly arrow (1) C – Cl breaking instead of intermediate) [4]
(Incorrect starting material or product maximum 2 marks from 3 for mechanism)

- (ii) Peak at 650–800 cm^{-1} due to C – Cl bond will be gone (1)
Peak at 2500–3500 cm^{-1} due to O – H bond /
1000–1300 cm^{-1} due to C – O bond will be present (1) [2]

- (c) (i)  [1]

(ii) Structural / positional / chain [1]

(iii) Colour change from orange to green [1]

(iv) Concentrated sulfuric acid / aluminium oxide (1)
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \longrightarrow \text{CH}_3\text{CH}_2\text{CHCH}_2 + \text{H}_2\text{O}$ (1) [2]

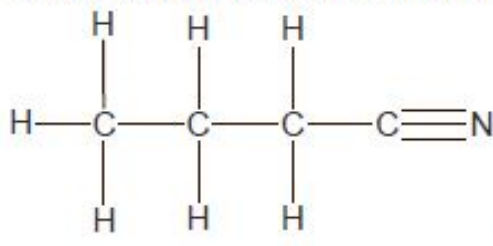
- (d) (i) C – F bond stronger than C – Cl bond (1)
C – Cl bond breaks (in stratosphere) forming $\text{Cl}\cdot$ which
reacts with ozone (1) [2]

(ii) Some CFCs still being used / CFCs take a very long time to reach the
ozone layer / other substances deplete the ozone layer [1]

Total [16]

- 2 (a) (i) Nucleophilic substitution / Hydrolysis [1]
- (ii) Dissolved in alcohol (1) Propene or unambiguous structure (1) [2]
- (iii) Potassium manganate(VII) / Potassium dichromate(VI) - must be name (1)
Oxidation (1) [2]
- (iv) (Add Potassium dichromate(VI)) and distil off the propanal from the reaction mixture [1]

- (b) (i) Step 1: Potassium cyanide in ethanol / Heat (1)
Step 2: Heat with aqueous hydrochloric acid (or other acid) (1)



- (ii) Two points from different bullet points – 1 mark each.
- Atom economy / Amount of waste / Whether waste material was recyclable / Whether waste was toxic.
 - Amount of energy required / temperature required / pressure required / conditions used
 - Rate of production / time
 - Availability of catalyst
 - Cost of reactants / Availability of reactants / toxicity of reactants.
 - Two step processes usually have lower yields than one step processes / percentage yield [2]
 - Purification method / separation
- (c) (i) Butanoic acid is $\text{C}_4\text{H}_8\text{O}_2$ so $M_r = 88$ (1)
 Percentage carbon = $48/88 \times 100 = 54.5\%$; percentage hydrogen = $8/88 = 9.1\%$;
 Percentage oxygen = $32/88 = 36.4\%$ (At least two of these for 1)
 OR empirical formula for butanoic acid = $\text{C}_2\text{H}_4\text{O}$ (1) and
 calculate empirical formula from percentage masses = $\text{C}_2\text{H}_4\text{O}$ (1) [2]

(ii) Structure 1 mark + 4 marks for explanations.

- Product is ethyl ethanoate. (1)
- Two points from the following required for each mark– MAX 4 marks
 - Sweet-smelling = ester
 - Peak at 1.0ppm implies – CH₃
 - Peak area 3 = CH₃
 - Peak area 2 = CH₂
 - Triplet shows CH₃ is next to a CH₂ group.
 - Singlet shows CH₃ no hydrogen atoms bonded to adjacent carbon.
 - Peak at 2.1 ppm suggests this is next to C=O.
 - Quartet shows CH₂ is adjacent to a CH₃ group.
 - Peak at 4.0 ppm shows it is –O-CH₂-
 - IR Peak at 1752 cm⁻¹ = C=O
 - IR Peak at 2981 cm⁻¹ = C-H or O-H
 - Cannot be –OH as we know there is no –OH in NMR spectrum

[5]

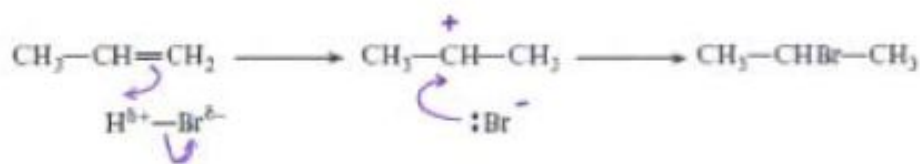
QWC: selection of a form and style of writing appropriate to purpose and to complexity of subject matter. (1)

QWC: organisation of information clearly and coherently; use of specialist vocabulary where appropriate. (1)

[2]

[20 marks]

3 (a) (i)



curly arrows (1)
charges (1)

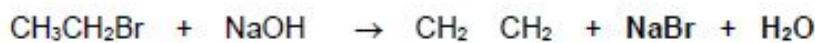
[2]

(ii) Nucleophile hydroxide ion / OH⁻ / water (1)

Substitution the replacement of one functional group by another (1)

[2]

(iii)



(accept Na⁺ and Br⁻ in place of NaBr) [1]

- 4 (a) $C_6H_{12}Br_2$ [1]
- (b) Elimination [1]
-
- 5 (a) (i) δ^- on Br and δ^+ on C attached (1)
- Arrow from lone pair on OH^- to δ^+ on C (1)
- Arrow from C-Br bond to Br (1)
- Correct alcohol + Br^- (1) [4]
- (ii) Nucleophilic substitution [1]
- (iii) The bond breaks and both the electrons go to one of the bonded atoms/ the bond breaks and ions are formed. [1]
-
- (b) (i) Sodium hydroxide in ethanol/ alcohol [1]
- (ii) Elimination/ dehydrohalogenation [1]
- (iii) Structural formulae for but-1-ene (1)
- and but-2-ene (1) [2]