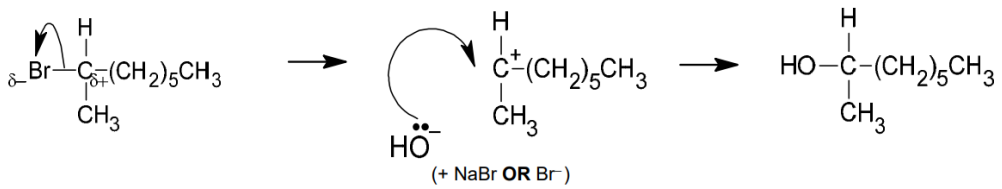
15. Halogen compounds

15.1 Halogenoalkanes

Paper 2

Marking Scheme

Q1.

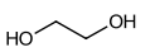
(b)	 (+ NaBr **OR** Br^-) **M1** correct dipole ($^{\delta+}C—Br^{\delta-}$) **AND** curly arrow from bond of C—Br to Br (or just beyond) **M2** correct intermediate **ALLOW** R for $–(CH_2)_5CH_3$ **M3** curly arrow from lone pair on OH^- to the C of intermediate (or suitable position where C–OH bond is made) *If $SN2$ mechanism shown:* Apply $SN2$ mechanism mark scheme **only** if mechanism shows OH / NaOH species attacking the reactant and no OH **M1** correct dipole ($^{\delta+}C—Br^{\delta-}$) AND curly arrow from bond of C—Br to Br of reactant (or just beyond) **NOT M2** **M3** curly arrow from lone pair on $:OH^-$ to the appropriate C of the reactant	**3**

(d)(i)	elimination	**1**
(d)(ii)	NaOH / sodium hydroxide in ethanol	**1**

Q2.

(c)(iii)	CH_3COCH_3 + **3**$NaClO$ → **1**$CHCl_3$ + **1**CH_3COONa + **2**$NaOH$	**1**
(c)(iv)	**M1 white** precipitate/**white** ppt forms	**1**
	M2 $CHCl_3$ is hydrolysed / chloride ions are released **OR** Cl^- / chloride ions which are released react with Ag^+ **OR** silver chloride / $AgCl$ is formed	**1**

Q3.

(c)(i)		**1**
	bromoethene	**1**

Q4.

(e)	$CHCl_3 + 2HF \rightarrow CHClF_2 + 2HCl$	**1**

Q5.

(a)(i)	KCN in ethanol + heat	1

Q6.

(a)

reaction	reagent and conditions	type of reaction
1	NaOH(aq) **[M1]**	substitution
2	NH_3 **[M2]** in ethanol **AND** heat under pressure **[M3]**	substitution
3	NaOH in ethanol **AND** heat **[M4]**	elimination

M5 and M6 types of reaction
[3 correct types = 2 marks and 2 correct types = 1 mark]

All reagents can be identified as (correct) formula or in words

6

(b)

M1 C–I (covalent bond) is weaker ora

M2 lower activation energy / lower E_a (with 2-iodopropane)

OR

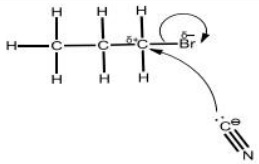
M2 *explain in terms of the SN_1 mechanism (that is dominant / preferred / occurring with 2-iodopropane is fast(er))*
(identical) carbocation is made (more) quickly (with 2-iodopropane)
OR
low / less energy is required to make the (same)carbocation / intermediate (from 2-iodopropane)

OR

M2 iodine / I (of C–I) has weaker attraction of nucleus to bonding / shared pair (of electrons) due to
any one of:
- more / high shielding (of electrons from inner shells)
- more / 5 electron shells in iodine
- C-I greater distance from nuclei (to bonding pair of electrons)

2

(c)(i)

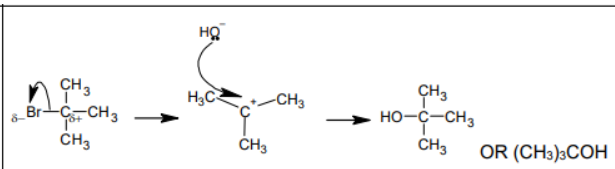
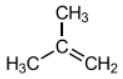


M1 dipole $C^{\delta+}$–$Br^{\delta-}$ **AND** curly arrow from C–Br bond to $Br^{\delta-}$

M2 lone pair on C of ^-CN **AND** curly arrow from lone pair to C (on C-1 of bromopropane)

2

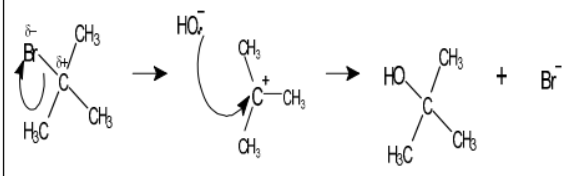
Q7.

(e)(i)	 OR $(CH_3)_3COH$ **M1** correct dipole in on $^{\delta+}C—Br^{\delta-}$ (in ^{t}BuBr) **AND** curly arrow from C—Br to Br	**1**
	M2 curly arrow from electron pair on O of $^-$:OH / :OH^- to C^+ in carbocation	**1**
	M3 ^{t}BuOH product	**1**
(e)(ii)	The C—Br carbon is bonded to three other carbon atoms *owtte*	**1**
(e)(iii)		**1**

Q8.

(e)(i)	elimination	**1**
(e)(ii)	**M1** NaOH / KOH	**1**
	M2 ethanolic solution / ethanol / alcohol + heat	**1**

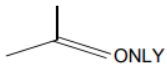
Q9.

(c)(i)	 **M1** correct dipole on haloalkane AND arrow from bond to Br or just beyond	**1**
	M2 correct intermediate	**1**
	M3 arrow from lone pair on O of OH^- / ^-OH to central C of their intermediate shown in M2 OR arrow from lone pair on O of OH^- / ^-OH to central C of 2-bromo 2-methylpropane if S_N2 mechanism shown	**1**
(c)(ii)	nucleophilic substitution	**1**
(d)	**M1** more time (because the rate is lower)	**1**
	M2 C-C*l* (bond) is stronger (than C-Br)	**1**

Q10.

(b)(iii)	*reagent* **M1** NaCN or KCN	**1**
	conditions **M2** ethanolic AND heat (under reflux)	**1**

Q11.

(b)(i)	$CH_3CH_2CH_2CH_2CH_2Br$	**1**
(b)(i)	**M1** primary/ 1° (carbo)cation formed is not very stable **M2 EITHER** (as) only one alkyl group exerting an inductive effect **OR** only one alkyl group so the charge is (more) localised on the C+	**2**
(c)(i)	elimination	**1**
(c)(ii)	$C_4H_9Cl + NaOH \rightarrow C_4H_8 + NaCl + H_2O$	**1**
(c)(iii)	 ONLY	**1**
(c)(iv)	**M1** 2-chloro(-2-)methylpropane **M2** 1-chloro(-2-)methylpropane ALLOW in any order	**2**

Q12.

(b)(i)	**Human activity** creates / additional / more/increase / thicker layer in greenhouse gas(es) / $CHClF_2$ **OR** **Human activity** has an impact on climate change / temperature at earth's surface / temperature of sea	**1**
(b)(ii)	**M1** traps (more)heat **M2** (in the atmosphere leading to) greater global warming or wtte	**2**
(b)(iii)	ozone depletion / thinning	**1**