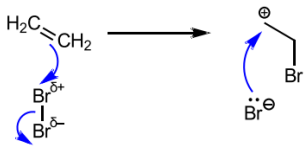
14. Hydrocarbons

14.2 Alkenes

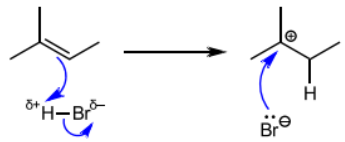
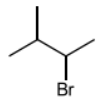
Paper 2

Marking Scheme

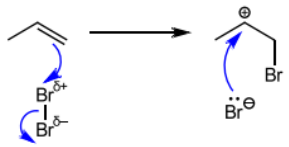
Q1.

(a)	 **pt 1** dipole on Br_2 **pt 2** curly arrow from C=C bond to a $Br^{\delta+}$ **pt 3** curly arrow from Br–Br bond to the other Br **pt 4** correct intermediate **pt 5** curly arrow from lone pair on Br^- to C^+ **5•** = 3 marks. **4•** = 2 marks. **3•** = 2 marks. **2•** = 1 marks. **1•** = 0 marks.	**3**

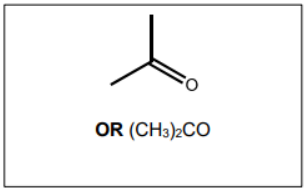
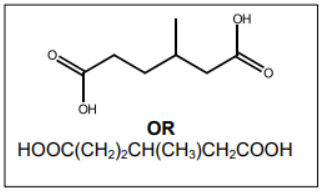
Q2.

(c)(i)	 correct dipole on H-Br AND curly arrow from C=C bond to $H^{\delta+}$ **AND** curly arrow from H—Br bond to $Br^{\delta-}$	**1**
	correct (Markovnikoff) intermediate	**1**
	curly arrow from lone pair on Br^- to C^+ of intermediate	**1**
(c)(ii)		**1**
(c)(iii)	**•C has a tertiary carbocation and a 2ndry carbocation** **•D has a secondary carbocation and a primary carbocation** **• alkyl groups have a +ve / positive / +I / inductive effect** **• more alkyl groups / more inductive effects give a <u>more stable</u> intermediate / carbocation / C+** • **In C** tertiary carbocation is more stable than the secondary carbocation Any **two** • for 1 mark Any **four** • for 2 marks	**2**

Q3.

(b)(i)	 curly arrow from C=C bond to $Br^{\delta+}$ **AND** curly arrow from $Br^{\delta+}$—$Br^{\delta-}$ bond to $Br^{\delta-}$ **AND** $Br^{\delta+}$ closest to the double bond	1
	correct intermediate	1
	curly arrow from lone pair on Br^- to $C^{(+)}$ of the intermediate	1

Q4.

(b)	 **OR** $(CH_3)_2CO$  **OR** $HOOC(CH_2)_2CH(CH_3)CH_2COOH$	2

Q5.

(a)	$Br_2(aq)$	orange to colourless **OR** orange disappears	2
	$Na_2CO_3(s)$	fizzing OR bubbles **OR** effervescence	

Q6.

(a)	addition	1
(b)	**M1** *catalyst* = sulfuric acid / phosphoric(V) acid	1
	M2 *conditions of reaction* = steam / heat (and pressure)	1

(d)(i)	**M1** more stable = $CH_3C^+(H)(CH_3)$ 	1
	M2 less stable = $CH_3CH_2C^+(H_2)$ / 	1
	M3 greater (positive) inductive effect of two alkyl groups OR greater electron donation of two alkyl groups owtte	1
(d)(ii)	propan-2-ol	1

Q7.

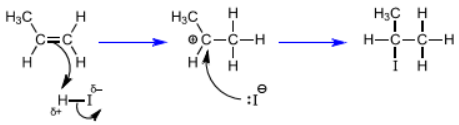
(b)(i)	**A**	**1**

(b)(ii)	 **M1** skeletal formula only	**1**
	M2 *explanation in terms of increased / greater stability of intermediate / carbocation* intermediate / (secondary) carbocation / $CH_3C^+(H)(CH_2CH_3)$ is (more) stable	**1**
	M3 *reason for increased stability of intermediate in terms of greater number of alkyl groups showing largest inductive (electron releasing) effect* greater (positive) inductive effect due to two alkyl groups OR greater electron donation of two alkyl groups	**1**

Q8.

(d)	$CH_3CH_2CO_2H$ | CH_3COCH_3	**2**

Q9.

(g)(i)	**M1** 2-iodopropane – formed from a (more) stable (secondary) (carbo)cation/intermediate **M2** (because of) greater (positive) inductive effect / (+)I of two alkyl groups **OR** (because of positive) inductive effect / (+)I of more R / more methyl / more alkyl groups	**2**
(g)(ii)	 **M1** curly arrow from = of C=C to H **AND** curly arrow from bond of H—I to I **M2** curly arrow from lone pair of I^- to $C^{(+)}$ of their intermediate **M3** correct carbocation **AND** product for 2-iodopropane	**3**

Q10.

(a)(ii)	HC*l* **AND** H_2O	**1**

Q11.

(d)(i)	*Two structures representing the intermediate* **M1** $C_2H_5C^+HCH_3$ **M2** $CH_3CH_2CH_2C^+H_2$	**2**
(d)(ii)	*Identify the most stable intermediate* **M1** $C_2H_5C^+HCH_3$ *explanation* **M2** (more / 2 alkyl groups attached so) it has the greater inductive / electron donating effect	**2**

Q12.

(b)(i)	hot **AND** concentrated	**1**
(b)(ii)	oxidation	**1**

(c)	*Structural formula of **X**:* HCO_2H OR HCOOH	**1**

Q13.

(a) **6**

Rxn.	name of mechanism	**Name** of reagents and conditions
1	**M1** electrophilic addition	**M2** steam **AND** concentrated phosphoric acid (catalyst)
2		***M3*** *&* ***M4*** *Two marks for name of reagent and both conditions.* *One mark for name of reagent and one conditions* acidified potassium dichromate ((VI)) *condition 1* warm *condition 2* distil NOT reflux
6	**M5** nucleophilic substitution	**M6** ammonia (alcoholic) AND heat in a sealed tube / heat under pressure

Q14.

(c) **3**

reagent	**result with P**	**result with Q**
$Br_2(aq)$	no change / **stays** orange	no change / **stays** orange
2,4-DNPH	no change	orange ppt
Na_2CO_3	effervescence	no change

Award one mark for every two correct observations.

Q15.

(c)(i)	$C_3H_7ClO_2$	**1**
(c)(ii)	oxidation	**1**

(c)(iii)		**1**

	alcohol group present in Z
primary	✓
secondary	✓
tertiary	