F322: Chains, Energy and Resources
Halogenoalkanes

Mark Scheme

1. **Any TWO from:**
CFCs take many years to reach the ozone layer **OR** long residence time ✓

CFCs are still being used ✓

there are other ozone depleting substances ✓

IGNORE *because chlorine radicals stay in the stratosphere*

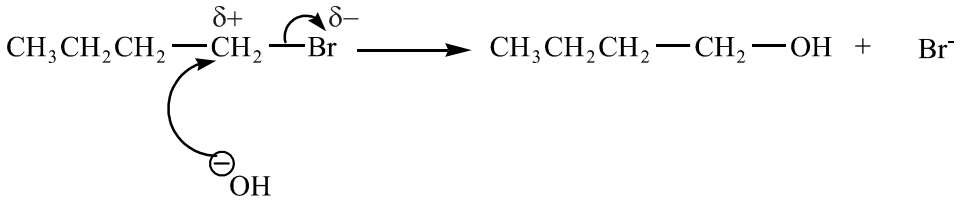
ALLOW *other named ozone depleting substances e.g. NO and HFCs*

[2]

2. (i) substitution/hydrolysis **(1)** 1

(ii) electron pair donor **(1)** 1

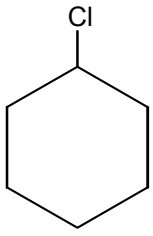
(iii)



correct dipole **(1)**
curly arrow from the O in the OH- to C in the CH_2 **(1)**
curly arrow to show movement of bonded pair in the C–Br bond **(1)**
Br^- as a product **(1)** 4

[6]

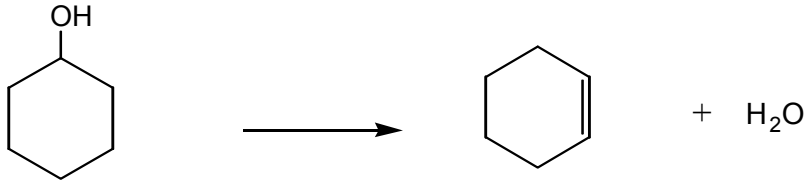
3. (a) (i) 1



(ii) H_2SO_4/Al_2O_3/(hot) pumice/H_3PO_4 1

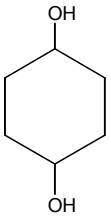
(H_2SO_4(aq) or dil H_2SO_4 loses the mark)

(iii) 1



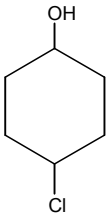
$C_6H_{11}OH$ / $C_6H_{12}O \rightarrow C_6H_{10} + H_2O$

(b) (i) 1



diol

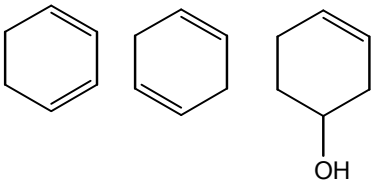
also allow



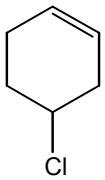
Cl-alcohol

(ii) 2

from the diol allow

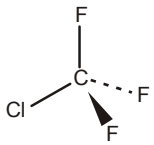


from the Cl-alcohol allow



[6]

4. (i) 1



require an attempt at a 3D structure and bond angles must clearly not be 90°.
require at least one 'wedge' bond or one 'dotted' bond

(ii) 108 – 111° 1

(iii) volatile/low boiling/gas/non-toxic/non-flammable/unreactive/liquefied under pressure/inert 1

(iv) homolytic = bonded pair split <u>equally</u>/ each retains 1 electron 1

fission = <u>bond</u> breaking 1

(v) C-C*l* (no mark) because it is the <u>weaker bond</u> 1

(vi) C*l*• 1

•CF_3 (allow CF_3•) 1
(lack of 'dots' penalise once)

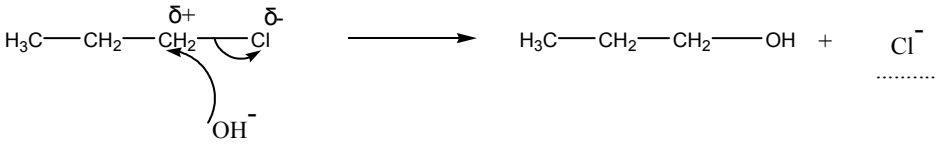
[8]

5. (a) (i) reaction 1 1

(ii) reaction 4 1

(iii) reaction 3 1

(b) (i) lone pair/electron pair donor 1



Correct dipole 1

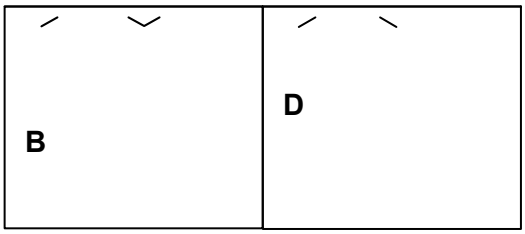
Curly arrow from the O in the OH^- to C in the CH_2 1

Curly arrow to show movement of bonded pair in the C-C*l* bond 1

C*l*$^-$ as a product 1

(c) (i) same molecular formula , different structure/arrangement of atoms. (same formula, different structure.) 2

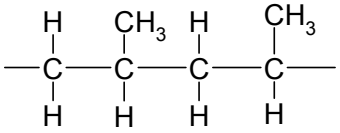
(ii) 2



(d) (i) addition, (not additional) 1

(ii) poly(propene)/ polypropene/ polypro-1-ene, polypropylene 1

(iii) 1



[15]

6. Essential marks:

Order	RI>RBr>RC*l* /owtte	1
reason for the order	C-I bond weakest/length/C-C*l* bond strongest and mention/intermolc forces loses the mark	1
an equation	$Ag^+ + X^- \longrightarrow AgX$ (solid or ppt) or an equation for hydrolysis/using OH- or H_2O	1

max = 3

Two possible methods of monitoring the reaction

Method 1	**Method 2**	
$AgNO_3$	$AgNO_3$	1
Ethanol & Waterbath/ /hydroxide temp 40 – 80°C not heat/not bunsen	$NaOH/OH^-$ & neutralise with HNO_3	1
relative rate of precipitation	relative amount of precipitation	1

[6]

7. Properties:

	Non-toxic/harmless	1
	non-flammable	1
any two from:		2
(propellant in) aerosols	because it is volatile/ unreactive/ non-toxic/ easily compressed	
blowing polystyrene	because it is unreactive	
dry cleaning	because it is a good solvent for organic material	
degreasing agent	because it is a good solvent for organic material	
fire extinguishers	because it is non-flammable	

QWC

- reasonable spelling, punctuation and grammar throughout

[4]

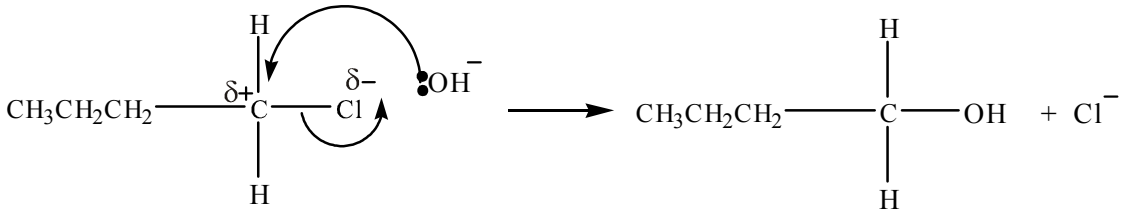
8. (a) Cl^- must be shown as a product ✓ 1

(at least 1) lone pair of electrons on the O in the OH^- with curly arrow from the lone pair on the OH^- to the $C(^{\delta+})$✓ 1

dipoles on the C-C*l* bond ✓ 1

curly arrow from C-C*l* bond to the $Cl^{\delta-}$ ✓ 1

The mechanism below would get all 4 marks.



(b) (i) mark for method/dividing by A_r / C, 3.15; H, 6.3; C*l*, 1.58. ✓ 1

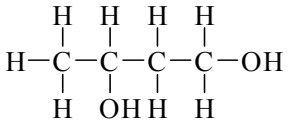
divide by smallest to get C_2H_4Cl ✓ 1

alternative method:

% of each element x 127 ÷ A_r of that element = molecular formula, hence deduce empirical formula

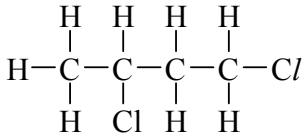
(ii) $C_4H_8Cl_2$ ✓ 1

(iii) any unambiguous form of: ✓



1

(iv) any unambiguous form of: ✓



1

ecf to (iii) provided that there are two OHs in (iii)

[9]