

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]

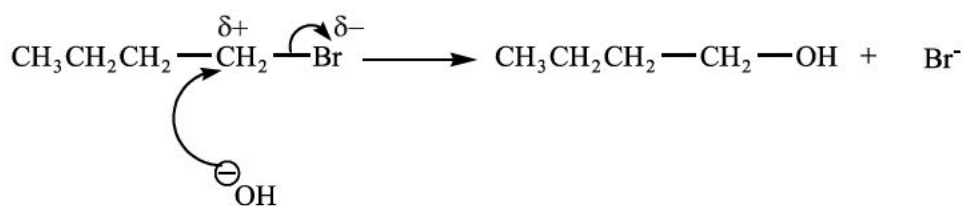
2. (i) substitution/hydrolysis (1)

1

(ii) electron pair donor (1)

1

(iii)



correct dipole (1)

curly arrow from the O in the OH- to C in the CH₂ (1)

curly arrow to show movement of bonded pair in the C-Br bond (1)

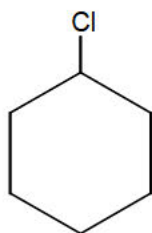
Br⁻ as a product (1)

4

[6]

3. (a) (i)

1

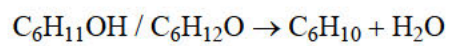


(ii) H₂SO₄/Al₂O₃/(hot) pumice/H₃PO₄

1

(H₂SO₄(aq) or dil H₂SO₄ loses the mark)

1

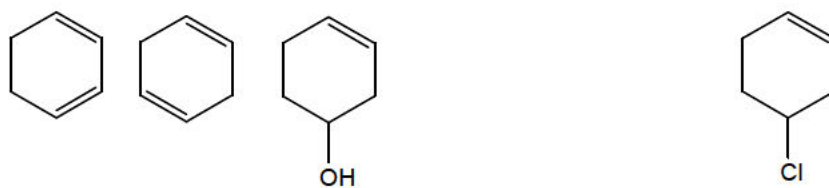


1



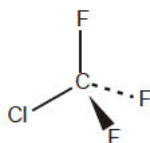
2

from the C1-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 equally/ each retains 1 electron 1

fission = bond breaking 1

(v) C-Cl (no mark) because it is the weaker bond 1

(vi) Cl• 1

•CF₃ (allow CF₃•) 1

(lack of 'dots' penalise once)

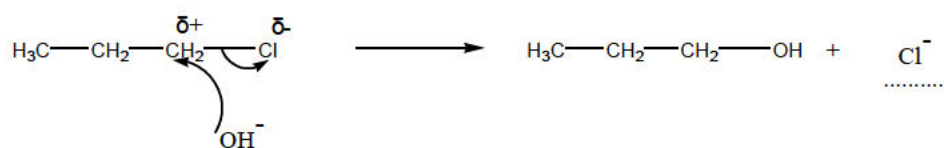
[8]

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

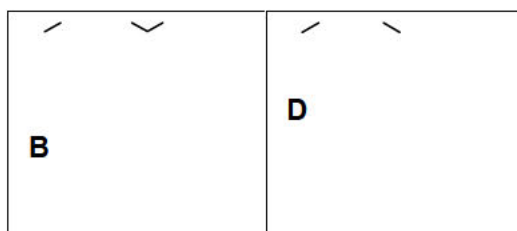
Curly arrow from the O in the OH⁻ to C in the CH₂ 1

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

Cl⁻ as a product 1

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

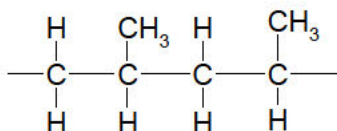
- (ii) 2



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

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

- (iii) 1



[15]

6. Essential marks:

Order RI>RBr>RCl /owtte 1

reason for the order C-I bond weakest/length/C-C/ bond strongest and mention/intermolc forces loses the mark 1

an equation $\text{Ag}^+ + \text{X}^- \longrightarrow \text{AgX}$ (solid or ppt) or an equation for hydrolysis/using OH⁻ or H₂O 1

max = 3

Two possible methods of monitoring the reaction

Method 1

AgNO₃

Ethanol & Waterbath/
/hydroxide

temp 40 – 80°C

not heat/not bunsen

relative rate of
precipitation

Method 2

AgNO₃

NaOH/OH⁻

& neutralise with HNO₃

relative amount of
precipitation

1

1

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

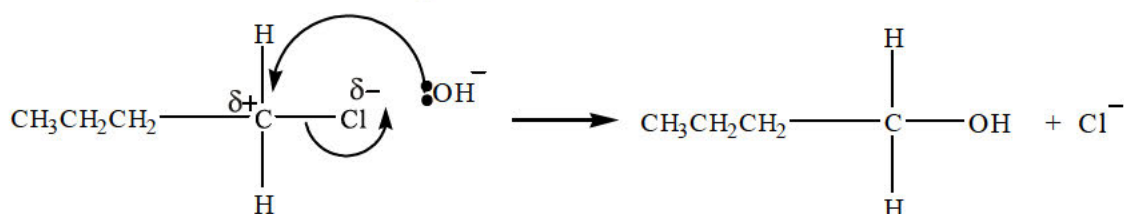
(at least 1) lone pair of electrons on the O in the OH^- with curly arrow

from the lone pair on the OH^- to the $\text{C}(\delta^+)$ ✓ 1

dipoles on the C-Cl bond ✓ 1

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

The mechanism below would get all 4 marks.



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

divide by smallest to get $\text{C}_2\text{H}_4\text{Cl}$ ✓ 1

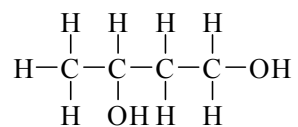
alternative method:

% of each element $\times 127 \div A_r$ of that

element = molecular formula, hence deduce empirical formula

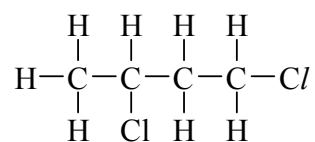
(ii) $\text{C}_4\text{H}_8\text{Cl}_2$ ✓ 1

(iii) any unambiguous form of: ✓



1

(iv) any unambiguous form of: ✓



1

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

[9]