

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*

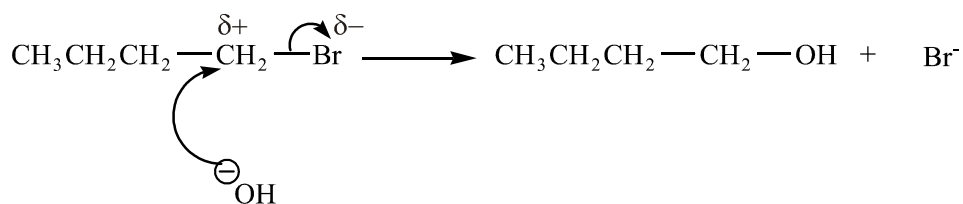
***ALLOW** other named ozone depleting substances e.g. NO and HFCs*

[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)

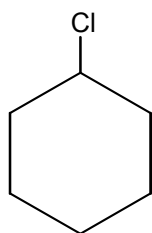
Br⁻ as a product (1)

4

[6]

3. (a) (i)

1

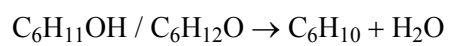
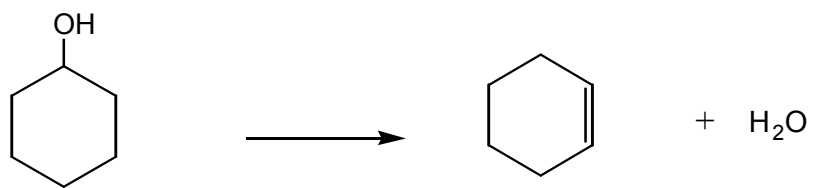


(ii) H₂SO₄/Al₂O₃/(hot) pumice/H₃PO₄ 1

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

(iii)

1



(b) (i)

1

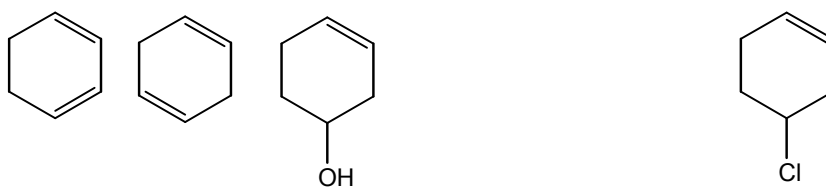


(ii)

2

from the diol allow

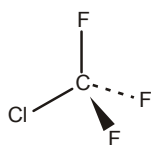
from the Cl-alcohol allow



[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 equally/ each retains 1 electron
fission = bond breaking

1

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

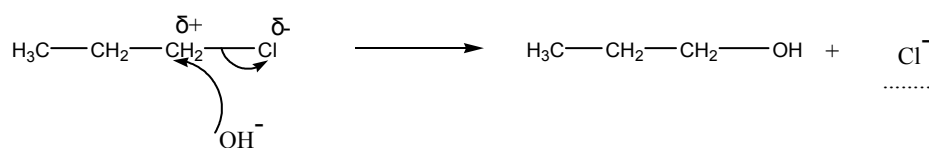
1

(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

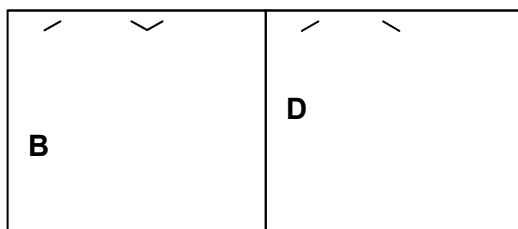
1

Cl⁻ as a product

1

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

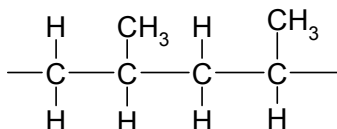
(ii) 2



(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-Cl bond strongest and mention/intermole 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	Method 2	
AgNO ₃	AgNO ₃	1

Ethanol & Waterbath/ /hydroxide	NaOH/OH ⁻	1
temp 40 – 80°C	& neutralise with HNO ₃	
not heat/not bunsen		

relative <u>rate</u> of precipitation	relative <u>amount</u> of precipitation	1
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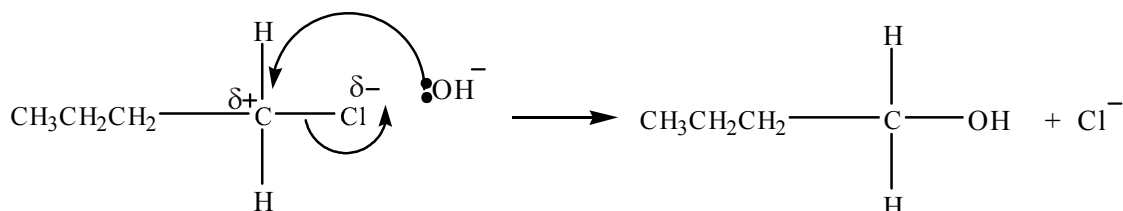
[6]

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

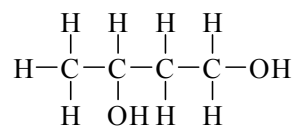
[4]

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 1
- from the lone pair on the OH^- to the $C(\delta^+)$ ✓ 1
- dipoles on the C-Cl bond ✓ 1
- curly arrow from C-Cl bond to the $Cl^{\delta-}$ ✓ 1
- The mechanism below would get all 4 marks.*



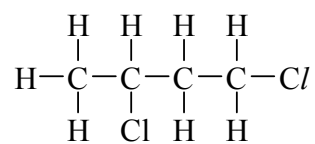
- (b) (i) mark for method/dividing by $A_r / C, 3.15; H, 6.3; Cl, 1.58.$ ✓ 1
- divide by smallest to get C_2H_4Cl ✓ 1
- alternative method:
- % of each element $\times 127 \div A_r$ of that element = molecular formula, hence deduce empirical formula
- (ii) $C_4H_8Cl_2$ ✓ 1

(iii) any unambiguous form of: ✓



1

(iv) any unambiguous form of: ✓



1

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

[9]