HALOLKANES

1. A student reacted bromobutane with an excess of OH^- to produce butan-1-ol.

In this reaction the hydroxide ion acts as a nucleophile.

(i) What name is given to this type of reaction?

.....

[1]

(ii) Explain the term *nucleophile*.

.....

[1]

(iii) Outline the mechanism for this reaction.

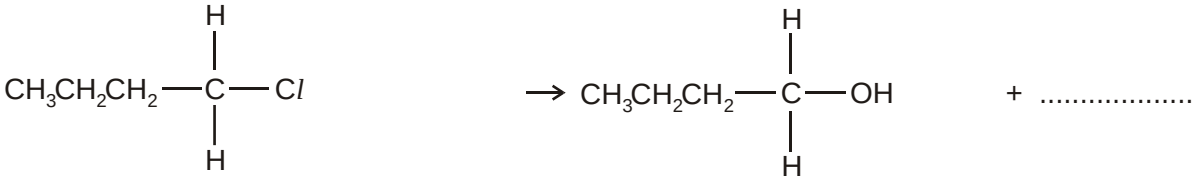
Show curly arrows and relevant dipoles.

[4]

[Total 6 marks]

2. Halogenoalkanes, such as 1-chlorobutane, are hydrolysed with hot aqueous alkali, $OH^-(aq)$, to form alcohols.

(a) Describe, with the aid of curly arrows, the mechanism of the hydrolysis of 1-chlorobutane with $OH^-(aq)$ ions to produce butan-1-ol. Show any relevant lone pairs of electrons and dipoles.



[4]

(b) Another halogenoalkane, **H**, has a relative molecular mass of 127 and has the following composition by mass:
C, 37.8%; H, 6.3%; C*l*, 55.9%.

(i) Show that the empirical formula of compound **H** is C_2H_4Cl.

[2]

(ii) Deduce the molecular formula of compound **H**.

[1]

(iii) Compound **H** can also be hydrolysed with hot aqueous alkali to form butane-1,3-diol. Draw the structure of butane-1,3-diol

[1]

(iv) Deduce the structure of compound **H**.

[1]

[Total 9 marks]

3. Halogenoalkanes are used in the production of pharmaceuticals, polymers and flame retardants.

1-Bromo-2-methylpropane is used in the production of ibuprofen and can be prepared from the reaction between 2-methylpropan-1-ol and HBr.

$$(CH_3)_2CHCH_2OH + HBr \rightarrow (CH_3)_2CHCH_2Br + H_2O$$

A student reacted 4.44 g of 2-methylpropan-1-ol with an excess of HBr. The student produced 5.48 g of 1-bromo-2-methylpropane.

(i) Calculate the number of moles of $(CH_3)_2CHCH_2OH$ used.

answer …… mol

[2]

(ii) Calculate the number of moles of $(CH_3)_2CHCH_2Br$ collected.
$(CH_3)_2CHCH_2Br$, M_r =137

answer …… mol

[1]

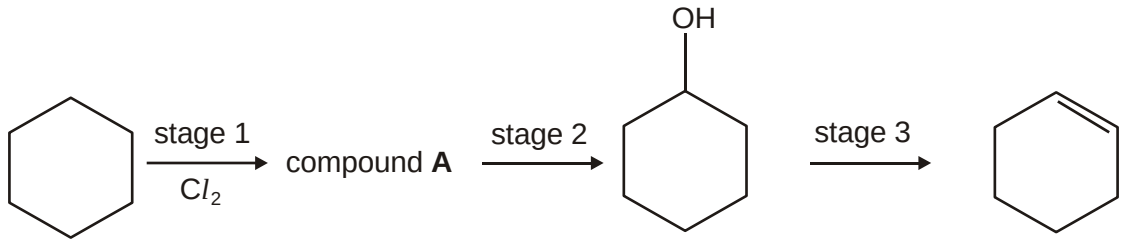
(iii) Calculate the percentage yield. Quote your answer to three significant figures.

answer ……

[1]

[Total 4 marks]

4. (a) Cyclohexane can be converted into cyclohexene via a three-stage synthesis.



cyclohexane **cyclohexanol** **cyclohexene**

(i) In stage 1, cyclohexane reacts with chlorine to form the organic product, compound **A**.

Show the structure of compound **A**

[1]

(ii) Stage 3 involves the dehydration of an alcohol.

State a suitable reagent for dehydrating an alcohol.

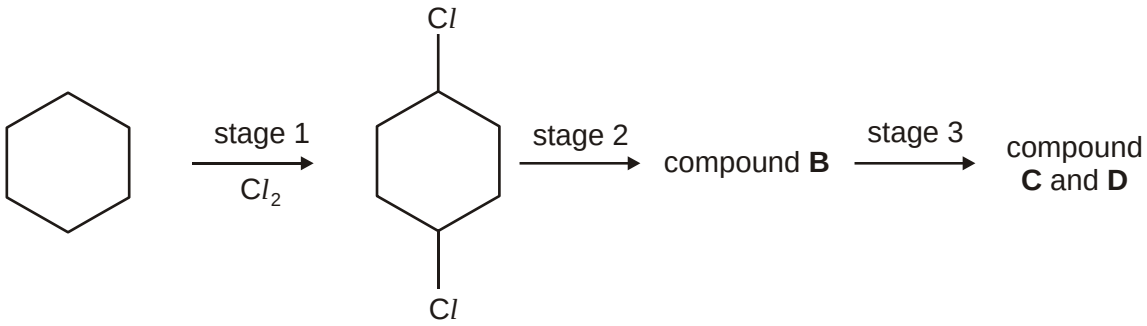
.....

[1]

(iii) Write a balanced equation for the dehydration of cyclohexanol, $C_6H_{11}OH$.

[1]

(b) The reaction in stage 1 is difficult to control. One other possible chlorinated product is 1,4-dichlorocyclohexane.This is shown below.



cyclohexane **1,4-dichlorocyclohexane**

1,4-Dichlorocyclohexane reacts in the same way as compound **A** in stages 2 and 3.

(i) Suggest the structure of compound **B**.

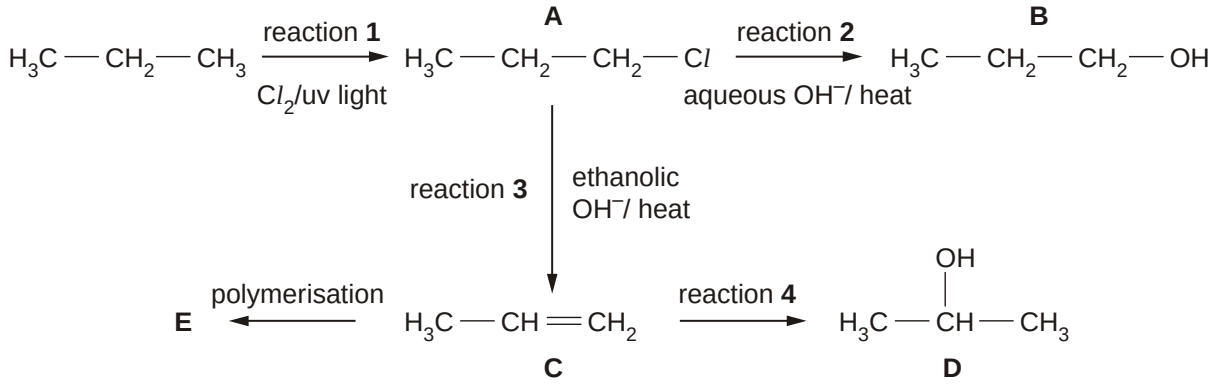
[1]

(ii) Two cyclic alkenes, **C** and **D** are formed in stage 3. **C** and **D** are structural isomers. Suggest the structures of **C** and **D**.

[2]

[Total 6 marks]

5. Propane, C_3H_8, is used in the reaction sequence shown below.



(a) The reaction sequence shows several important reaction mechanisms. Select from reactions **1** to **4**, the reaction that shows

(i) free radical substitution, reaction .....

[1]

(ii) electrophilic addition, reaction .....

[1]

(iii) elimination, reaction .....

[1]

(b) In reaction **2**, the aqueous OH^- acts as a nucleophile.

(i) State what is meant by the term *nucleophile*.

.....

[1]

(ii) Complete, with the aid of curly arrows, the mechanism involved in reaction **2**. Show any relevant dipoles.

$H_3C-CH_2-CH_2-Cl \longrightarrow H_3C-CH_2-CH_2-OH$ + ...

OH^-

[4]

(c) Compounds **B** and **D** are structural isomers of each other.

(i) State what is meant by the term *structural isomers*.

.....

.....

[2]

(ii) Draw the skeletal formulae of compounds **B** and **D**.

Compound **B**	Compound **D**

[2]

(d) Compound **C** can be polymerised to form compound **E**.

(i) State the type of polymerisation. .....

[1]

(ii) Name compound **E**. .....

[1]

(iii) Draw a section of compound **E**. Show **two** repeat units.

[1]

[Total 15 marks]