EXAM PAPERS PRACTICE

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Time allowed
61 Minutes

Score /51

Percentage %

CHEMISTRY

OCR AS & A LEVEL

Topic Questions

Module 4: Core organic chemistry

1 A student carries out an investigation on some halogenoalkanes.

(a) She decided to hydrolyse 1-bromopentane and 1-chloropentane using aqueous sodium hydroxide.

State and explain the difference in the rates of hydrolysis of 1-bromopentane and 1-chloropentane.

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..... **[2]**

(b) A student wants to determine the structure of an unknown iodoalkane **B**.

She knows that the molecular formula of **B** is C_4H_9I.

The student heats **B** with aqueous sodium hydroxide. A reaction mixture forms containing the organic compound **C** and $I^-(aq)$.

(i) Draw all of the possible structural isomers for **B**.

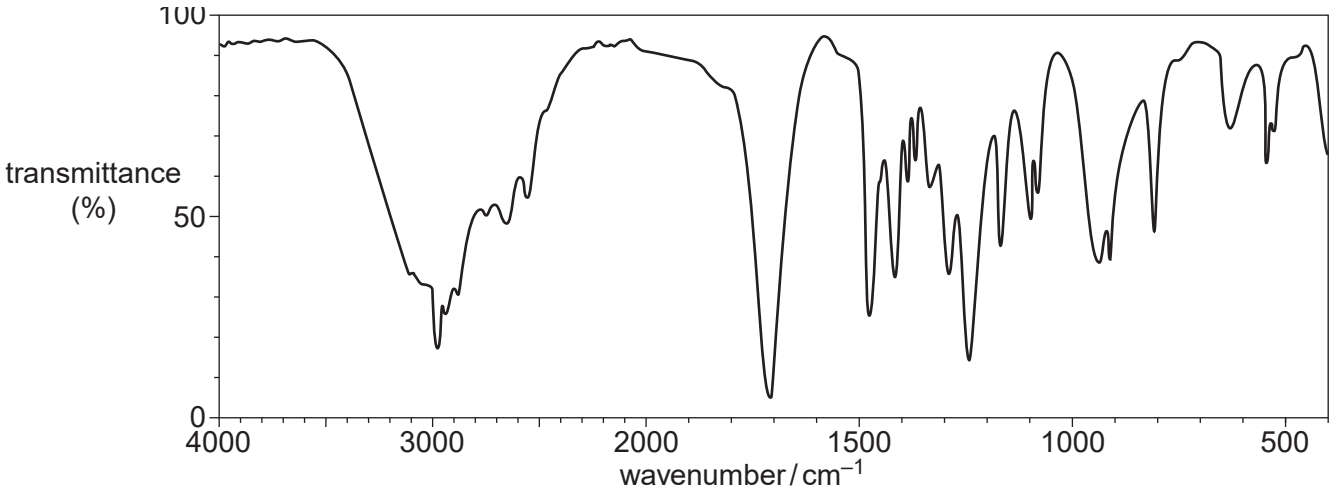
[4]

(ii) What is the molecular formula for compound **C**?

..... **[1]**

(iii) The student purifies compound **C** and splits it into two portions.

- She heats one portion of **C** with concentrated sulfuric acid. The product of this reaction is methylpropene.
- To the other portion of **C**, she adds acidified potassium dichromate(VI) and heats the mixture under reflux. The product of this reaction is compound **D**.
- The infrared spectrum for compound **D** is shown at the top of page 19.



Use this evidence to suggest structures for **B**, **C** and **D**.

In your answer you should make clear how your explanations are linked to the evidence.

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[Total: 13]

2 A student carried out an investigation to compare the rates of hydrolysis of 1-iodopropane and 1-bromopropane. The student heated hot aqueous sodium hydroxide with each halogenoalkane and found that 1-iodopropane was hydrolysed faster.

The equation for the reaction with 1-iodopropane is shown below.

$$CH_3CH_2CH_2I + OH^- \rightarrow CH_3CH_2CH_2OH + I^-$$

(a) (i) Outline the mechanism for this hydrolysis of 1-iodopropane.

Show curly arrows and relevant dipoles.

[3]

(ii) State the name of this type of mechanism.

..... **[1]**

(b) Explain why 1-iodopropane is hydrolysed faster than 1-bromopropane.

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..... **[2]**

(c) Chlorofluoroalkanes, CFCs, were developed from fluoroalkanes and were used in aerosols and as refrigerants. Under the Montreal Protocol, CFCs are now largely banned because of their ozone-depleting properties. CFCs have now been replaced in many applications.

Suggest **two** reasons why there is still concern about ozone depletion.

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..... **[2]**

(d) Fluoroalkenes are used to make polymers. For example, PVF, $(CH_2CHF)_n$, is used to make non-flammable interiors of aircraft.

(i) Draw **two** repeat units of the polymer PVF showing all bonds.

[1]

(ii) Draw the structure of the monomer of PVF.

[1]

(e) Once polymers have been used, they become waste.

Outline **two** ways that waste polymers are processed usefully, rather than just dumped in landfill sites.

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..... **[2]**

[Total: 12]

3 Chlorofluorocarbons, CFCs, were once used as propellants in aerosols. CFCs contribute to ozone depletion in the upper atmosphere.

(a) A CFC has the formula CF_2Cl_2.

State the three-dimensional shape of a CF_2Cl_2 molecule and the F–C–Cl bond angle.

shape .....

bond angle ..... **[2]**

(b) Two reasons that CF_2Cl_2 was used as an aerosol propellant are that it has low reactivity and will not hydrolyse in water.

(i) State **one** other reason why CF_2Cl_2 was developed for use as an aerosol.

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..... **[1]**

(ii) Suggest why CF_2Cl_2 does **not** hydrolyse in water.

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..... **[1]**

(c) Explain, with the aid of equations, how the presence of CFCs in the upper atmosphere leads to ozone depletion.

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..... **[3]**

(d) Why are scientists concerned about ozone depletion?

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..... **[1]**

(e) International agreements have reduced the use of CFCs. However the concentration of atmospheric CFCs has hardly changed.

Suggest **two** reasons why.

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..... **[2]**

[Total: 10]

4 This question is about halogenated hydrocarbons.

(a) Halogenoalkanes undergo nucleophilic substitution reactions with ammonia to form amines. Amines contain the $–NH_2$ functional group.

For example, 1-bromopropane reacts with ammonia to form propylamine, $CH_3CH_2CH_2NH_2$.

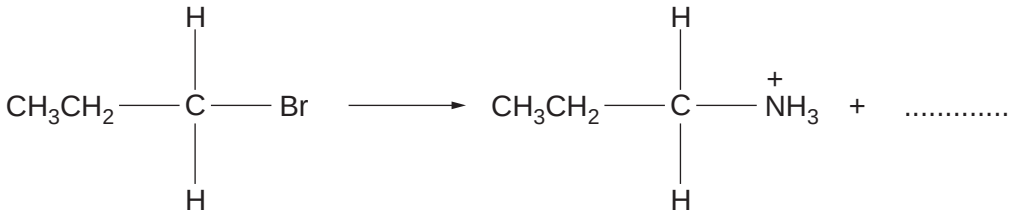
$$CH_3CH_2CH_2Br + 2NH_3 \longrightarrow CH_3CH_2CH_2NH_2 + NH_4Br$$

(i) Iodoethane is reacted with ammonia.

Write an equation for this reaction.

..... **[2]**

(ii) The first step in the mechanism of the reaction between $CH_3CH_2CH_2Br$ and NH_3 is shown below. It is incomplete.



Complete the mechanism.

Include relevant dipoles, lone pairs, curly arrows and the missing product. **[3]**

(b) A student investigates the rate of hydrolysis of six halogenoalkanes.

The student mixes 5 cm^3 of ethanol with five drops of halogenoalkane. This mixture is warmed to 50 °C in a water bath. The student adds 5 cm^3 of aqueous silver nitrate, also heated to 50 °C, to the halogenoalkane. The time taken for a precipitate to form is recorded in a results table.

The student repeats the whole experiment at 60 °C instead of 50 °C.

halogenoalkane	**time taken for a precipitate to form / s**	
	at 50 °C	**at 60 °C**
$CH_3CH_2CH_2CH_2Cl$	243	121
$CH_3CH_2CH_2CH_2Br$	121	63
$CH_3CH_2CH_2CH_2I$	40	19
$CH_3CH_2CHBrCH_3$	89	42
$(CH_3)_2CHCH_2Br$	110	55
$(CH_3)_3CBr$	44	21

Describe and explain the factors that affect the rate of hydrolysis of halogenoalkanes.

Include ideas about
- the halogen in the halogenoalkanes
- the groups attached to the carbon of the carbon–halogen bond (the type of halogenoalkane)
- the temperature of the hydrolysis.

In your answer you should link the evidence with your explanation.

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(c) Poly(tetrafluoroethene), PTFE, and poly(chloroethene), PVC, are halogenated plastics.

(i) Write an equation, using displayed formulae, for the reaction to form PTFE from its monomer.

[3]

(ii) The combustion of waste polymers can be used for energy production.

What problem is caused by disposing of PTFE and PVC in this way?

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..... **[1]**

[Total: 16]