

Halogenoalkanes

Question Paper 3

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Halogen Derivatives
Sub-Topic	Halogenoalkanes
Paper Type	Multiple Choice
Booklet	Question Paper 3

Time Allowed: 27 minutes

Score: /22

Percentage: /100

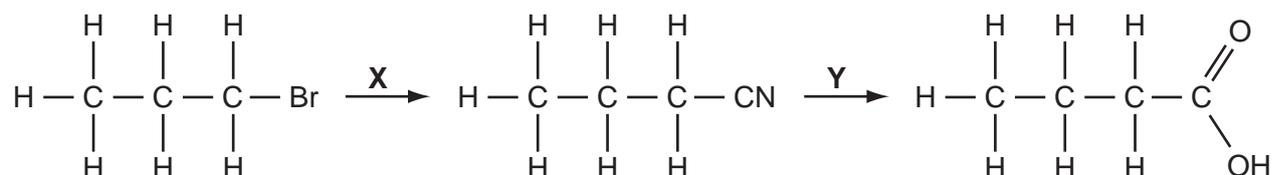
Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 **X** and **Y** are the reagents required to convert 1-bromopropane into butanoic acid.



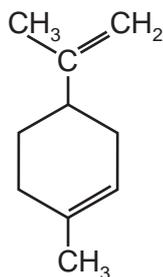
What are the correct identities of **X** and **Y**?

	X	Y
A	NH ₃	HCl(aq)
B	KCN in C ₂ H ₅ OH	NaOH(aq)
C	KCN in C ₂ H ₅ OH	HCl(aq)
D	HCN	NaOH(aq)

- 2 Which reaction occurs when ethane and chlorine are mixed in diffused sunlight?

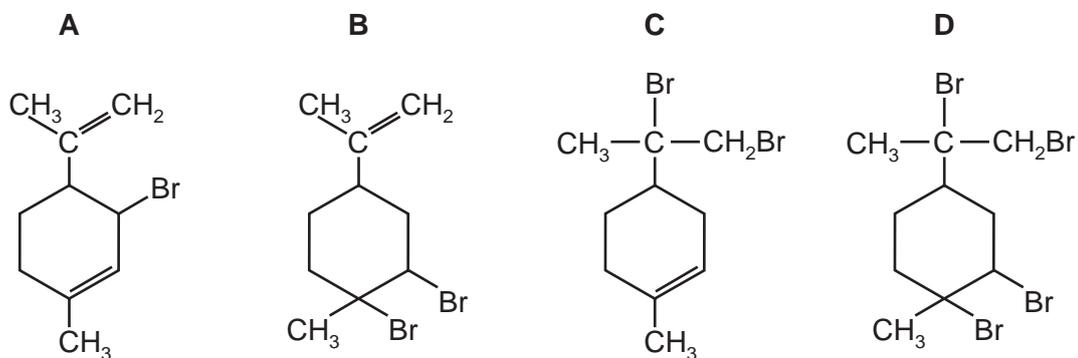
- A** a free-radical substitution with hydrogen given off
- B** a free-radical substitution with hydrogen chloride given off
- C** a free-radical substitution with no gas given off
- D** a nucleophilic substitution with hydrogen chloride given off

- 3 Limonene is an oil formed in the peel of citrus fruits.



limonene

Which product is formed when molecular bromine reacts with limonene at room temperature in the dark?



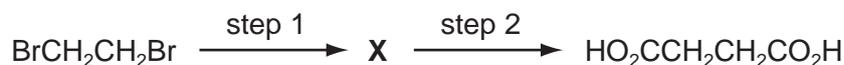
- 4 Chlorofluoroalkanes, CFCs, can be used as refrigerants, aerosol propellants and fire extinguishers.

CFCs such as CCl₃F and CCl₂F₂ are more stable than chloroalkanes such as CCl₄.

What is the reason for their greater stability?

- A** Fluorine has a higher first ionisation energy than chlorine.
B Fluorine radicals are more stable than chlorine radicals.
C The C–F bond energy is larger than the C–Cl bond energy.
D The C–F bond is more polar than the C–Cl bond.

- 5 Butanedioic acid occurs in amber, algae, lichens, sugar cane and beets. It may be synthesised in two steps from 1,2-dibromoethane.



Which reagents could be used for this synthesis?

	step 1	step 2
A	HCN(g)	HCl(aq)
B	HCO ₂ Na(aq)	HCl(aq)
C	KCN(aq/alcoholic)	H ₂ SO ₄ (aq)
D	NaOH(aq)	K ₂ Cr ₂ O ₇ /H ₂ SO ₄ (aq)

- 6 Light initiates the following reaction.



What happens to chlorine in this photochemical reaction?

- A** heterolytic fission to give an electrophile
B homolytic fission to give an electrophile
C heterolytic fission to give a free radical
D homolytic fission to give a free radical
- 7 High-energy irradiation in the stratosphere produces radicals from chlorofluoroalkanes, commonly known as CFCs.

Which radical could result from this irradiation of CHFC₁CF₂Cl?

- A** CHFC₁ $\dot{\text{C}}$ FC₁
B $\dot{\text{C}}$ HC₁CF₂Cl
C $\dot{\text{C}}$ HFCF₂Cl
D $\dot{\text{C}}$ FC₁CF₂Cl

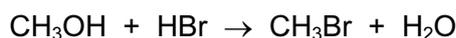
8 What is the total number of different chloroethanes, formula $C_2H_{6-n}Cl_n$, where n can be any integer from 1 to 4?

- A 4 B 6 C 7 D 8

9 Which reaction is an example of nucleophilic substitution?

- A $CH_3CH_2Br \rightarrow CH_2=CH_2 + HBr$
 B $CH_2=CH_2 + HBr \rightarrow CH_3CH_2Br$
 C $C_3H_7Br + H_2O \rightarrow C_3H_7OH + HBr$
 D $C_2H_6 + Br_2 \rightarrow C_2H_5Br + HBr$

10 Bromomethane, CH_3Br , is used as a fumigant to destroy insect pests in grain that is to be stored. It can be made by reacting methanol with hydrogen bromide.



What type of reaction is this?

- A condensation
 B electrophilic substitution
 C free radical substitution
 D nucleophilic substitution

11 Under the Montreal Protocol the use of chlorofluorocarbons is to be phased out. Fluorocarbons are often used to replace them. One chlorofluorocarbon which was widely used as a solvent is CCl_2FCClF_2 and large stocks of it remain. One process to use up these stocks is to convert it into the fluorocarbon CH_2FCF_3 by the following route.



What type of reaction is step 1?

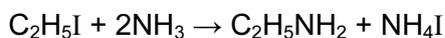
- A elimination
 B free radical substitution
 C isomerisation
 D nucleophilic substitution

- 12 Dichlorodifluoromethane, CCl_2F_2 , has been used in aerosol propellants and as a refrigerant.

Which statement helps to explain why dichlorodifluoromethane is chemically inert?

- A The carbon-fluorine bond energy is large.
- B The carbon-fluorine bond has a low polarity.
- C Fluorine is highly electronegative.
- D Fluorine compounds are non-flammable.

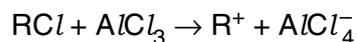
- 13 An amine is produced in the following reaction.



What is the mechanism?

- A electrophilic addition
 - B electrophilic substitution
 - C nucleophilic addition
 - D nucleophilic substitution
- 14 How many different substitution products are possible, in principle, when a mixture of bromine and ethane is allowed to react?
- A 3 B 5 C 7 D 9
- 15 The reaction of chlorine with methane is carried out in the presence of light.
- What is the function of the light?
- A to break the C–H bonds in methane
 - B to break up the chlorine molecules into atoms
 - C to break up the chlorine molecules into ions
 - D to heat up the mixture

- 16 Aluminium chloride catalyses certain reactions by forming carbocations (carbonium ions) with chloroalkanes as shown.



Which property makes this reaction possible?

- A $AlCl_3$ is a covalent molecule.
- B $AlCl_3$ exists as the dimer Al_2Cl_6 in the vapour.
- C The aluminium atom in $AlCl_3$ has an incomplete octet of electrons.
- D The chlorine atom in RCl has a vacant p orbital.

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

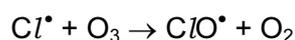
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

17 What types of reaction are undergone by 2-bromopropane?

- 1 elimination
- 2 free radical substitution
- 3 nucleophilic substitution

18 The chlorine oxide free radical, ClO^\bullet , is formed during the depletion of the ozone layer by chlorofluoroalkanes (CFCs).



Which features are present in the chlorine oxide free radical?

- 1 an odd number of electrons
- 2 a single covalent bond
- 3 a dative covalent bond from oxygen to chlorine

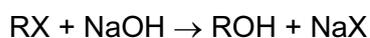
19 Which are properties of fluoroalkanes?

- 1 They are less reactive than the corresponding chloroalkanes.
- 2 They are non-flammable.
- 3 The C-F bond is stronger than a C-Cl bond.

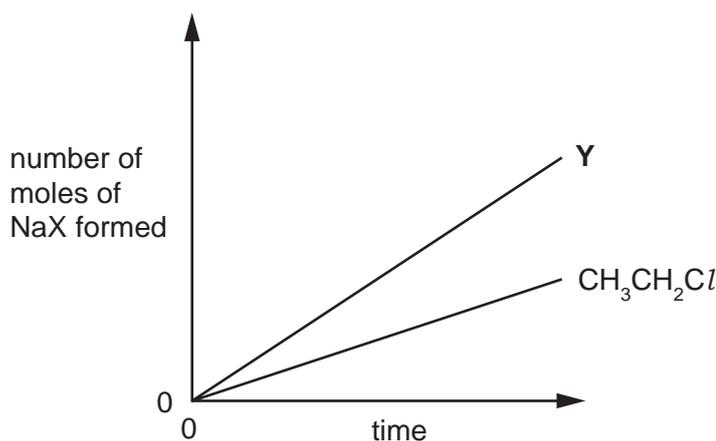
20 Which compounds may result from mixing ethane and chlorine in the presence of sunlight?

- 1 $\text{CH}_3\text{CH}_2\text{Cl}$
- 2 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- 3 $\text{CH}_3\text{CHClCHClCH}_3$

21 When halogenoalkanes, RX, are hydrolysed with NaOH, the corresponding sodium halide, NaX, is produced.



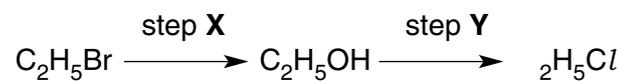
A student investigated the amount of NaX produced by hydrolysing $\text{CH}_3\text{CH}_2\text{Cl}$ and another halogenoalkane, Y. In a given time the amount of sodium halide formed was greater with Y than with $\text{CH}_3\text{CH}_2\text{Cl}$.



Which compound could be Y?

- 1 $\text{ClCH}_2\text{CH}_2\text{Cl}$
- 2 $\text{CH}_3\text{CH}_2\text{Br}$
- 3 $\text{CH}_3\text{CH}_2\text{I}$

22 Chloroethane can be formed from bromoethane in two steps.



Which statements about these steps are correct?

- 1 Step X involves a nucleophilic substitution.
- 2 Hot aqueous sodium hydroxide is the reagent in step X.
- 3 Hot aqueous sodium chloride is the reagent in step Y.