

Cambridge AS & A Level

# CHEMISTRY

## Paper 1

Topical Past Paper Questions  
+ Answer Scheme

2015 - 2021



## Chapter 15

# Halogen compounds

### 15.1 Halogenoalkanes

877. 9701\_m22\_qp\_12 Q: 28

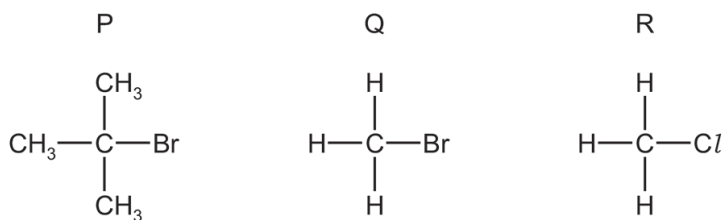
Alkenes react with aqueous hydrogen bromide. The reaction proceeds via an intermediate carbocation. The more stable the intermediate, the faster the reaction.

Which sequence correctly shows an **increase** in the speed of reaction of the alkenes with hydrogen bromide?

- A ethene, propene, 2-methylpropene
  - B 2-methylpropene, ethene, propene
  - C propene, ethene, 2-methylpropene
  - D propene, 2-methylpropene, ethene
-

878. 9701\_m22\_qp\_12 Q: 30

The diagram shows the structures of three halogenoalkanes.



P, Q and R can all be hydrolysed.

Which row is correct?

	relative speed of hydrolysis		mechanism of hydrolysis	
	Q	R	P	Q
<b>A</b>	fast	slow	S <sub>N</sub> 1	S <sub>N</sub> 2
<b>B</b>	fast	slow	S <sub>N</sub> 2	S <sub>N</sub> 1
<b>C</b>	slow	fast	S <sub>N</sub> 1	S <sub>N</sub> 2
<b>D</b>	slow	fast	S <sub>N</sub> 2	S <sub>N</sub> 1

879. 9701\_m21\_qp\_12 Q: 25

Dibromopentanes can undergo 'double elimination' reactions to produce hydrocarbons.



Which isomer produces only one hydrocarbon product?

- A 1,5-dibromopentane
- B 1,4-dibromopentane
- C 2,3-dibromopentane
- D 2,4-dibromopentane

880. 9701\_s21\_qp\_12 Q: 24

A few drops of 2-bromopropane were placed in a test-tube. An equal volume of aqueous silver nitrate was added. A precipitate was formed.

The experiment was repeated with 2-iodopropane.

Which row is correct?

	colour of precipitate from <b>2-bromopropane</b> + AgNO <sub>3</sub> (aq)	faster rate of reaction
<b>A</b>	cream	2-bromopropane + AgNO <sub>3</sub> (aq)
<b>B</b>	yellow	2-bromopropane + AgNO <sub>3</sub> (aq)
<b>C</b>	cream	2-iodopropane + AgNO <sub>3</sub> (aq)
<b>D</b>	yellow	2-iodopropane + AgNO <sub>3</sub> (aq)

881. 9701\_s21\_qp\_12 Q: 25

Sodium methoxide, Na<sup>+</sup>CH<sub>3</sub>O<sup>-</sup>, reacts with 2-chloro-2-methylpropane in a nucleophilic substitution reaction. The nucleophile is the CH<sub>3</sub>O<sup>-</sup> ion.

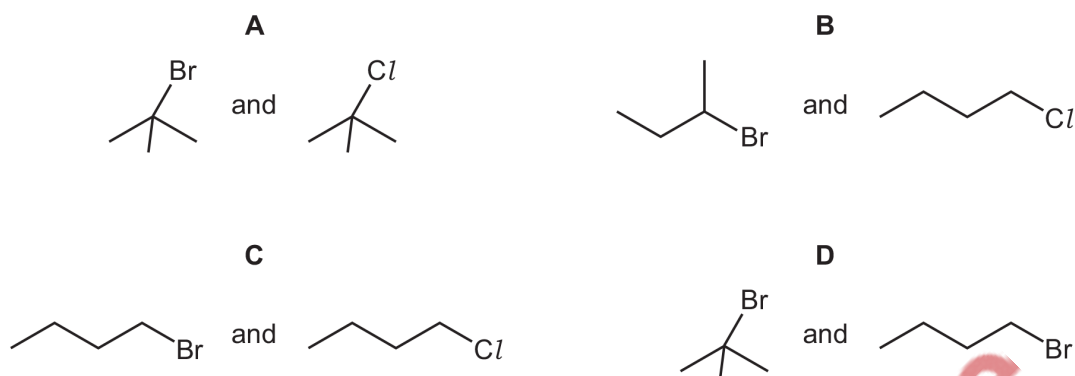
Which row is correct?

	intermediate or transition state	product
<b>A</b>	(CH <sub>3</sub> ) <sub>3</sub> C <sup>+</sup>	(CH <sub>3</sub> ) <sub>3</sub> COCH <sub>3</sub>
<b>B</b>	(CH <sub>3</sub> ) <sub>3</sub> C <sup>+</sup>	(CH <sub>3</sub> ) <sub>3</sub> CCH <sub>2</sub> OH
<b>C</b>	$\left[ \begin{array}{c} \text{H}_3\text{C} \quad \text{CH}_3 \\ \vdots \quad \diagup \\ \text{H}_3\text{CO} \cdots \text{C} \cdots \text{Cl} \\ \vdots \\ \text{CH}_3 \end{array} \right]^-$	HOCH <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub>
<b>D</b>	$\left[ \begin{array}{c} \text{H}_3\text{C} \quad \text{CH}_3 \\ \vdots \quad \diagup \\ \text{H}_3\text{CO} \cdots \text{C} \cdots \text{Cl} \\ \vdots \\ \text{CH}_3 \end{array} \right]^-$	H <sub>3</sub> COC(CH <sub>3</sub> ) <sub>3</sub>

882. 9701\_s21\_qp\_13 Q: 23

Halogenoalkanes react with nucleophiles such as  $\text{OH}^-$ .

Which pair of halogenoalkanes **both** react via an  $\text{S}_{\text{N}}1$  mechanism?



883. 9701\_w21\_qp\_12 Q: 25

A halogenoalkane has the molecular formula  $\text{C}_5\text{H}_{11}\text{Br}$ . The halogenoalkane does **not** form an alkene when treated with ethanolic sodium hydroxide.

What could be the halogenoalkane?

- A 1-bromo-2-methylbutane
- B 2-bromo-2-methylbutane
- C 3-bromopentane
- D 1-bromo-2,2-dimethylpropane

884. 9701\_m20\_qp\_12 Q: 21

Which row identifies a suitable starting material and reagent that can be used to produce butanenitrile?

	starting material	reagent
<b>A</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$	$\text{HCN}$
<b>B</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$	$\text{NaCN}$
<b>C</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$	$\text{HCN}$
<b>D</b>	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$	$\text{NaCN}$

885. 9701\_s20\_qp\_11 Q: 23

2-bromo-2-methylpentane is a tertiary halogenoalkane.

Which organic products are formed when 2-bromo-2-methylpentane reacts with a hot concentrated ethanolic solution of sodium hydroxide?

- A 2-methylpent-1-ene only
- B 2-methylpent-1-ene and 2-methylpent-2-ene
- C 2-methylpent-2-ene only
- D 2-methylpent-2-ene and 4-methylpent-2-ene

886. 9701\_s20\_qp\_13 Q: 27

1,2-dibromopropane can be made from 1-bromopropane in two steps.

Which row is correct?

	step 1	step 2
<b>A</b>	addition	substitution
<b>B</b>	elimination	addition
<b>C</b>	hydrolysis	elimination
<b>D</b>	substitution	hydrolysis

887. 9701\_w20\_qp\_11 Q: 23

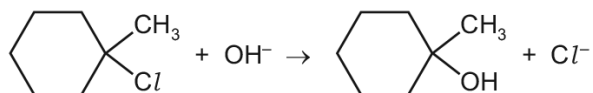
Iodoethane,  $\text{CH}_3\text{CH}_2\text{I}$ , reacts with aqueous silver nitrate at  $50^\circ\text{C}$ . A precipitate forms during this reaction.

Which row of the table is correct about this reaction?

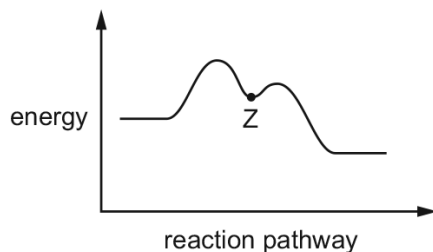
	type of organic reaction	colour of precipitate
<b>A</b>	electrophilic substitution	cream
<b>B</b>	electrophilic substitution	yellow
<b>C</b>	nucleophilic substitution	cream
<b>D</b>	nucleophilic substitution	yellow

888. 9701\_w20\_qp\_11 Q: 25

1-chloro-1-methylcyclohexane is hydrolysed by heating with NaOH(aq).



The reaction pathway is shown.



One carbon atom in 1-chloro-1-methylcyclohexane is bonded to three other carbon atoms.

What is the charge on this carbon atom at point Z?

- A** 1-                      **B**  $\delta^-$                       **C**  $\delta^+$                       **D** 1+

889. 9701\_m19\_qp\_12 Q: 23

Structural isomerism and stereoisomerism should be considered when answering this question.

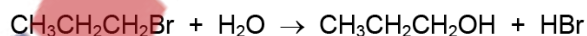
2-bromopentane is heated with an excess of ethanolic sodium hydroxide.

How many different hydrocarbons are produced?

- A** 1                      **B** 2                      **C** 3                      **D** 4

890. 9701\_m19\_qp\_12 Q: 24

Bromopropane reacts with water as shown.



Which statement is correct?

- A** This is an elimination reaction.  
**B** This is a hydrolysis reaction.  
**C** This is a redox reaction.  
**D** This reaction tends to proceed via the  $\text{S}_{\text{N}}1$  mechanism.

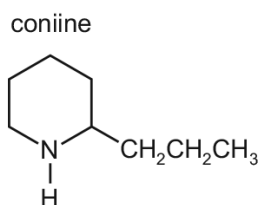
891. 9701\_s19\_qp\_11 Q: 23

Which reaction is most likely to involve the formation of a positively charged intermediate?

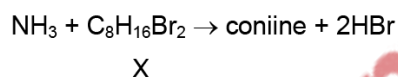
- A 1-bromopentane and warm dilute NaOH(aq)
- B 1-bromo-2,2-dimethylpropane and warm dilute NaOH(aq)
- C 1-bromo-3-methylbutane and warm dilute NaOH(aq)
- D 2-bromo-2-methylbutane and warm dilute NaOH(aq)

892. 9701\_s19\_qp\_11 Q: 25

The structure of coniine is shown.



Coniine can be synthesised by reacting ammonia with a dibromo compound, X.



What is the name of compound X?

- A 1,1-dibromo-2-propylcyclopentane
- B 1,2-dibromo-2-propylcyclopentane
- C 1,4-dibromooctane
- D 1,5-dibromooctane

893. 9701\_s19\_qp\_12 Q: 25

Which product can be made from bromoethane by an elimination reaction?

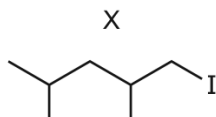
- A ethanol
- B ethene
- C ethylamine
- D propanenitrile



894. 9701\_s19\_qp\_13 Q: 20

The Finkelstein reaction occurs when NaI in propanone reacts with a chloroalkane or bromoalkane. The halogen is directly replaced by I. The reaction only works for primary halogenoalkanes.

Which halogenoalkane produces compound X?



- A  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{Br}$
- B  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{Br}$
- C  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{Cl}$
- D  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$

895. 9701\_s19\_qp\_13 Q: 24

Water is added to a sample of 2,3-dibromohexane.

Some of the 2,3-dibromohexane undergoes complete hydrolysis and some of it undergoes partial hydrolysis.

What is **not** present in the mixture of products?

- A  $\text{CH}_3\text{CH}(\text{OH})\text{CHBrCH}_2\text{CH}_2\text{CH}_3$
- B  $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CH}_3$
- C  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
- D  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CHBrCH}_3$

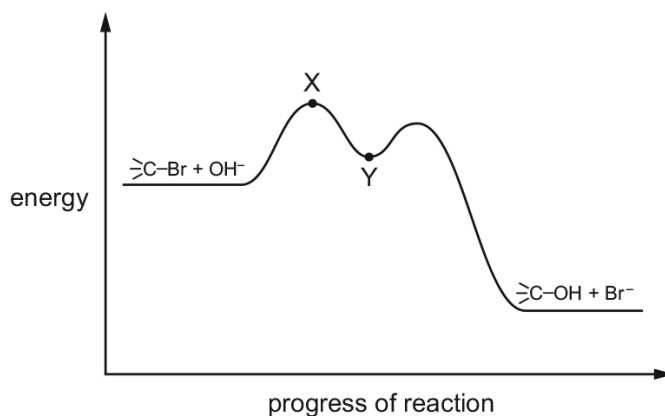
896. 9701\_s19\_qp\_13 Q: 25

Which statement about the mechanism of an  $\text{S}_{\text{N}}1$  reaction of a halogenoalkane is correct?

- A A nucleophile is substituted by an electrophile.
- B One intermediate is formed from two reacting molecules.
- C The intermediate is stabilised by adjacent alkyl groups.
- D The intermediate is uncharged.

897. 9701\_w19\_qp\_11 Q: 23

A tertiary bromoalkane, indicated here by  $\text{>C-Br}$ , reacts with aqueous NaOH. The mechanism has the reaction pathway shown.



Which point in the diagram is correctly identified?

A X is  $\text{>C}^+$

B X is  $\left[ \text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

C Y is  $\text{>C}^+$

D Y is  $\left[ \text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

898. 9701\_w19\_qp\_11 Q: 24

Bromoethane and chloroethane are added separately to water. Hydrolysis reactions occur.

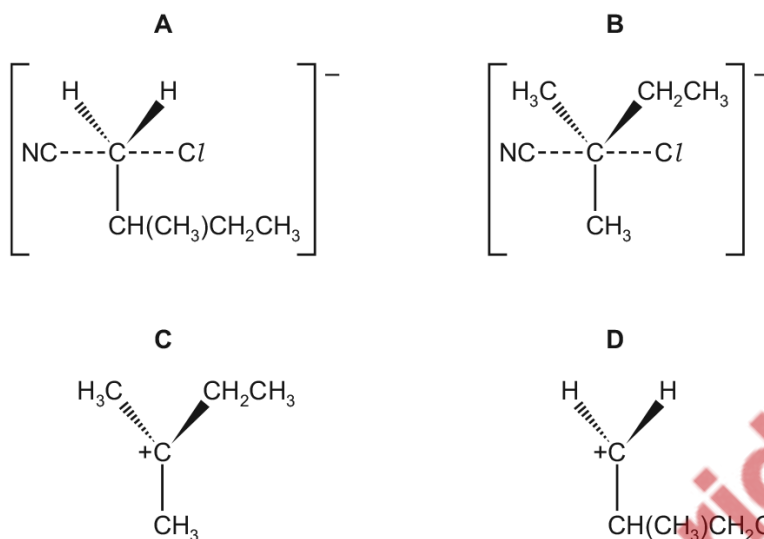
Which compound hydrolyses more rapidly and what is the mechanism?

	compound that hydrolyses more rapidly	mechanism
A	bromoethane	electrophilic substitution
B	bromoethane	nucleophilic substitution
C	chloroethane	electrophilic substitution
D	chloroethane	nucleophilic substitution

899. 9701\_w19\_qp\_12 Q: 23

1-chloro-2-methylbutane reacts with sodium cyanide in ethanol in a nucleophilic substitution reaction.

What is the most likely intermediate or transition state in this reaction?



900. 9701\_m18\_qp\_12 Q: 28

Ethanedioic acid has the formula  $\text{HO}_2\text{CCO}_2\text{H}$ .

What is the formula of aluminium ethanedioate?

- A**  $\text{AlC}_2\text{O}_4$       **B**  $\text{Al}(\text{C}_2\text{O}_4)_3$       **C**  $\text{Al}_2\text{C}_2\text{O}_4$       **D**  $\text{Al}_2(\text{C}_2\text{O}_4)_3$

901. 9701\_s18\_qp\_11 Q: 22

Sodium methoxide,  $\text{Na}^+\text{CH}_3\text{O}^-$ , reacts with 2-chloro-2-methylpropane in a nucleophilic substitution reaction. The nucleophile is the  $\text{CH}_3\text{O}^-$  ion.

Which row is correct?

	intermediate or transition state	product
<b>A</b>	$(\text{CH}_3)_3\text{C}^+$	$(\text{CH}_3)_3\text{COCH}_3$
<b>B</b>	$(\text{CH}_3)_3\text{C}^+$	$(\text{CH}_3)_3\text{CCH}_2\text{OH}$
<b>C</b>	$[\text{HOCH}_2 \cdots \text{C}(\text{CH}_3)_3 \cdots \text{Cl}]^-$	$\text{HOCH}_2\text{C}(\text{CH}_3)_3$
<b>D</b>	$[\text{H}_3\text{CO} \cdots \text{C}(\text{CH}_3)_3 \cdots \text{Cl}]^-$	$\text{H}_3\text{COC}(\text{CH}_3)_3$

902. 9701\_s18\_qp\_12 Q: 23

Primary halogenoalkanes undergo hydrolysis reactions.

Which reaction would occur most rapidly if they are all warmed to the same temperature?

- A  $\text{C}_2\text{H}_5\text{Br}$  with  $\text{H}_2\text{O}$
  - B  $\text{C}_2\text{H}_5\text{Br}$  with  $\text{NaOH}(\text{aq})$
  - C  $\text{C}_2\text{H}_5\text{Cl}$  with  $\text{H}_2\text{O}$
  - D  $\text{C}_2\text{H}_5\text{Cl}$  with  $\text{NaOH}(\text{aq})$
- 

903. 9701\_s18\_qp\_12 Q: 24

Structural isomerism and stereoisomerism should be considered when answering this question.

A colourless liquid,  $\text{C}_5\text{H}_{11}\text{Cl}$ , exists as a mixture of two optical isomers.

When heated with sodium hydroxide in ethanol, a mixture of **only** two alkenes is formed.

What could the colourless liquid be?

- A  $(\text{CH}_3\text{CH}_2)_2\text{CHCl}$
  - B  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHClCH}_3$
  - C  $(\text{CH}_3)_2\text{CHCHClCH}_3$
  - D  $\text{CH}_3\text{CH}_2\text{CCl}(\text{CH}_3)_2$
- 

904. 9701\_s18\_qp\_12 Q: 25

When warm water is added to halogenoalkane X, an  $\text{S}_{\text{N}}1$  reaction occurs.

$\text{AgNO}_3(\text{aq})$  is then added; a yellow precipitate is formed.

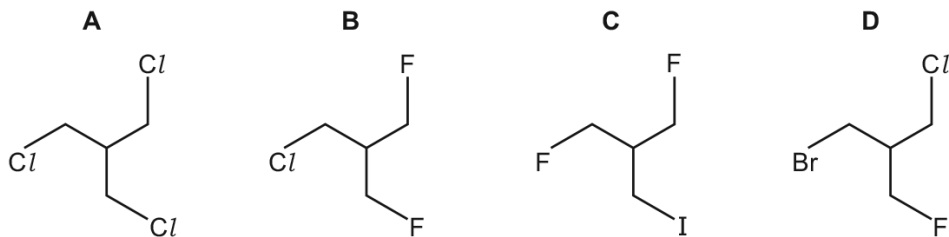
What could be X?

- A 1-chlorobutane
  - B 1-iodobutane
  - C 2-chloro-2-methylpropane
  - D 2-iodo-2-methylpropane
-

905. 9701\_s18\_qp\_13 Q: 23

The presence of a halogen in an organic compound may be detected by warming the organic compound with aqueous silver nitrate.

Which compound would be the quickest to produce a precipitate?



906. 9701\_s18\_qp\_13 Q: 24

Halogenoalkanes react with NaOH(aq) either by an  $S_N1$  mechanism or by an  $S_N2$  mechanism. The mechanism followed by the reaction depends on the structure of the halogenoalkane.

This question is about the reaction of 3-bromo-3-ethylpentane,  $(C_2H_5)_3CBr$ .

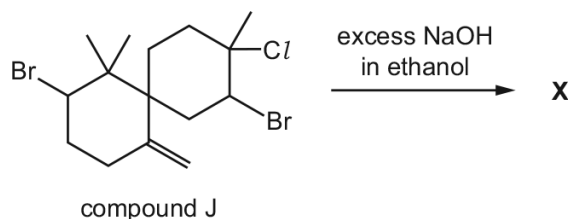
Which statement is correct?

- A** The mechanism is  $S_N1$ , due to the stabilisation of an intermediate anion by three alkyl groups.
- B** The mechanism is  $S_N1$ , due to the stabilisation of an intermediate cation by three alkyl groups.
- C** The mechanism is  $S_N2$ , due to the stabilisation of an intermediate anion by three alkyl groups.
- D** The mechanism is  $S_N2$ , due to the stabilisation of an intermediate cation by three alkyl groups.

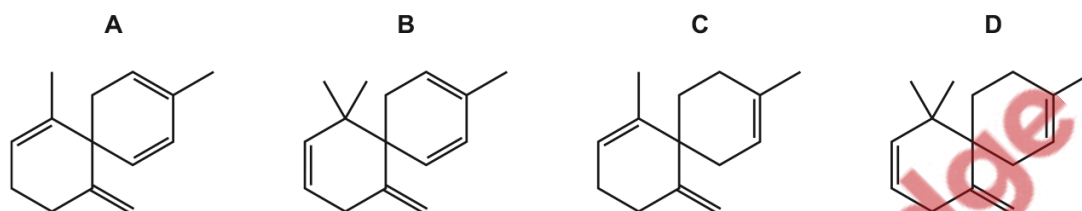


907. 9701\_w18\_qp\_11 Q: 25

Compound J,  $C_{15}H_{23}Br_2Cl$ , is reacted with an excess of a hot concentrated solution of sodium hydroxide in ethanol. One of the products is X.

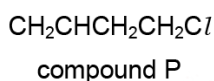


What could be the skeletal formula of X?



908. 9701\_w18\_qp\_12 Q: 23

Compound P reacts separately with  $KOH(aq)$  and  $HBr$ .



What are the mechanisms of these two reactions?

	$KOH(aq)$	$HBr$
<b>A</b>	nucleophilic addition	electrophilic addition
<b>B</b>	nucleophilic addition	free radical substitution
<b>C</b>	nucleophilic substitution	electrophilic addition
<b>D</b>	nucleophilic substitution	free radical substitution

909. 9701\_w18\_qp\_12 Q: 25

A halogenoalkane has the molecular formula  $C_5H_{11}Br$ . The halogenoalkane does not form an alkene when treated with ethanolic sodium hydroxide.

What could be the halogenoalkane?

- A** 1-bromo-2-methylbutane
- B** 2-bromo-2-methylbutane
- C** 3-bromopentane
- D** bromodimethylpropane

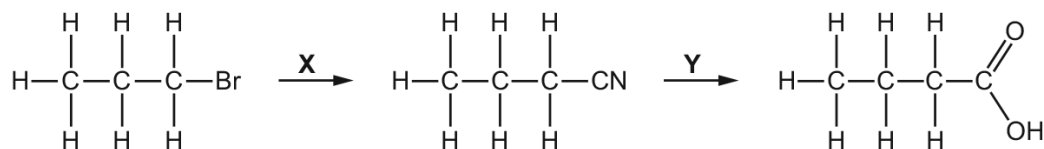
910. 9701\_m17\_qp\_12 Q: 22

Which radical is most likely to form by the homolytic fission of one covalent bond in bromochloromethane,  $\text{CH}_2\text{BrCl}$ ?

- A  $\cdot\text{CH}_2\text{Cl}$       B  $\cdot\text{CH}_2\text{Br}$       C  $\cdot\text{CHBrCl}$       D  $\cdot\text{CH}_2\text{BrCl}$

911. 9701\_s17\_qp\_11 Q: 26

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	$\text{NH}_3$	$\text{HCl}(\text{aq})$
B	KCN in $\text{C}_2\text{H}_5\text{OH}$	$\text{NaOH}(\text{aq})$
C	KCN in $\text{C}_2\text{H}_5\text{OH}$	$\text{HCl}(\text{aq})$
D	$\text{HCN}$	$\text{NaOH}(\text{aq})$

912. 9701\_s17\_qp\_12 Q: 23

Aqueous sodium hydroxide reacts with 1-bromopropane to give propan-1-ol.

What should be included in a diagram of the first step in the mechanism?

- A a curly arrow from a lone pair on the  $\text{OH}^-$  ion to the  $\text{C}^{\delta+}$  atom of 1-bromopropane  
 B a curly arrow from the  $\text{C}^{\delta+}$  atom of 1-bromopropane to the  $\text{OH}^-$  ion  
 C a curly arrow from the  $\text{C}-\text{Br}$  bond to the C atom  
 D the homolytic fission of the  $\text{C}-\text{Br}$  bond

913. 9701\_s17\_qp\_12 Q: 26

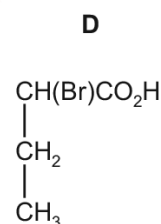
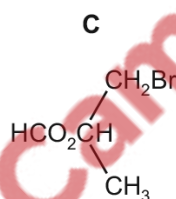
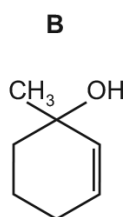
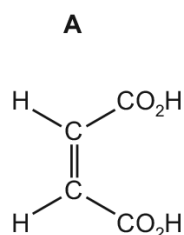
2-bromo-2-methylpropane undergoes nucleophilic substitution when heated under reflux with an aqueous solution of sodium hydroxide.

Which row is correct?

	mechanism for this reaction	reason
<b>A</b>	S <sub>N</sub> 1	the hydroxide ion is helped in its approach to the central carbon atom by the methyl groups
<b>B</b>	S <sub>N</sub> 1	the intermediate carbocation is stabilised by the inductive effect of the methyl groups
<b>C</b>	S <sub>N</sub> 2	the hydroxide ion is hindered in its approach to the central carbon atom by the methyl groups
<b>D</b>	S <sub>N</sub> 2	the intermediate carbocation is destabilised by the inductive effect of the methyl groups

914. 9701\_s17\_qp\_12 Q: 29

Which compound is chiral and reacts with Na<sub>2</sub>CO<sub>3</sub> to give CO<sub>2</sub>?



915. 9701\_w17\_qp\_12 Q: 25

Equal volumes of aqueous silver nitrate were added to separate small volumes of bromoethane and iodoethane in two test-tubes. The test-tubes were shaken.

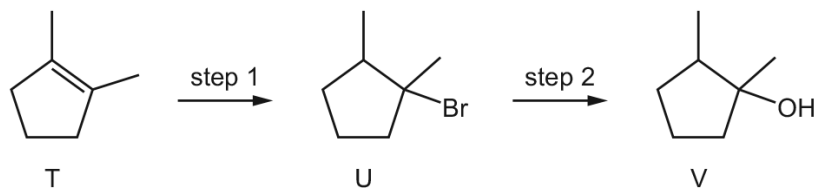
Which row about the observations made for **bromoethane** is correct?

	colour of precipitate	rate of reaction
<b>A</b>	cream	faster than for iodoethane
<b>B</b>	cream	slower than for iodoethane
<b>C</b>	yellow	faster than for iodoethane
<b>D</b>	yellow	slower than for iodoethane



916. 9701\_m16\_qp\_12 Q: 24

Hydrogen bromide can be added to T to give compound U. Compound U can be hydrolysed to compound V.



Four students, W, X, Y and Z, made the following statements.

- W All the atoms in a molecule of compound T lie in the same plane.
- X Compound V contains only one chiral centre.
- Y Step 1 is an electrophilic addition reaction.
- Z Step 2 is a nucleophilic substitution reaction.

Which two students are correct?

- A** W and Y      **B** W and Z      **C** X and Y      **D** Y and Z

917. 9701\_m16\_qp\_12 Q: 25

Structural isomerism and stereoisomerism should be considered in answering this question.

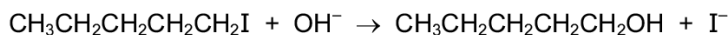
Compound J is reacted with KOH dissolved in ethanol. Three isomeric alkenes with molecular formula  $C_4H_8$  are formed.

What is J?

- A**  $CH_3-CH_2-CH_2-CH_2-Br$
- B**  $CH_3-\underset{\substack{| \\ Br}}{CH}-CH_2-CH_3$
- C**  $CH_3-\underset{\substack{| \\ CH_3}}{CH}-CH_2-Br$
- D**  $CH_3-\underset{\substack{| \\ CH_3}}{\overset{\substack{CH_3 \\ |}}{C}}-Br$

918. 9701\_s16\_qp\_11 Q: 25

A student prepares pentan-1-ol by the alkaline hydrolysis of 1-iodopentane. She gently warms the reaction mixture for 20 minutes.



When the student uses 1-chloropentane to prepare the same alcohol she has to change the condition of the reaction.

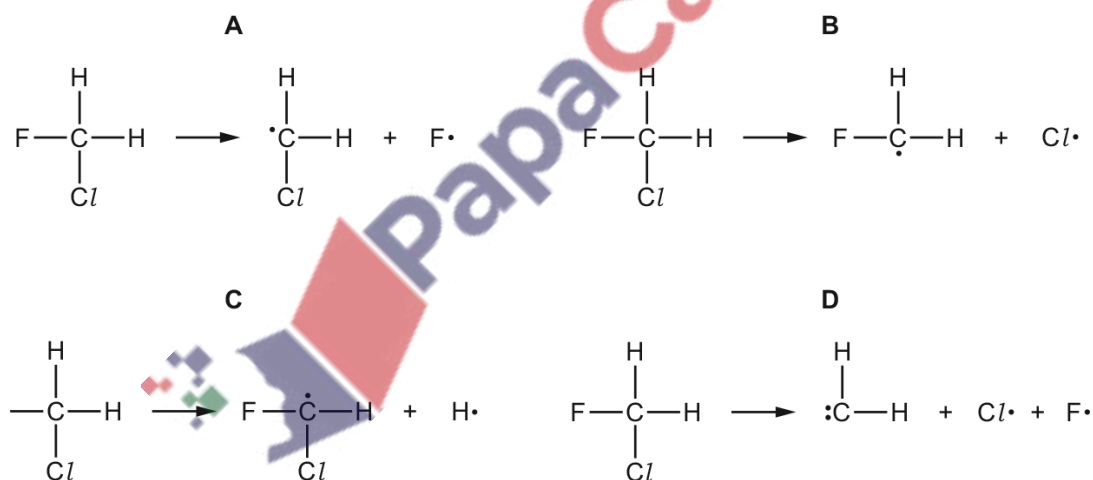
Which change in condition should she use and what is the correct reason for its use?

	change in condition	reason
<b>A</b>	heat under reflux	C–Cl bond is more polar than the C–I bond
<b>B</b>	heat under reflux	C–Cl bond is stronger than the C–I bond
<b>C</b>	room temperature	C–Cl bond is more polar than the C–I bond
<b>D</b>	room temperature	C–Cl bond is shorter than the C–I bond

919. 9701\_s16\_qp\_12 Q: 20

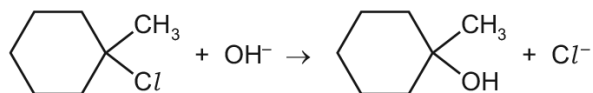
Chlorofluorocarbons damage the ozone layer by undergoing reactions with a free radical mechanism. The first stage of this is initiation.

Which equation is most likely to be the initiation stage when chlorofluoromethane is involved in such a reaction?

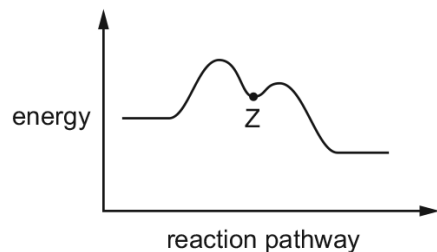


920. 9701\_s16\_qp\_12 Q: 24

1-chloro-1-methylcyclohexane is hydrolysed by heating with NaOH(aq).



The reaction pathway is shown.



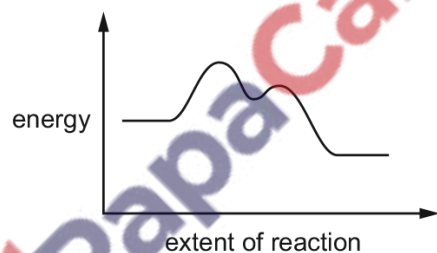
One carbon atom in 1-chloro-1-methylcyclohexane is bonded to three other carbon atoms.

What is the charge on this carbon atom at point Z?

- A  $\delta+$                       B +                      C  $\delta-$                       D -

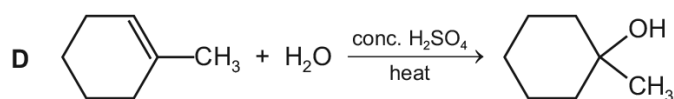
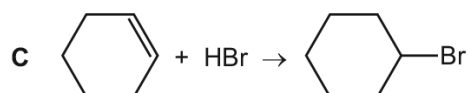
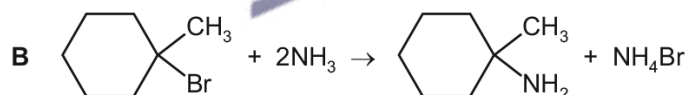
921. 9701\_s16\_qp\_13 Q: 25

A reaction pathway diagram is shown.



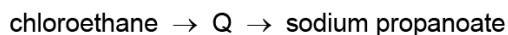
The four reactions that follow are all exothermic.

Which reaction would **not** have such a pathway?



922. 9701\_w16\_qp\_11 Q: 24

Chloroethane can be used to make sodium propanoate.



The intermediate, Q, is hydrolysed with boiling aqueous sodium hydroxide to give sodium propanoate.

Which reagent would produce the intermediate, Q, from chloroethane?

- A concentrated ammonia solution
- B dilute sulfuric acid
- C hydrogen cyanide in water
- D potassium cyanide in ethanol

923. 9701\_w16\_qp\_12 Q: 22

The reaction  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br} + \text{OH}^- \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + \text{Br}^-$  proceeds via an  $\text{S}_{\text{N}}2$  mechanism.

The reaction  $(\text{CH}_3)_3\text{CBr} + \text{OH}^- \rightarrow (\text{CH}_3)_3\text{COH} + \text{Br}^-$  proceeds via an  $\text{S}_{\text{N}}1$  mechanism.

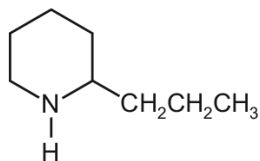
Which statement about these two reactions is correct?

- A Both reactions involve homolytic bond fission.
- B Both reactions involve hydroxide ions acting as electron pair donors.
- C Both reactions involve the formation of a positively-charged intermediate.
- D Both reactions occur in a single step.



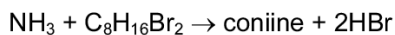
924. 9701\_s15\_qp\_11 Q: 24

Coniine is the major constituent of the poison 'oil of hemlock'.



coniine

Coniine can be synthesised by reacting ammonia with a dibromo compound, **X**.



**X**

What is the name of compound **X**?

- A 1,1-dibromo-2-propylcyclopentane
- B 1,2-dibromo-2-propylcyclopentane
- C 1,4-dibromooctane
- D 1,5-dibromooctane

925. 9701\_s15\_qp\_11 Q: 25

2-bromopropane reacts with a hot concentrated solution of sodium hydroxide in ethanol.

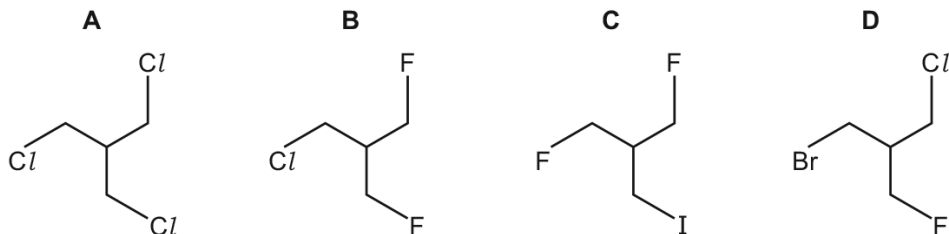
Which substance is the major product of this reaction?

- A propan-1-ol
- B propan-2-ol
- C 2-hydroxypropene
- D propene

926. 9701\_s15\_qp\_11 Q: 26

The presence of a halogen in an organic compound may be detected by warming the organic compound with aqueous silver nitrate.

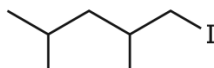
Which compound would be the quickest to produce a precipitate?



927. 9701\_s15\_qp\_13 Q: 22

The Finkelstein reaction occurs when NaI in propanone reacts with a chloroalkane or bromoalkane. The halogen is directly replaced by I and the reaction only works for primary halogenoalkanes.

Which halogenoalkane would produce compound X?



compound X

- A  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{Br}$
- B  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{Br}$
- C  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{Cl}$
- D  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$

928. 9701\_s15\_qp\_13 Q: 26

Alkane X has molecular formula  $\text{C}_4\text{H}_{10}$ .

X reacts with  $\text{Cl}_2(\text{g})$  in the presence of sunlight to produce only two different monochloroalkanes,  $\text{C}_4\text{H}_9\text{Cl}$ . Both of these monochloroalkanes produce the same alkene Y, and no other organic products, when they are treated with hot ethanolic KOH.

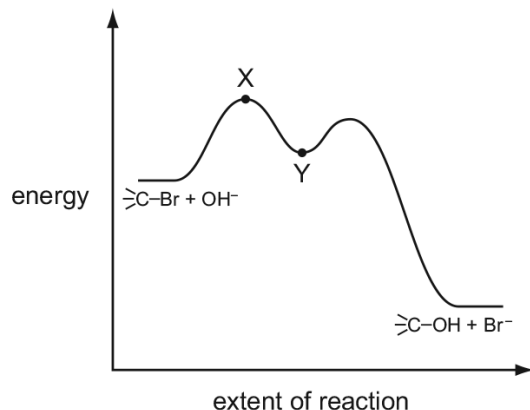
What is produced when Y is treated with hot concentrated acidified  $\text{KMnO}_4$ ?

- A  $\text{CO}_2$  and  $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
- B  $\text{CO}_2$  and  $\text{CH}_3\text{COCH}_3$
- C  $\text{HCO}_2\text{H}$  and  $\text{CH}_3\text{COCH}_3$
- D  $\text{CH}_3\text{CO}_2\text{H}$  only



929. 9701\_s15\_qp\_13 Q: 28

A tertiary bromoalkane, indicated here by  $\text{>C-Br}$ , reacts with aqueous NaOH. The mechanism has the reaction pathway below.



Which point in the diagram is correctly identified?

A X is  $\text{>C}^+$

B X is  $\left[ \text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

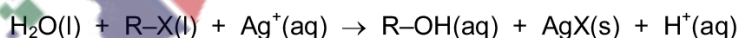
C Y is  $\text{>C}^+$

D Y is  $\left[ \text{HO} \cdots \text{C} \cdots \text{Br} \right]^-$

930. 9701\_s15\_qp\_13 Q: 29

Four drops of 1-chlorobutane, 1-bromobutane and 1-iodobutane were put separately into three test-tubes containing  $1.0 \text{ cm}^3$  of aqueous silver nitrate at  $60^\circ\text{C}$ .

In each case, a hydrolysis reaction occurred. R represents the butane chain  $\text{C}_4\text{H}_9$  and X the halogen atom.



The rate of formation of cloudiness in the test-tubes was in the order  $\text{RCI} < \text{RBr} < \text{RI}$ .

Why is this?

A The bond energy of R-X decreases from RCI to RI.

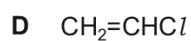
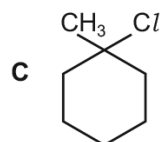
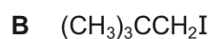
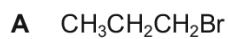
B The first ionisation energy of the halogen decreases from Cl to I.

C The solubility of AgX(s) decreases from AgCl to AgI.

D The R-X bond polarity decreases from RCI to RI.

931. 9701\_w15\_qp\_11 Q: 24

Which compound undergoes an  $S_N1$  substitution reaction with  $\text{NaOH(aq)}$ ?

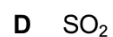
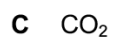
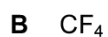


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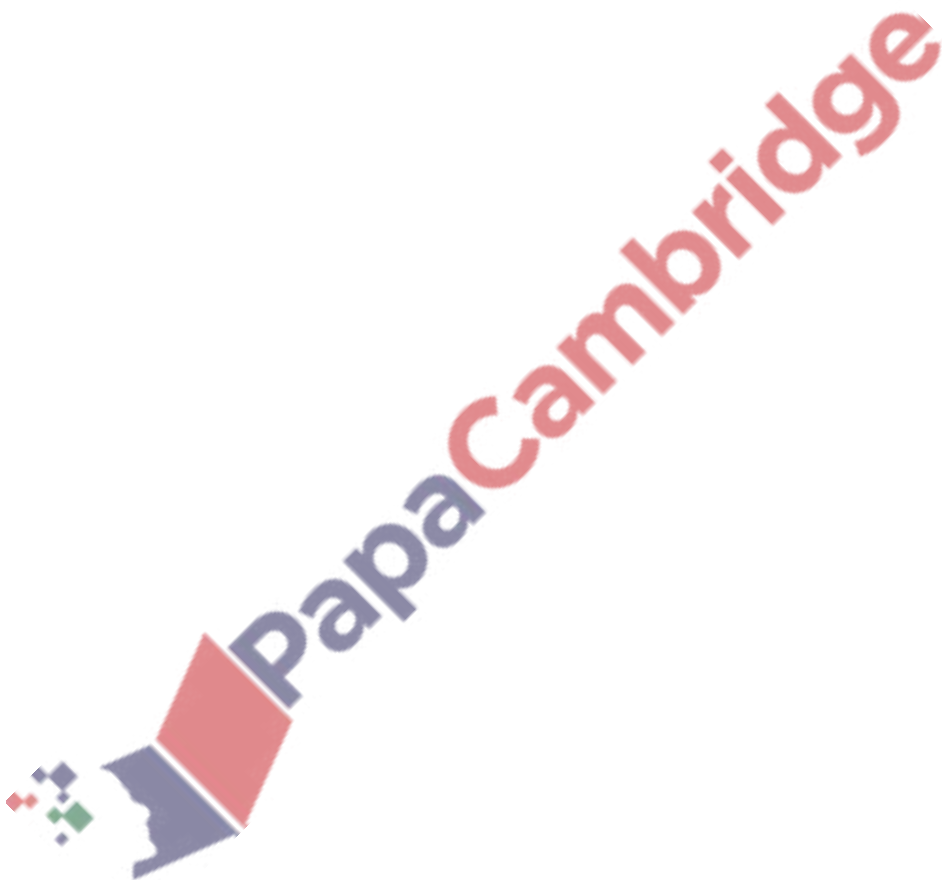
932. 9701\_w15\_qp\_12 Q: 24

The depletion of the ozone layer in the upper atmosphere reduces the Earth's natural protection from harmful ultraviolet radiation.

Which compound would cause the most depletion of the ozone layer?





 PapaCambridge