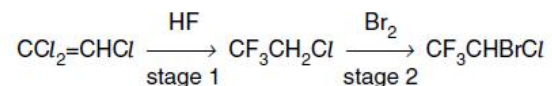

CHEMISTRY MULTIPLE CHOICE QUESTIONS

Organic Chemistry
Halogen Derivatives

2002 -2009

1.

The anaesthetic *halothane*, CF_3CHBrCl , is made industrially as shown below.



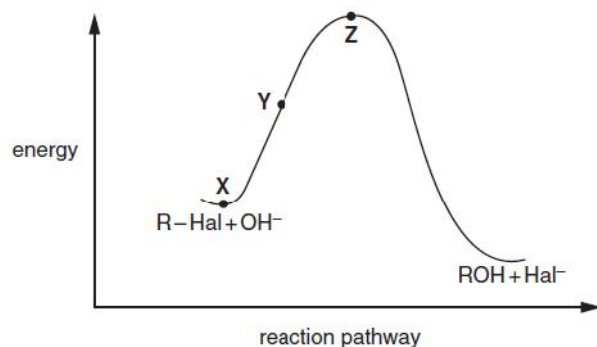
What type of reaction is occurring in stage 2?

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

[2002 M/J (19)]

2.

Halogenoalkanes react with aqueous alkali. One mechanism of this reaction has the reaction pathway diagram shown below.



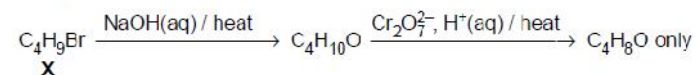
Which of the following statements are correct?

- 1 The reaction is an example of nucleophilic substitution.
- 2 Between X and Y the C-Hal bond will be lengthening.
- 3 The energy difference between X and Z represents the activation energy.

[2002 M/J (39)]

3.

Compound X undergoes the following reactions.



What is X?

- A 1-bromobutane
- B 2-bromobutane
- C 1-bromo-2-methylpropane
- D 2-bromo-2-methylpropane

[2002 O/N (24)]

4.

Chlorofluoroalkanes, commonly known as CFCs, undergo homolytic fission by ultraviolet irradiation in the stratosphere.

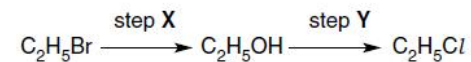
Which radical could result from this irradiation of $\text{CHFC}(\text{CF}_2)\text{Cl}$?

- A $\text{CHFC}(\dot{\text{C}}\text{FCl})$
- B $\dot{\text{C}}\text{HC}(\text{CF}_2)\text{Cl}$
- C $\dot{\text{C}}\text{HFCF}_2\text{Cl}$
- D $\dot{\text{C}}\text{FC}(\text{CF}_2)\text{Cl}$

[2003 M/J (27)]

5.

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.

[2003 M/J (38)]

6.

1,2-Dibromo-3-chloropropane (DBCP) has been used in the control of earthworms in agricultural land.

What would be the best synthesis of this compound?

- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + 2\text{Br}_2 \rightarrow \text{DBCP} + 2\text{HBr}$
 B $\text{CH}_3\text{CHBrCH}_2\text{Br} + \text{Cl}_2 \rightarrow \text{DBCP} + \text{HCl}$
 C $\text{CH}_2=\text{CHCH}_2\text{Cl} + \text{Br}_2 \rightarrow \text{DBCP}$
 D $\text{ClCH}_2\text{CH}=\text{CH}_2 + \text{PBr}_5 \rightarrow \text{DBCP} + \text{PBr}_3$

[2003 O/N (23)]

7.

Each of the following compounds is effective as a refrigerant.

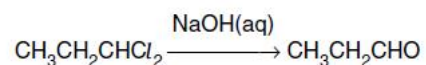
The release of which one of these causes the greatest depletion of the ozone layer?

- A CCl_2F_2 B CH_3OCH_3 C CH_3CHF_2 D $\text{CH}_3\text{CH}_2\text{CH}_3$

[2003 O/N (24)]

8.

1,1-Dichloropropane reacts with aqueous sodium hydroxide in a series of steps to give propanal.



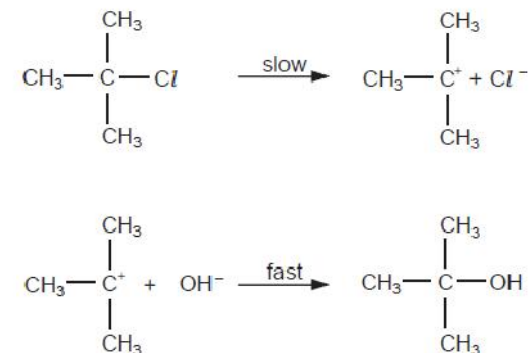
What is the mechanism of the first step of this reaction?

- A electrophilic substitution
 B elimination
 C nucleophilic substitution
 D oxidation

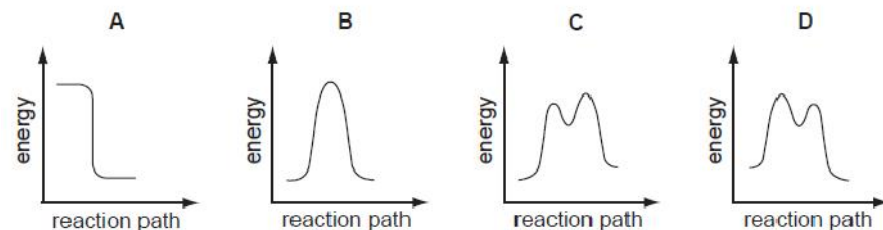
[2003 O/N (25)]

9.

A possible mechanism of the hydrolysis of 2-chloro-2-methylpropane is shown.



Which diagram represents the reaction profile for this mechanism?

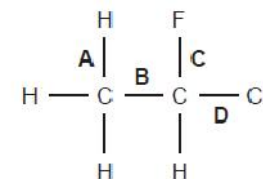


[2004 M/J (26)]

10.

Use of the Data Booklet is relevant to this question.

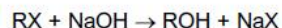
Which of the bonds in the structure below has the lowest bond energy?



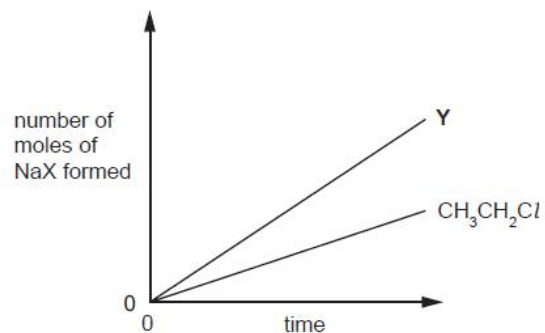
[2004 O/N (27)]

11.

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

[2004 O/N (38)]

12.

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.



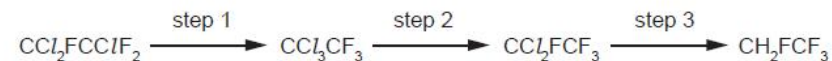
What type of reaction is this?

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

[2005 M/J (19)]

13.

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 $\text{CCl}_2\text{FCClF}_2$ 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

[2005 M/J (21)]

14.

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

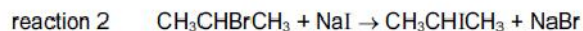
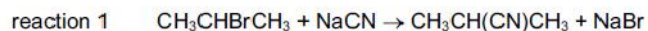
Which statement helps to explain why dichlorodifluoromethane is chemically inert?

- 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.

[2005 M/J (23)]

15.

Under identical conditions, even though it proceeds by the same mechanism, reaction 1 is faster than reaction 2.



What factor will explain this result?

- A The C—I bond is a stronger bond than the C—Br bond.
- B The C—N bond is a stronger bond than the C—I bond.
- C The cyanide ion is a stronger nucleophile than the iodide ion.
- D The cyanide ion is a weaker nucleophile than the iodide ion.

[2005 M/J (24)]

16.

In the upper atmosphere chlorofluoroalkanes (CFCs) are broken down to give chlorine radicals but not fluorine radicals.

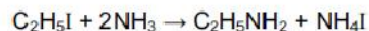
What is the best explanation for this?

- A Fluorine is more electronegative than chlorine.
- B Fluorine radicals are less stable than chlorine radicals.
- C The C—F bond is stronger than the C—Cl bond.
- D The chlorine atom is larger than the fluorine atom.

[2005 O/N (22)]

17.

An amine is produced in the following reaction.



What is the mechanism?

- A electrophilic addition
- B electrophilic substitution
- C nucleophilic addition
- D nucleophilic substitution

[2005 O/N (23)]

18.

High-energy irradiation in the stratosphere produces radicals from chlorofluoroalkanes, commonly known as CFCs.

Which radical could result from this irradiation of $\text{CHFClCF}_2\text{Cl}$?

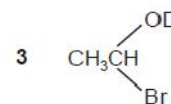
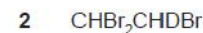
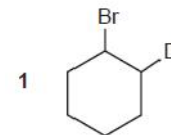
- A $\text{CHFCl}\dot{\text{C}}\text{FCl}$
- B $\dot{\text{C}}\text{HClCF}_2\text{Cl}$
- C $\dot{\text{C}}\text{HFCF}_2\text{Cl}$
- D $\dot{\text{C}}\text{FClCF}_2\text{Cl}$

[2006 M/J (25)]

19.

Deuterium, D, is the ^2_1H isotope of hydrogen. DBr has the same chemical properties as HBr.

Which compounds could be made by the reaction of DBr with another compound in a single reaction?



[2006 M/J (38)]

20.

When (chloromethyl)benzene, $C_6H_5CH_2Cl$, is treated in succession with two reagents **X** and **Y**, it gives phenylethanoic acid, $C_6H_5CH_2CO_2H$.

What are reagents **X** and **Y**?

	X	Y
A	NaOH(aq)	$K_2Cr_2O_7$ (aq)
B	Cl_2 (aq)	NaOH(aq)
C	NaCN (in aqueous ethanol)	dilute H_2SO_4
D	NaOH(aq)	CO_2

[2006 O/N (26)]

21.

The chlorine oxide free radical, ClO^* , 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

[2006 O/N (31)]

22.

Which are properties of fluoroalkanes?

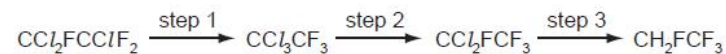
- 1 They are less reactive than the corresponding chloroalkanes.
- 2 They are non-flammable.
- 3 The C-F bond is stronger than a C-Cl bond.

[2006 O/N (38)]

23.

Under the Montreal Protocol, the manufacture of chlorofluorocarbons has been phased out, and they are being replaced by fluorocarbons.

One chlorofluorocarbon which was widely used as a solvent is CCl_2FCClF_2 . 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 2?

- A electrophilic substitution
- B free radical reduction
- C isomerisation
- D nucleophilic substitution

[2007 M/J (20)]

24.

The compound 1,2-dichloroethene, $C_2H_2Cl_2$, has been used as an industrial solvent for a number of compounds including fats, camphor and caffeine.

Which statement about this compound is **incorrect**?

- A The compound can be catalytically hydrogenated.
- B The compound is a planar molecule.
- C The compound shows *cis-trans* isomerism.
- D The compound shows optical isomerism.

[2007 M/J (23)]

25.

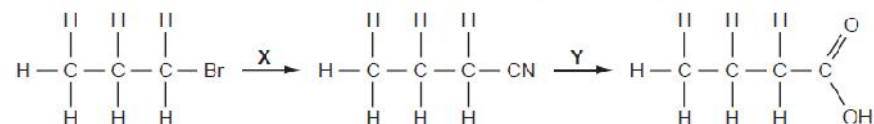
Which term describes the action of NaOH(aq) on a bromoalkane?

- A acid-base reaction
- B electrophilic substitution
- C elimination of HBr
- D nucleophilic substitution

[2007 M/J (24)]

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	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)

[2007 M/J (25)]

27.

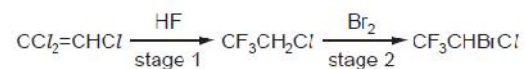
What types of reaction are undergone by 2-bromopropane?

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

[2007 M/J (38)]

28.

The anaesthetic *halothane*, CF₃CHBrCl, is made industrially as shown below.



Which type of reaction is occurring in stage 2?

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

[2007 O/N (24)]

29.

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.

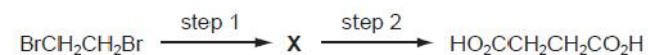
What is the reason for their greater stability?

- 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.

[2007 O/N (25)]

30.

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

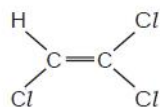


Which reagents could be used for this synthesis?

	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)

[2007 O/N (26)]

31. Trichloroethene is widely used as a dry-cleaning agent.



With which of the following does trichloroethene react to give a chiral product?

- A Br_2 B HCl C NaCN(aq) D NaOH(aq)

[2008 M/J (21)]

32. Halogenoalkanes are important molecules in organic synthetic reactions. In particular they undergo a range of nucleophilic reactions.

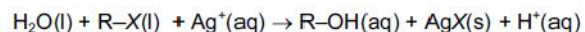
Which reaction proceeds **only** by an $\text{S}_{\text{N}}1$ mechanism?

- A $\text{CH}_3\text{CH}_2\text{Br} + \text{NH}_3$
 B $\text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{OH}^-$
 C $\text{CH}_3\text{CHBrCH}_3 + \text{NH}_3$
 D $(\text{CH}_3)_3\text{CI} + \text{OH}^-$

[2008 M/J (25)]

33. Four drops of 1-chlorobutane, 1-bromobutane and 1-iodobutane were put separately into three test-tubes containing 1.0cm^3 of aqueous silver nitrate at 60°C .

A hydrolysis reaction occurred. (R represents the butane chain C_4H_9- and X the halogen atom.)



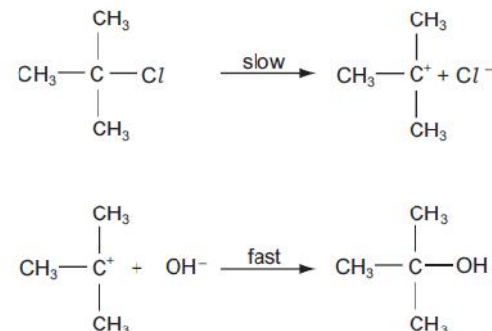
The rate of formation of cloudiness in the tubes was in the order $\text{RCI} < \text{RBr} < \text{RI}$.

Why is this?

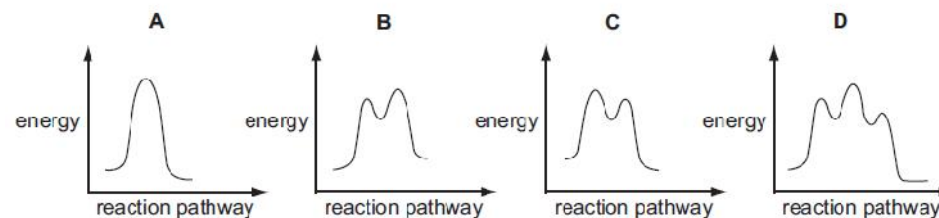
- A The R-X bond polarity decreases from RCI to RI .
 B The solubility of AgX(s) decreases from AgCI to AgI .
 C The ionisation energy of the halogen decreases from Cl to I .
 D The bond energy of R-X decreases from RCI to RI .

[2008 O/N (23)]

34. A possible mechanism of the exothermic hydrolysis of 2-chloro-2-methylpropane is shown.



Which diagram represents the reaction profile for this mechanism?



[2008 O/N (24)]

35. Which of the following would be suitable for use in a fire extinguisher?

- 1 CBrF_3
 2 $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{Br}$
 3 HCl

[2008 O/N (38)]

36.

In the hydrolysis of bromoethane by aqueous sodium hydroxide, what is the nature of the attacking group and of the leaving group?

	attacking group	leaving group
A	electrophile	electrophile
B	electrophile	nucleophile
C	nucleophile	electrophile
D	nucleophile	nucleophile

[2009 M/J (24)]

37.

Which reaction would **not** give propene as one product?

- A** adding an excess of concentrated sulfuric acid to propan-1-ol
- B** adding warm aqueous sodium hydroxide to 2-bromopropane
- C** adding warm ethanolic sodium hydroxide to 1-bromopropane
- D** passing propan-2-ol vapour over heated aluminium oxide

[2009 M/J (25)]

38.

Which statements are true for an S_N2 reaction?

- 1** One bond is broken as another bond is formed.
- 2** The formation of a transition state involves the collision of two molecules or ions.
- 3** A carbon atom in the transition state is bonded, either fully or partially, to five other atoms.

[2009 O/N-11 (37)]

39.

The chlorine free radical takes part in the destruction of the ozone layer.

Which statements about this free radical are correct?

- 1** It is formed by the heterolytic fission of the covalent bond in a chlorine-containing molecule.
- 2** It has a single unpaired electron.
- 3** It has the same electron arrangement as a chlorine atom.

[2009 O/N-11 (38)]