MODERN'S abc of

Nytra
Watch books come alive

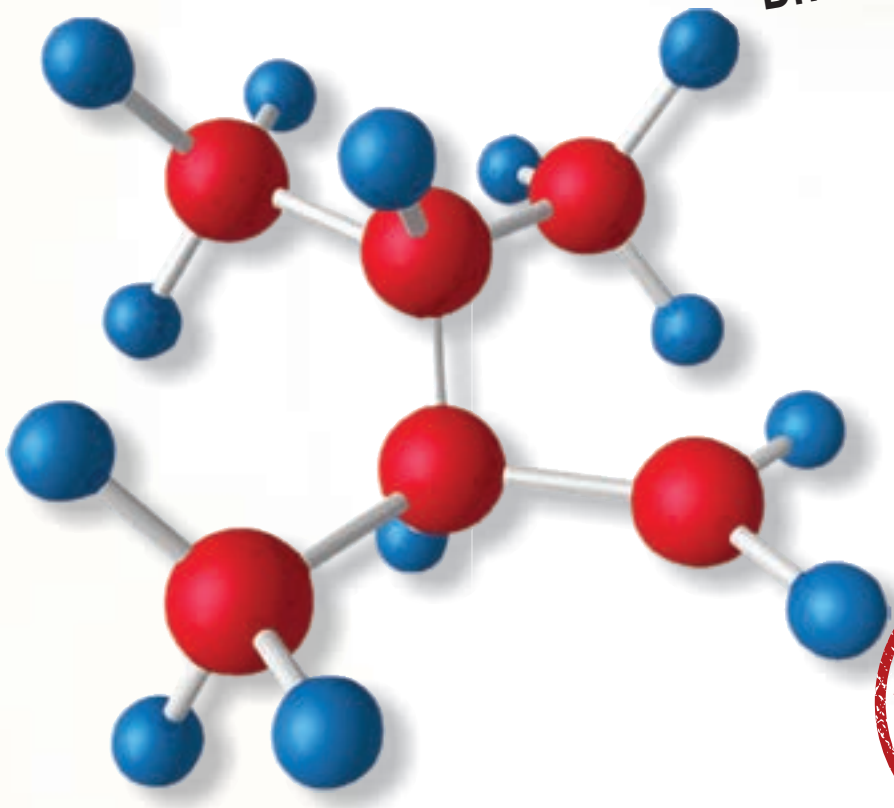
Award for Excellence in Book Production
FIRST PRIZE

Chemistry

CLASS-XII

PART-II

Dr. S.P. Jauhar



THOROUGHLY REVISED EDITION

STRICTLY ACCORDING TO THE NEW SYLLABUS

INDIA'S FIRST SMART BOOK

According to new syllabus prescribed by Central Board of Secondary Education (CBSE), New Delhi and State Boards of Uttarakhand, Karnataka (IInd Year PUC), Chhattisgarh, Jharkhand, Punjab, Haryana, Himachal, Kerala, Mizoram, Meghalaya, Nagaland, Assam, Manipur and other States following CBSE & ISC curriculum.

MODERN'S abc of

CHEMISTRY

INDIA'S FIRST SMART BOOK

For Class XII

PART-II

Strictly in accordance with the Latest Guidelines and Syllabus Including Value Based Questions issued by N.C.E.R.T. / C.B.S.E.

By
Dr. S.P. JAUHAR
Formerly Professor of Chemistry
Department of Chemistry
Panjab University, **Chandigarh**

Nytra
Watch books come alive

THOROUGHLY REVISED & UPDATED
EDITION 2017–2018

MODERN PUBLISHERS
(Producers of Quality Textbooks)

Price of Part I & II : ₹ 1200.00

OUR ADDRESSES IN INDIA

- **New Delhi:** MBD House, Gulab Bhawan, 6, Bahadur Shah Zafar Marg — *Ph. 23317931, 23318301*
- **Mumbai:** A-683, T.T.C. Industrial Area, M.I.D.C. Off. Thane-Belapur Road, Navi Mumbai — *Ph. 32996410, 27780821, 8691053365*
- **Chennai:** No. 26 B/2 SIDCO Estate, North Phase, Pataravakkam, Ambattur Industrial Estate, Ambattur — *Ph. 26359376, 26242350*
- **Chennai:** Plot No. 3018, Old Y Block, 3rd Street, 12th Main Road, Anna Nagar West — *Ph. 23741471*
- **Kolkata:** Satyam Building, 46-D, Rafi Ahmed Kidwai Marg — *Ph. 22296863, 22161670*
- **Jalandhar City:** MBD House, Railway Road — *Ph. 2458388, 2459046, 2455663*
- **Bengaluru:** 124/31, 1st Main, Industrial Town (Near Chowdeshwari Kalyan Mantap), West of Chord Road, Rajajinagar — *Ph. 23103329, 23104667*
- **Hyderabad:** 3-4-492, Varun Towers, Barkatpura — *Ph. 27564788, 9985820001*
- **Ernakulam:** Surabhi Building, South Janatha Road, Palarivattom — *Ph. 2338107, 2347371*
- **Pune:** Survey No. 44, Behind Matoshree Garden, Kondhwa–Khadi Machine, Pisoli Road, at Post-Pisoli — *Ph. 65271413, 65275071*
- **Nagpur:** 'Chandrakor', Plot No. G-15, Aath Rasta Chowk, West High Court Road, Laxmi Nagar — *Ph. 2248104, 2248106, 2248649, 2245648*
- **Ahmedabad:** Godown No. 10, Vedant Prabha Estate, Opp. ONGC Pumping Station, Sarkhej Sanand Road, Sarkhej — *Ph. 26890336, 32986505*
- **Cuttack:** Badambadi, Link Road — *Ph. 2367277, 2367279, 2313013*
- **Guwahati:** Chancellor Commercial, Hem Baruah Road, Paan Bazar — *Ph. 2131476, 8822857385*
- **Lucknow:** 173/15, Dr. B. N. Verma Road, Old 30 Kutchery Road — *Ph. 4010992, 4010993*
- **Patna:** Ist Floor, Annapurna Complex, Naya Tola — *Ph. 2672732, 2686994, 2662472*
- **Bhopal:** Plot No. 137, 138, 139, Sector-I, Special Industrial Area, Govindpura — *Ph. 2581540, 2601535*
- **Jabalpur:** 840, Palash Chamber, Malviya Chowk — *Ph. 2405854*
- **Goa:** H. No. 932, Plot No. 66, Kranti Nagar (Behind Azad Bhawan), Alto Porvorim, Bardez — *Ph. 2413982, 2414394*
- **Jaipur:** C-66A, In front of Malpani Hospital, Road No. 1, V.K. Industrial Area, Sikar Road — *Ph. 4050309, 4020168*
- **Raipur:** Behind Aligarh Safe Steel Industries, Vidhan Sabha Road, Avanti Bai Chowk, Lodhi Para Pandri — *Ph. 2445370, 4052529*
- **Karnal:** Plot No. 203, Sector-3, HSIDC, Near Namaste Chowk, Opp. New World — *Ph. 2220006, 2220009*
- **Shimla (H.P.):** C-89, Sector-I, New Shimla-9 — *Ph. 2670221,2670816*
- **Jammu (J&K):** Guru Nanak College of Education, Jallo Chak, Bari Brahmana — *Ph. 2467376, 9419104035*
- **Ranchi (Jharkhand):** Shivani Complex, 2nd Floor, Jyoti Sangam Lane, Upper Bazar — *Ph. 9431257111*
- **Sahibabad (U.P.):** B-9 & 10, Site IV, Industrial Area — *Ph. 3100045, 2896939*
- **Dehradun (Uttarakhand):** Plot No. 37, Bhagirathipuram Niranjanpur, GMS Road — *Ph. 2520360, 2107214*

DELHI LOCAL OFFICES:

- **Delhi (Shakarpur):** MB 161, Street No. 4 — *Ph. 22546557, 22518122*
- **Delhi (Daryaganj):** MBD House, 4587/15, Opp. Times of India — *Ph. 23245676*
- **Delhi (Patparganj):** Plot No. 225, Industrial Area — *Ph. 22149691, 22147073*

MODERN'S OUTSTANDING TEXTBOOKS FOR CLASS XII

- **Modern's** abc of Physics
- **Modern's** abc of Practical Physics
- **Modern's** abc of Physics Lab Manual
- **Modern's** abc + of Chemistry
- **Modern's** abc of Practical Chemistry
- **Modern's** abc of Chemistry Lab Manual
- **Modern's** abc + of Biology
- **Modern's** abc of Practical Biology
- **Modern's** abc of Biology Lab Manual
- **Modern's** abc + of Mathematics
- Solutions of **Modern's** abc of Mathematics
- **Modern's** abc of Computer Science C++

FOR JEE-Main, JEE-Advance & Medical (NEET)

- **Modern's** abc of Objective Physics
- **Modern's** abc of Objective Chemistry
- **Modern's** abc of Objective Mathematics
- **Modern's** abc of Objective Biology
- **Modern's** abc of Crash Course Physics (JEE-Main)
- **Modern's** abc of Crash Course Chemistry (JEE-Main)
- **Modern's** abc of Crash Course Mathematics (JEE-Main)

KIND ATTENTION : DEAR CUSTOMER

To avoid duplicacy, a HOLOGRAM has been pasted on the cover of this book. If this hologram is missing, please do not purchase the book as it is likely to be a duplicate book. Any such duplicacy if noted may please be intimated to the Publishers.

We are committed to serve students with best of our knowledge and resources. We have taken utmost care and paid much attention while editing and printing this book but we would beg to state that Authors and Publishers should not be held responsible for unintentional mistakes that might have crept in. However, errors brought to our notice shall be gratefully acknowledged and attended to.

© All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written permission of the publisher. Any breach will entail legal action and prosecution without further notice.

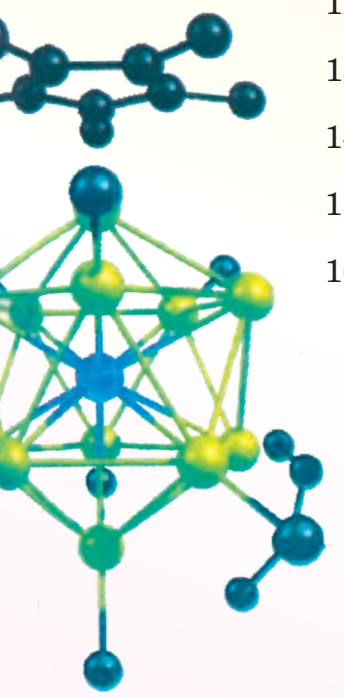
Published by : **Balwant Sharma**
MODERN PUBLISHERS
MBD House, Railway Road, Jalandhar City.

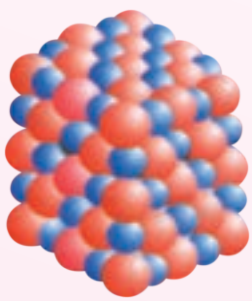
Printed at : **HOLY FAITH INTERNATIONAL (P) LTD.**
B-9 & 10, Site IV, Industrial Area, Sahibabad (U.P.)

E info@mbdgroup.com
W www.mbdgroup.com
Toll Free No. : 1800 200 2233

CONTENTS

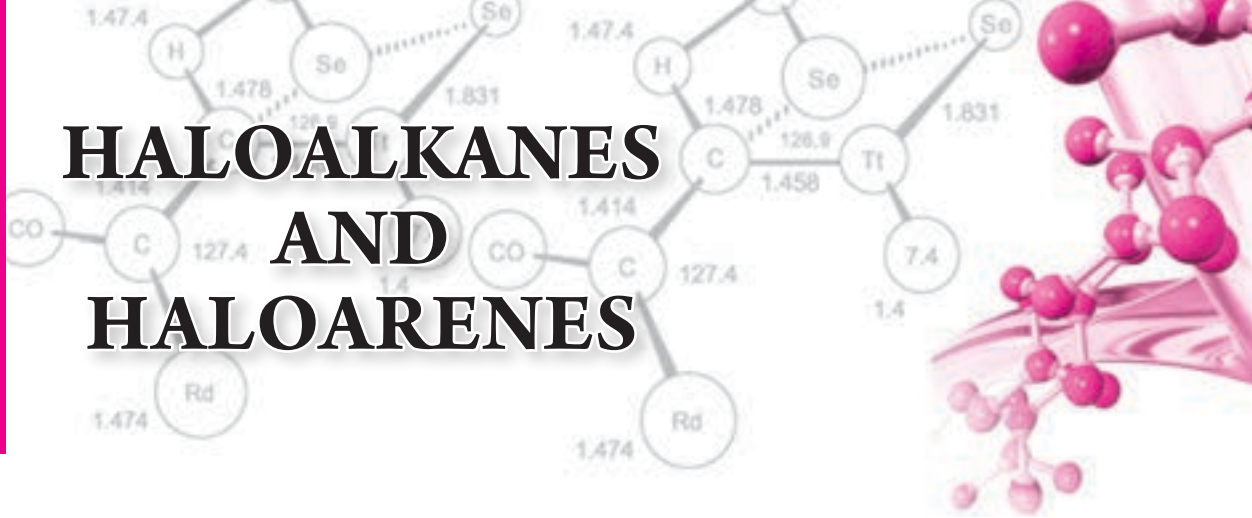
PART–II





UNIT 10

HALOALKANES AND HALOARENES



The replacement of one or more hydrogen atoms of a hydrocarbon, aliphatic or aromatic, by an equal number of halogen atoms results in the formation of **haloalkanes** (or **alkyl halides**) and **haloarenes** (or **aryl halides**) respectively.

Haloalkane : RX where R is *alkyl group*

Haloarene : ArX where Ar is *arene*.

X is halogen atom (F, Cl, Br, I)

Thus, haloalkanes and haloarenes are **halogen derivatives of aliphatic and aromatic hydrocarbons**.

Haloalkanes contain halogen atom (s) attached to the sp^3 hybridised carbon atom(s) of an alkyl group whereas haloarenes contain halogen atom(s) attached to sp^2 hybridised carbon atom(s) of aryl group.

These classes of compounds find wide applications in industry as well as in our day-to-day life. Some naturally occurring halogen containing organic compounds are important in **health care** and **medicine**. For example, chlorine containing antibiotic, *chloramphenicol*, produced by soil micro-organisms is very effective in the treatment of typhoid fever. An iodine containing hormone, known as *thyroxine* is produced in our body. The deficiency of this hormone causes a disease called *goitre*. Some synthetic organic halogen compounds are also clinically useful. For example, *chloroquine* is used for the treatment of malaria and *halothane* ($CF_3CHClBr$) is used in surgery as an anaesthetic. In modern electronics industry, halogenated solvents such as trichloroethylene are used for cleaning semiconductors, chips and other components.

Above all, these organic halogen compounds are regarded as **synthetic tools in the hands of a chemist** because these serve as important starting materials for the synthesis of a wide range of other substances.

CLASSIFICATION OF HALOGEN DERIVATIVES OF HYDROCARBONS

The halogen derivatives of hydrocarbons are broadly classified into two simple types :

1. *Aliphatic halogen compounds*
2. *Aromatic halogen compounds*

IN THIS UNIT.....

1. Aliphatic halogen compounds

These are the compounds which are obtained by the replacement of one or more hydrogen atoms of an aliphatic hydrocarbon by an equal number of halogen atoms. These can be further classified on the basis of the nature of aliphatic hydrocarbon, whether alkanes, alkenes or alkynes as haloalkanes, haloalkenes or haloalkynes, respectively.

(*i*) Haloalkanes : *The halogen derivatives of alkanes* are called *haloalkanes*. These are also called **alkyl halides**. These are formed by replacing one hydrogen atom in alkane by a halogen.

$$R{-}H \xrightarrow[+X]{-H} R{-}X$$ Haloalkane or alkyl halide

e.g., $CH_4 \xrightarrow[+Cl]{-H} CH_3Cl$ Chloromethane or methyl chloride

The general formula of haloalkanes or alkyl halides is $C_nH_{2n+1}X$ or commonly written as RX where R is an alkyl group and X is a halogen atom (F, Cl, Br or I) and n = 1, 2, 3 … .

Some common examples are :

CH_3Cl	CH_3CH_2Br	$CH_3CH_2CH_2Cl$	CH_3CH_2I
Chloromethane	Bromoethane	Chloropropane	Iodoethane
(Methyl chloride)	(Ethyl bromide)	(*n*-Propyl chloride)	(Ethyl iodide)

NOTE

Whenever, two names are given under the formula, the name outside the brackets refers to IUPAC name and the name given in the brackets refers to the common name.

The compounds are also known in which more than one hydrogen atoms of the alkane molecule have been replaced by halogen atoms. These compounds are called polyhalogen derivatives of alkanes or **polyhaloalkanes**.

(*ii*) Haloalkenes or alkenyl halides. *The halogen derivatives of alkenes* are called **haloalkenes** or **alkenyl halides.** The monohalogen derivatives of alkenes have the general formula $C_nH_{2n-1}X$ where X = F, Cl, Br or I. For example,

$CH_2{=}CHBr$	$\overset{1}{C}H_2{=}\overset{2}{C}H{-}\overset{3}{C}H_2I$	$\overset{4}{C}H_3{-}\overset{3}{C}H{=}\overset{2}{C}H{-}\overset{1}{C}H_2Cl$	$C_6H_5{-}\overset{1}{C}H{=}\overset{2}{C}H{-}\overset{3}{C}H_2Cl$
Bromoethene	3-Iodoprop-1-ene	1-Chlorobut-2-ene	3-Chloro-1-phenylprop-1-ene
(Vinyl bromide)	(Allyl iodide)	(Crotyl chloride)	(Cinnamyl chloride)

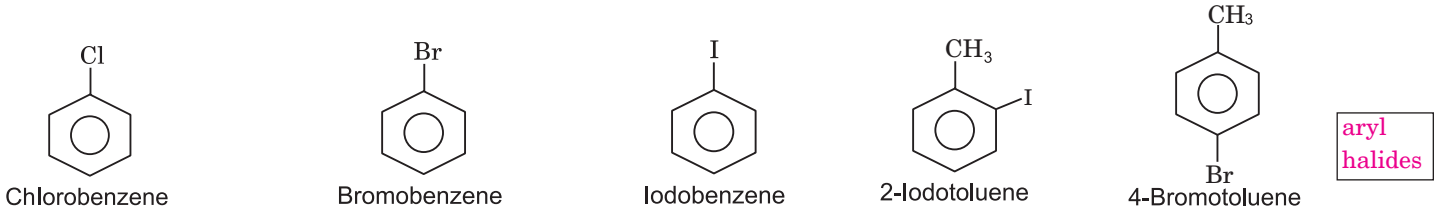
(*iii*) Haloalkynes or alkynyl halides. *These are the halogen derivatives of alkynes*. The monohalogen derivatives of alkynes have the general formula $C_nH_{2n-3}X$, where X = F, Cl, Br or I. For example,

$H{-}C{\equiv}C{-}Cl$	$\overset{3}{C}H_3{-}\overset{2}{C}{\equiv}\overset{1}{C}{-}Br$	$Br{-}\overset{3}{C}H_2{-}\overset{2}{C}{\equiv}\overset{1}{C}H$
Chloroethyne	1-Bromoprop-1-yne	3-Bromoprop-1-yne
(Chloroacetylene)		(Propargyl bromide)

2. Aromatic halogen compounds

These are the compounds which are obtained by the replacement of one or more hydrogen atoms of aromatic hydrocarbons by an equal number of halogen atoms. These are of two types :

(*i*) **Nuclear halogen derivatives.** *These are the halogen derivatives of aromatic hydrocarbons which are derived by replacing hydrogen atom attached to the benzene ring by a halogen atom.* These are also called **haloarenes** or **aryl halides.** Therefore, in **haloarenes, the halogen atom (F, Cl, Br or I) is directly bonded to the aromatic (benzene) ring.** For example,

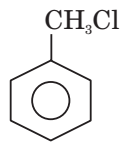


Chlorobenzene; Bromobenzene; Iodobenzene; 2-Iodotoluene or 1-Iodo-2-methylbenzene; 4-Bromotoluene or 1-Bromo-4-methylbenzene

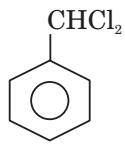
aryl halides

The aryl halides are commonly written as Ar–X, where Ar (short name for aryl) represents a phenyl group.

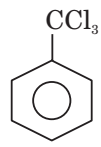
(*ii*) **Side chain halogen derivatives.** These are the derivatives of aromatic hydrocarbons in which one or more atoms of the alkyl side chain of a benzene are replaced by the halogen atoms. These compounds are not regarded as aryl halides because halogen is not directly attached to the benzene ring. These are called **side chain substituted aryl halides or aralkyl halides**. For example,



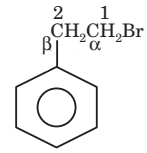
1-Chloro-1-phenylmethane
(Benzyl chloride)



1, 1-Dichloro-1-phenylmethane
(Benzal dichloride)



1, 1, 1-Trichloro-1-phenylmethane
(Benzo trichloride)



1-Bromo-2-phenylethane
(β-phenylethyl bromide)

aralkyl halides

These **haloalkanes or haloarenes may be simply classified on** the basis of the type of halogen atom present, the number of halogen atoms and the nature of carbon atom to which the halogen is attached.

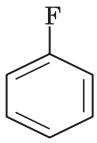
A. Type of halogen atom

The halogen derivatives of hydrocarbons may be classified as fluoro, chloro, bromo and iodo compounds depending upon the type of halogen present. For example,

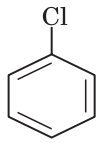
CH_3Br
Methyl bromide

CH_3CH_2Cl
Ethyl chloride

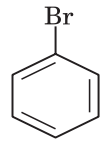
CH_3CH_2I
Ethyl iodide



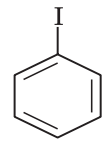
Fluorobenzene



Chlorobenzene



Bromobenzene



Iodobenzene

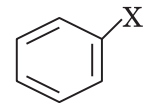
B. Number of halogen atoms

The halogen derivatives of hydrocarbons may be classified as mono, di, tri ... halo compounds depending upon whether they contain one, two, three... halogen atoms in their molecules. For example,

Monohalo compounds :

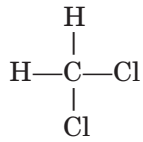
CH_3CH_2Br
Bromoethane
(Ethyl bromide)

CH_3CH_2Cl
Chloroethane
(Ethyl chloride)

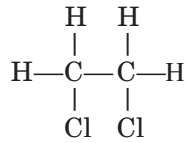


Monohalobenzene

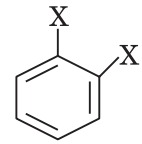
Dihalo compounds :



Dichloromethane

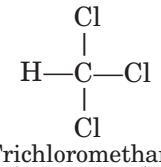


1,2-Dichloroethane

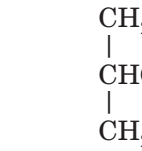


Dihalobenzene

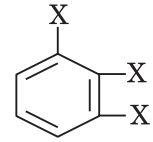
Trihalo compounds :



Trichloromethane
(Chloroform)

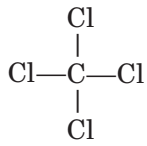


1,2,3-Trichloropropane



Trihalobenzene

Tetrahalo compounds :

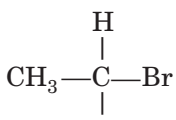


Tetrachloromethane
(Carbon tetrachloride)

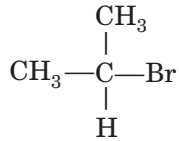
C. Nature of carbon atom

Haloalkanes are classified as *primary* (1°), *secondary* (2°) or *tertiary* (3°) depending upon the nature of carbon atom to which the halogen is attached.

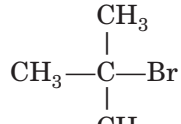
(*i*) **Primary haloalkanes** are those which have *one* or *none alkyl group* on the carbon bonded to the halogen atom.
(*ii*) **Secondary haloalkanes** are those which have *two alkyl groups* on the carbon bonded to the halogen atom.
(*iii*) **Tertiary haloalkanes** are those which have *three alkyl groups* on the carbon bonded to the halogen atom.



Bromoethane
(primary or 1°)



2-Bromopropane
(secondary or 2°)



2-Bromo-2-methylpropane
(tertiary or 3°)

Classification on the basis of type of hybridization of carbon bonded to the halogen atom

The monohalo compounds may further be classified according to the type of hybridization of the carbon atom bonded to the halogen atom.

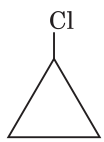
1. Compounds containing sp^3 hybridised carbon [C(sp^3) – X]

These compounds contain sp^3 hybridised carbon atom bonded to a halogen atom (X = F, Cl, Br, I). These are of the following types :

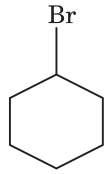
(*a*) Haloalkanes or alkyl halides (RX). In these halides, the halogen atom (X) is bonded to an alkyl group (R). These form homologous series of compounds represented by $C_nH_{2n+1}X$. For example,

CH_3Cl	CH_3CH_2I	$CH_3CH_2CH_2Br$
Chloromethane	Iodoethane	1-Bromopropane
(Methyl chloride)	(Ethyl iodide)	(Propyl bromide)

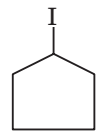
If R is alicyclic in R—X, the halide is called cyclo alkyl halide or halocyclo alkane, which may be secondary or tertiary. For example,



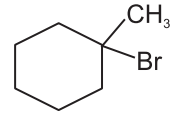
Cyclopropyl chloride (2°)



Cyclohexyl bromide (2°)

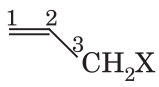


Cyclopentyl iodide (2°)

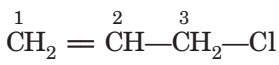


1-Bromo-1-methylcyclohexane (3°)

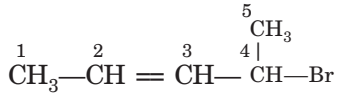
(*b*) Allylic halides. In these halides, the halogen is bonded to an sp^3 hybridized carbon atom next to a carbon-carbon double bond. The carbon atom next to carbon-carbon double bond is called allylic carbon and therefore, these are called **allylic halides.** For example,



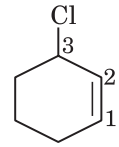
3-Haloprop-1-ene (1°) (Allyl halide)



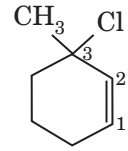
3-Chloroprop-1-ene (1°)



4-Bromopent-2-ene (2°)

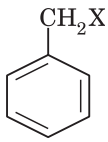


3-Chlorocyclohex- (2°)

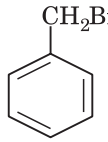


3-Chloro-3-methylcyclo hex-1-ene

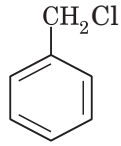
(*c*) Benzylic halides. In these halides the halogen atom is bonded to an sp^3 hybridised carbon atom next to an aromatic ring *i.e.,* to a benzylic carbon. For example,



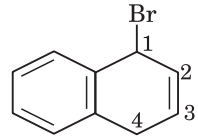
Halophenylmethane (Benzyl halide) (1°)



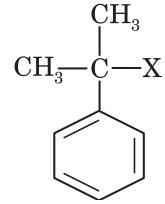
Bromophenylmethane (1°)



Chlorophenyl methane (1°)



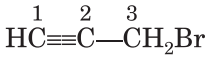
1-Bromo-1,2,3,4-tetra hydronaphthalene (2°)



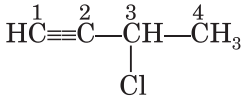
2-Halo-2-phenyl-propane (3°)

It may be noted that allylic and benzylic halides may be primary (1°), secondary (2°) or tertiary (3°).

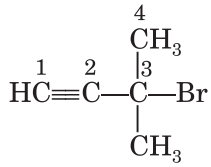
(*d*) Propargyl halides. In these halides, the halogen atom is bonded to a sp^3 hybridised carbon atom next to a carbon-carbon triple bond.



3-Bromoprop-1-yne (Propargyl bromide) (1°)



3-Chlorobut-1-yne (2°)

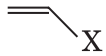


3-Bromo-3-methylbut-1-yne (3°)

2. Compounds containing sp^2 hybridised carbon [C(sp^2)–X]

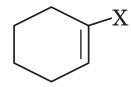
These halogen derivatives of hydrocarbons contain sp^2 hybridised carbon. In these compounds, halogen is directly bonded to one of the carbon atoms of a double bond ($—\overset{|}{C}=\overset{|}{C}—X$). These include :

(*a*) Vinylic halides. In these halides the halogen atom is bonded to an sp^2 hybridised carbon of one of the carbon atoms of a double bond *i.e.* vinylic carbon. For example,



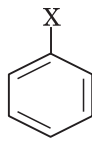
Haloethene
(Vinyl halide)

$CH_2=CH-Cl$
Chloroethene
(Vinyl chloride)

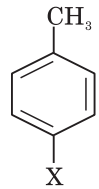


1-Halocyclohex-1-ene

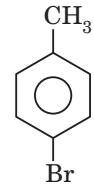
(*b*) Aryl halides. In these halides, the halogen atom is bonded to a sp^2 hybridised carbon of an aromatic ring. For example,



Halobenzene



p-Halotoluene



p-Bromotoluene

These aromatic halogen compounds are also called **haloarenes.**

3. Compounds containing *sp* hybridised carbon [C(*sp*) – X]

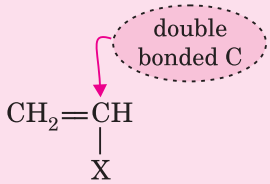
These halogen derivatives of hydrocarbons contain *sp* hybridised carbon. In these halogen derivatives, halogen is directly bonded to one of the carbon atoms of a triple bond (—C ≡ C—X). For exemple,

$HC \equiv C-Cl$
Chloroethyne

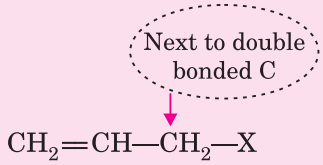
$\overset{3}{C}H_3-\overset{2}{C}\equiv\overset{1}{C}-Cl$
1-Chloropropyne

REMEMBER

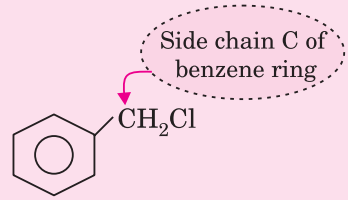
Some special types of halogen compounds are :



Vinylic halides
Halogen bonded to double bonded C atom



Allylic halides
Halogen bonded to next to double bonded C–atom



Benzylic or Aralkyl halides
Halogen bonded to side chain C atom of benzene ring

Let us discuss the chemistry of **alkyl halides and aryl halides.**

NOMENCLATURE OF HALOALKANES AND HALOARENES

Naming haloalkanes (or alkyl halides)

Monohalogen derivatives

Common Names : In the **common** or **trivial system** the monohalogen derivatives of alkanes are called **alkyl halides.** These are named by naming *the alkyl group attached to halogen and adding the name of the halide*. For example,

CH_3Cl
Methyl chloride

CH_3CH_2Br
Ethyl bromide

$CH_3CH_2CH_2I$
n-Propyl iodide

$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2Cl$
Isobutyl chloride

The name of the alkyl and halide is always written as two separate words. The prefixes *n*-, *iso*-, *sec*-, *tert*-, etc. used for the alkyl group are also written.

▶ It may be noted that *sec*-or *tert*- compounds are written with a dash between *sec*- or *tert*- and the name of the alkyl group. For example, *tert*-butyl, etc. However, the *iso*-or *neo-compounds are written as one word*. For example, isobutane, neopentane, etc.

REMEMBER

The prefixes **n-, iso-, neo-** are used for the following alkyl groups :

n- $CH_3CH_2CH_2CH_2-$ or $CH_3CH_2CH_2CH_2CH_2-$
The prefix *n*- is used for alkyl group having continuous chain of C-atoms with no branching.

iso- $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-$ or $CH_3\,\underset{\displaystyle CH_3}{\underset{|}{CH}}CH_2-$
The prefix *iso*- is used for those alkyl groups in which one methyl group is attached to the next to end C-atom.

neo- $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-$ or $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_2-CH_2-$
The prefix *neo*- is used for those alkyl groups which have two methyl groups attached to the next to end C-atom.

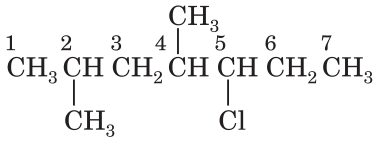
IUPAC names : In the **IUPAC system**, the monohalogen derivatives of alkanes are named as **haloalkanes.** The names are written *by prefixing the word* **halo** *to the name of the alkane corresponding to longest continuous carbon chain holding the halogen atom.* In case of branched chain alkanes, the following **rules** are followed :

(*i*) Select the longest continuous chain containing the carbon attached to the halogen group and name it as the **parent chain.** If a double or triple bond is present, the parent chain must contain it.

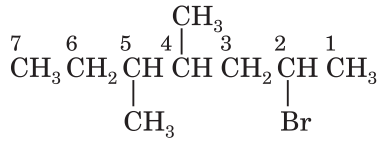
(*ii*) Number the carbon atoms of the parent chain, beginning from the end nearer to the first substituent, **regardless of whether it is alkyl or halo group.**

(*iii*) If two or more substituents are present on the parent chain, these are named in the alphabetical order alongwith their appropriate positions.

▶ It may be noted that di, tri, tetra etc. are not considered while comparing the substituents for alphabetizing purpose. For example,

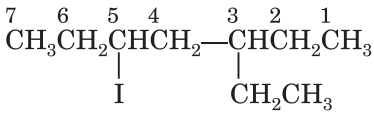


5-Chloro-2, 4-dimethylheptane

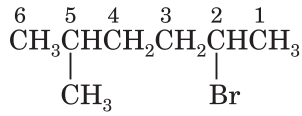


2-Bromo-4, 5-dimethylheptane

(*iv*) If two different substituents are present at **equivalent positions** from the two ends of the chain, then numbering the chain is done in such a way that the substituent which comes first in the alphabetical order (written first in the name) gets lower number. For example,



3-Ethyl-5-iodoheptane
(Not 5-Ethyl-3-iodoheptane)



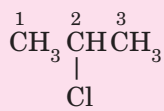
2-Bromo-5-methylhexane
(Not 5-Bromo-2-methylhexane)

[For more rules see Appendix A]

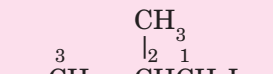
To illustrate the rules, some examples are given below:

Bromoethane

1-Bromopropane

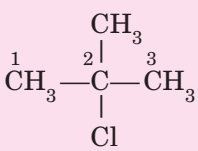


2-Chloropropane

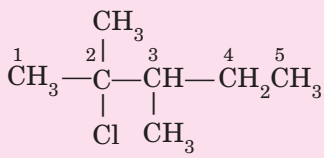


1-Iodo-2-methylpropane

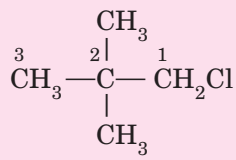
2-Bromo-5-methylhexane



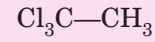
2-Chloro-2-methylpropane



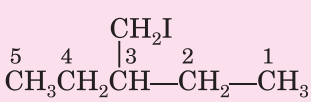
2-Chloro-2, 3-dimethylpentane



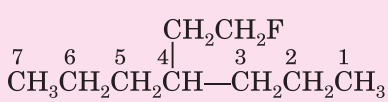
1-Chloro-2, 2-dimethylpropane



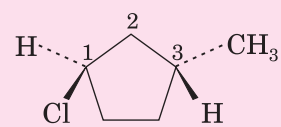
1,1,1-Trichloroethane



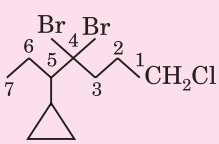
3-(Iodomethyl)pentane



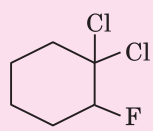
4-(2-fluoroethyl)heptane



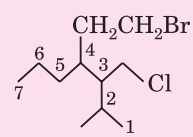
trans-1-chloro-3-methylcyclopentane



4, 4-Dibromo-1-chloro-5-cyclopropyl heptane



1, 1-Dichloro-2-fluorocyclohexane



4-(2-bromoethyl)-3-(chloromethyl)-2-methyl heptane

The common and IUPAC names of a few alkyl halides are given below :

Alkyl halide	Common name	IUPAC name
CH_3Cl	Methyl chloride	Chloromethane
CH_3CH_2Br	Ethyl bromide	Bromoethane
$CH_3CH_2CH_2F$	*n*-Propyl fluoride	1-Fluoropropane
CH_3CHICH_3	Isopropyl iodide	2-Iodopropane
$CH_3CH_2CH_2CH_2Cl$	*n*-Butyl chloride	1-Chlorobutane
$CH_3CHClCH_3$	*sec*-Butyl chloride	2-Chlorobutane
$(CH_3)_2CHCH_2Cl$	Isobutyl chloride	1-Chloro-2-methylpropane
$(CH_3)_3CCl$	*tert*-Butyl chloride	2-Chloro-2-methylpropane
$CH_3CH_2CH_2CH_2CH_2Cl$	*n*-Pentyl chloride or *n*-Amyl chloride	1-Chloropentane
$(CH_3)_2CHCH_2CH_2Cl$	Isopentyl chloride or Isoamyl chloride	1-Chloro-3-methylbutane
$CH_3C(CH_3)ClCH_2CH_3$	*tert*-Pentyl chloride or *tert*-Amyl chloride	2-Chloro-2-methylbutane
$(CH_3)_3CCH_2Cl$	Neopentyl chloride or Neoamyl chloride	1-Chloro-2,2-dimethylpropane

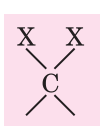
NOTE

Amyl is commonly used for C_5H_{11}—group. The prefixes *iso*, *neo*, *cyclo* are written as non-hyphenated prefixes while *n*-,*sec*- or *tert*-are written as hyphenated prefixes.

Dihalo and polyhalo derivatives

The dihalo derivatives have special common names depending upon whether the halogen atoms are present on the same or different carbon atoms. These are commonly named according to IUPAC system.

(*i*) When both the halogen atoms are attached to the same C-atom, these are called **gem-dihalides.** These are also called **alkylidene dihalides** or simply **alkylidene halides.** For example,

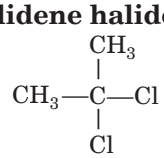


gem dihalide

CH_3CHCl_2

Ethylidene dichloride
(gem-dihalide)

IUPAC : 1, 1-Dichloroethane



Iso-propylidene dichloride

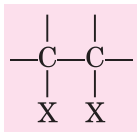
IUPAC : 2, 2-Dichloropropane

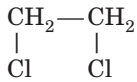
$CH_3CH_2CHCl_2$

Propylidene dichloride

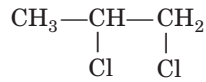
IUPAC : 1, 1-Dichloropropane

(*ii*) When the two halogen atoms are in adjacent C-atoms, they are called **vicinal dihalides** or simply **vic-dihalides.** These are named as the dihalide of alkene from which they may be prepared by the addition of halogen atoms *i.e.*, **alkylene dihalide** or simply **alkylene halide**. For example,

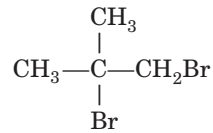

vicinal dihalide


Ethylene dichloride
(vic-dihalide)

IUPAC : 1, 2-Dichloroethane


Propylene dichloride

IUPAC : 1, 2-Dichloropropane


Isobutylene dibromide

IUPAC : 1, 2-Dibromo-2-methylpropane

(*iii*) **Polymethylene dihalides.** When the same two halogen atoms are present on the terminal carbon atoms *i.e.*, α, ω positions of the carbon chain, they are called **polymethylene dihalides**. For example,

$BrCH_2CH_2CH_2Br$	$ClCH_2CH_2CH_2CH_2Cl$	$ICH_2CH_2CH_2CH_2CH_2I$
Trimethylene dibromide	Tetramethylene dichloride	Pentamethylene diiodide
IUPAC : 1,3-Dibromopropane	**IUPAC :** 1, 4-Dichlorobutane	**IUPAC :** 1, 5-Diiodopentane

Polyhalogen derivatives are named according to IUPAC system.

Trihalomethanes and tetrahalomethanes are named as haloforms and tetrahalomethanes respectively.

$CHCl_3$	CHI_3	CCl_4
Chloroform	Iodoform	Carbon tetrachloride
Trichloromethane	Triiodomethane	Tetrachloromethane

Fully halogenated hydrocarbons are also called **perhalohydrocarbons** (per means that all the hydrogens of the hydrocarbons are replaced by halogen atoms). It may be noted that polyhaloalkanes and other complex halogen compounds are named according to IUPAC system.

$(CF_3—CF_2—CF_3)$: Perfluoropropane **IUPAC :** Octafluoropropane

It may be noted that the name of di- and polyhaloalkanes containing different halogen atoms are written by prefixing the name of each halogen atom (in alphabetical order) alongwith its locant to the name of the parent alkane. The lowest locant being given to that halogen atom which comes first in alphabetical order *provided it does not violate the lowest locant sum rule*. For example,

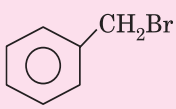
$\overset{3}{Cl}CH_2\overset{2}{C}H_2\overset{1}{C}H_2Br$	$Br\overset{1}{C}H_2\overset{2}{C}H(Cl)\overset{3}{C}H(Cl)\overset{4}{C}H_3$	$\overset{1}{Cl}CH_2\overset{2}{C}H(I)\overset{3}{C}H_2\overset{4}{C}H_2\overset{5}{C}H_2Br$
1-Bromo-3-chloropropane	1-Bromo-2,3-dichlorobutane	5-Bromo-1-chloro-2-iodopentane (**Not** 1-Bromo-4-iodo-5-chloropentane)

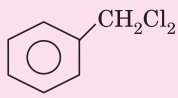
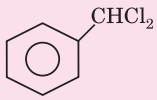
HELP

The compound $Cl\overset{5}{C}H_2\overset{4}{C}H(I)\overset{3}{C}H_2\overset{2}{C}H_2\overset{1}{C}H_2Br$ cannot be named 1-Bromo-4-iodo-5-chloropentane because it violates lowest set of locants rule.

Some of these are given in Table 1.

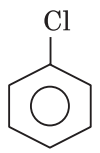
Table 1. Common names and IUPAC names of polyhaloalkanes and complex halogen compounds.

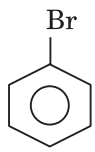
Structure	Common name	IUPAC name
CH_2Cl_2	Methylene chloride	Dichloromethane
$CH_2 = CHCl$	Vinyl chloride	Chloroethene
$CH_2 = CHCH_2Br$	Allyl bromide	1-Bromopropane
$CH_2Cl—CH_2Cl$	Ethylene chloride	1,2-Dichloroethane
CH_3CHCl_2	Ethylidene chloride	1,1-Dichloroethane
$CHCl_3$	Chloroform	Trichloromethane
CHI_3	Iodoform	Triiodomethane
$CHBr_3$	Bromoform	Tribromomethane
	Benzyl bromide	1-Bromo-1-phenylmethane

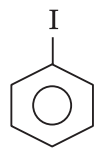
	Benzylic chloride	1,1-Dichloro-1-phenylmethane
	Benzochloride	1,1,1-Trichlorophenylmethane
$CF_3\,CF_2\,CF_3$	Perfluoropropane	Octafluoropropane

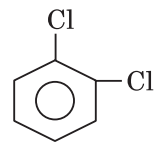
Naming haloarenes (or aryl halides)

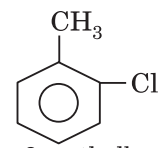
Haloarenes or aryl halides are named by adding the prefix *halo* (fluoro, chloro, bromo, iodo) *before the name of the aromatic hydrocarbon.* In case of disubstituted compounds, the relative positions of the substituents 1, 2 ; 1, 3 and 1, 4 are indicated by the prefixes *ortho* (*o*-), *meta* (*m*-) and *para* (*p*-) respectively. For example,

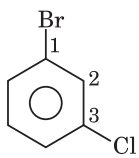

Chlorobenzene

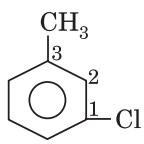

Bromobenzene

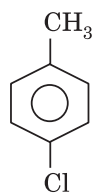

Iodobenzene

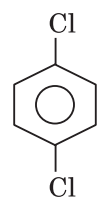

1,2-Dichlorobenzene
(o-Dichlorobenzene)

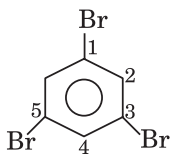

1-Chloro-2-methylbenzene
2-Chlorotoluene
(*o*-Chlorotoluene)


1-Bromo-3-chlorobenzene


3-Chlorotoluene
1-Chloro-3-methylbenzene
(*m*-Chlorotoluene)


1-Chloro-4-methylbenzene
4-Chlorotoluene
(*p*-Chlorotoluene)


1,4-Dichlorobenzene
(*p*-Dichlorobenzene)

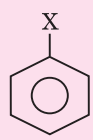

1,3,5-Tribromobenzene
(*sym*-Tribromobenzene)

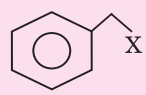
REMEMBER

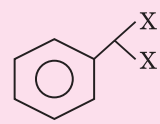
Special names

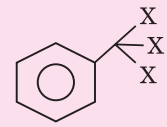

Vinyl


Allyl


Phenyl


Benzyl

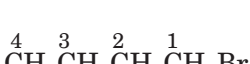

Benzal

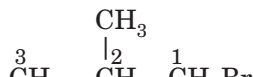

Benzo

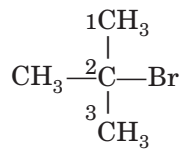
ISOMERISM IN HALOALKANES AND HALOARENES

Haloalkanes show two types of isomerisms :

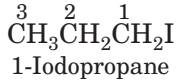
1. Chain isomerism. The haloalkanes containing four or more carbon atoms exhibit chain isomerism in which the *isomers differ in the chain of carbon atoms.* For example, C_4H_9Br has three chain isomers as :

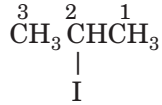

1-Bromobutane


1-Bromo-2-methylpropane

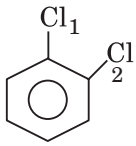

2-Bromo-2-methylpropane

2. Position isomerism. The haloalkanes containing three or more carbon atoms exhibit position isomerism in which the *isomers differ in the position of halogen atom*. For example, C_3H_7I has two position isomers :

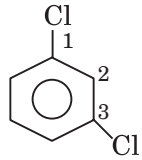

1-Iodopropane


2-Iodopropane

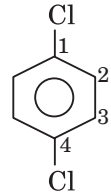
Haloarenes also show position isomerism as :



1,2-Dichlorobenzene
(*o*-Dichlorobenzene)



1,3-Dichlorobenzene
(*m*-Dichlorobenzene)

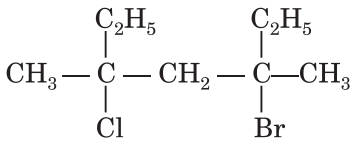


1,4-Dichlorobenzene
(*p*-Dichlorobenzene)

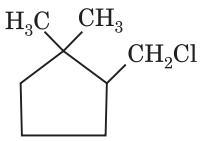
SOLVED EXAMPLES

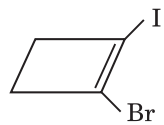
Example 1.

Write IUPAC names of the following compounds:

(*i*) 

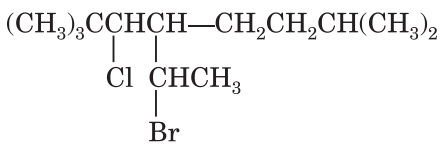
(*ii*) $(CH_3)_3CCH_2Br$ **(*D.S.B. 2011*)**

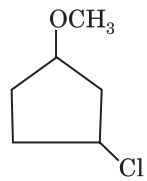
(*iii*) 

(*iv*) 

(*v*) $CH_3—\underset{\displaystyle Cl}{\underset{|}{CH}}—CH_2—CH=CH_2$ **(*D.S.B. 2013*)**

(*vi*) $CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}—CH_2Br$ **(*D.S.B. 2012*)**

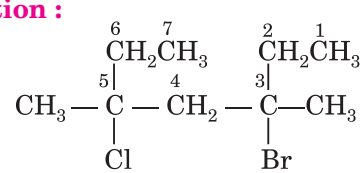
(*vii*) 

(*viii*) 

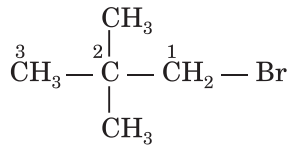
(*ix*) $BrCH_2CHClCHCl_2$

(*x*) $CH_3—\underset{\displaystyle Br}{\underset{|}{CH}}—CH_2—\underset{\displaystyle Cl}{\underset{|}{CH}}—CH_3$ **(*A.I.S.B. 2013*)**

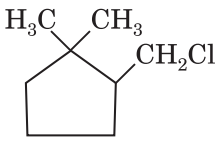
Solution :

(*i*) 

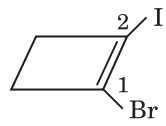
3-Bromo-5-chloro-3, 5-dimethylheptane

(*ii*) 

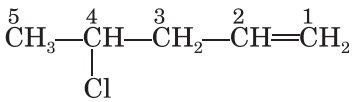
1-Bromo-2,2-dimethylpropane

(*iii*) 

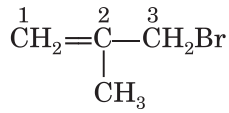
2-Chloromethyl-1, 1-dimethylcyclopentane

(*iv*) 

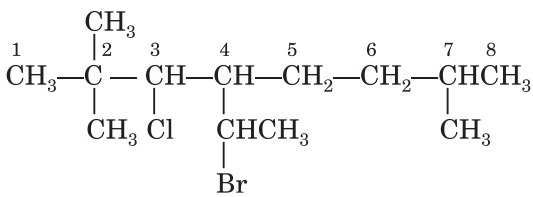
1-Bromo-2-iodocyclobutene

(*v*) 

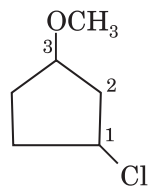
4-Chloropent-1-ene

(*vi*) 

3-Bromo-2-methylpropene

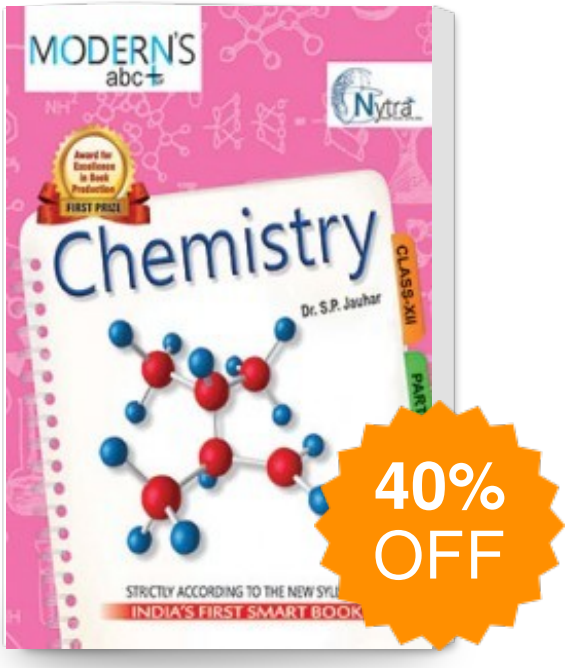
(*vii*) 

4-(1-Bromoethyl)-3-chloro-2, 2, 7-trimethyloctane

(*viii*) 

1-Chloro-3-methoxycyclopentane

Modern's abc Plus Of Chemistry For class XII Part-2



Publisher : MBD Group Publishers

ISBN : 9789351841227

Author : SP Jauhar, Shennu Jauhar, Saru Malhotra And Rita Batra

Type the URL : http://www.kopykitab.com/product/11322

Get this eBook