

Alkyl Halides

Nucleophilic Aliphatic Substitution
and Elimination

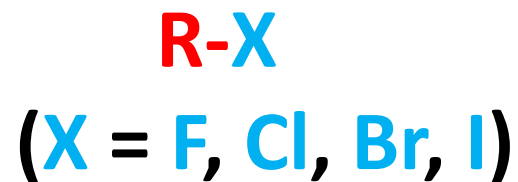
Dr. huda saleh abood
For 1st Stage Students

Alkyl halides

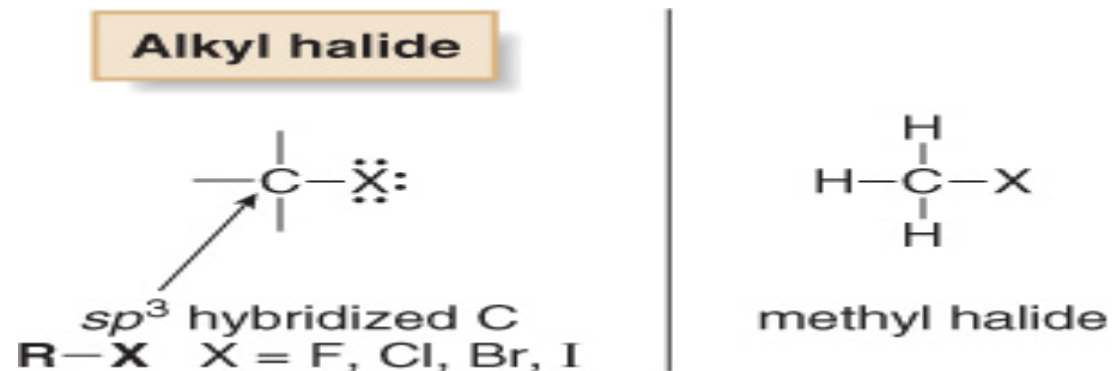
Alkyl halides are organic molecules containing a halogen atom bonded to an sp^3 hybridized carbon atom.

- Alkyl halides are classified as primary (1°), secondary (2°), or tertiary (3°), depending on the number of carbons bonded to the carbon with the halogen atom.
- The halogen atom in halides is often denoted by the symbol "X"

General structure of alkyl halides

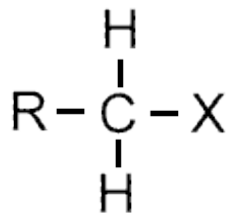


R is any simple alkyl or substituted alkyl group



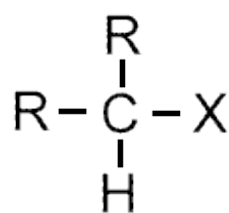
Classification

Alkyl halides can be classified according to the class of the carbon that the halogen is attached to.



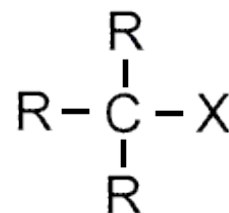
1°

Primary



2°

Secondary



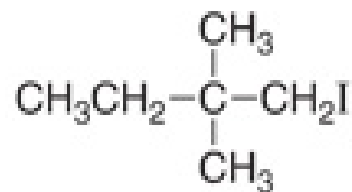
3°

Tertiary

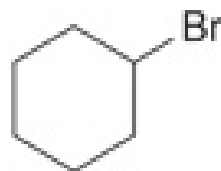
There are other types of organic halides, These include:

- Vinyl halides have a halogen atom (X) bonded to a C=C double bond.**
- Aryl halides have a halogen atom bonded to a benzene ring.**
- Allylic halides have X bonded to the carbon atom adjacent to a C=C double bond.**
- Benzylic halides have X bonded to the carbon atom adjacent to a benzene ring.**

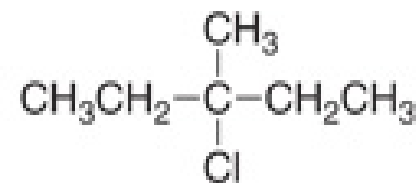
Examples of 1°, 2°, and 3° alkyl halides



1° iodide

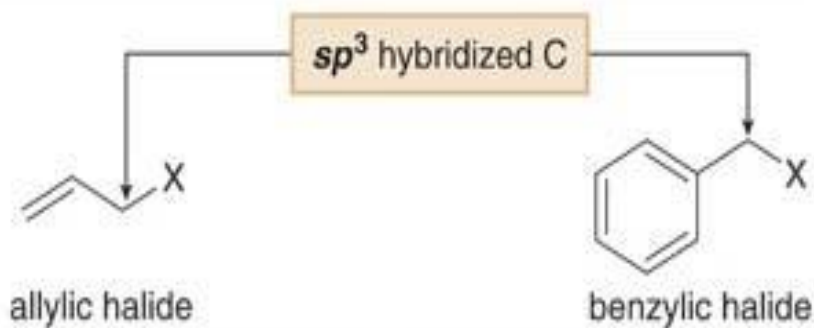
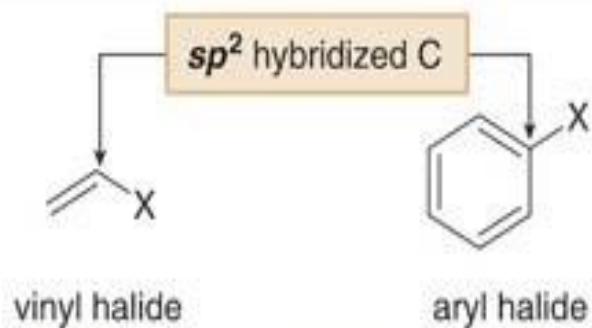


2° bromide



3° chloride

Four types of organic halides (RX) having X near a π bond



Nomenclature

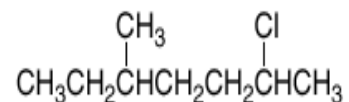
Common name: replacing **-ane** of alkane by **-yl** and follow by **halide** for longest chain.

IUPAC name: prefixing **Halo-** followed by **alkane**, as in alkanes.

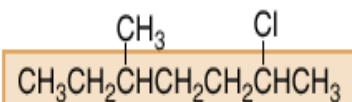
How To

Name an Alkyl Halide Using the IUPAC System

Example Give the IUPAC name of the following alkyl halide:



Step [1] Find the parent carbon chain containing the halogen.



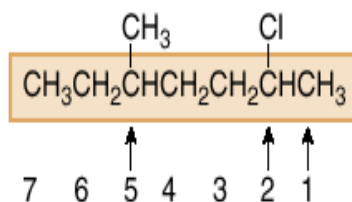
7 C's in the longest chain

7 C's ----> heptane

- Name the parent chain as an **alkane**, with the halogen as a substituent bonded to the longest chain.

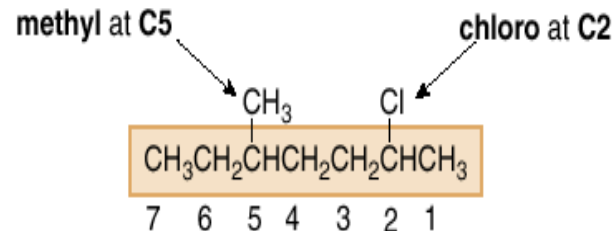
Step [2] Apply all other rules of nomenclature.

a. Number the chain.



- Begin at the end nearest the first substituent, either alkyl or halogen.

b. Name and number the substituents.



c. Alphabetize: c for chloro, then m for methyl.

ANSWER: 2-chloro-5-methylheptane

Common names

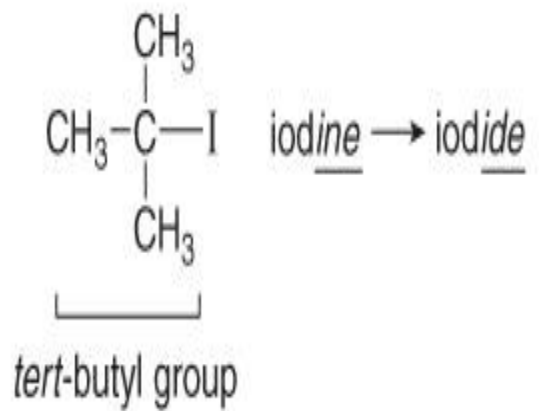
Common names are often used for simple alkyl halides. To give a common name:

1-Name all the carbon atoms for longest chain of the molecule as a separate alkyl group by replacing –ane of alkane by –yl.

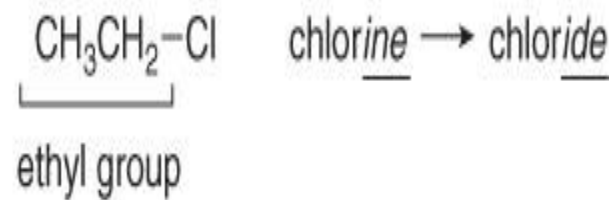
2-Name the halogen (replace to halide) that bonded to the alkyl group .

Combine the names of the alkyl group and halide, separating the words with a space.

Common
names

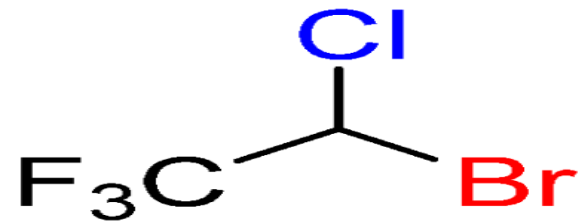


***tert*-butyl iodide**



ethyl chloride

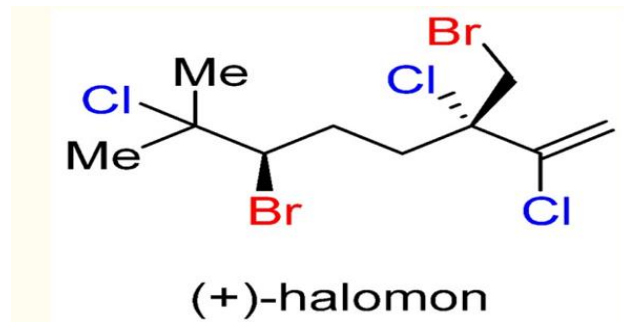
Example of drugs



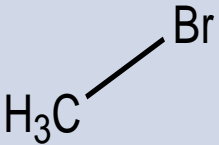
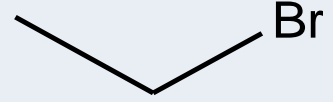
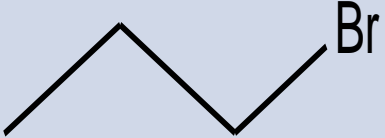
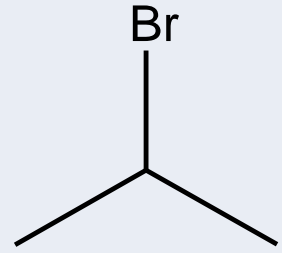
halothane

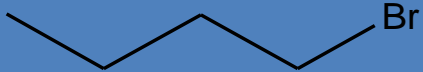
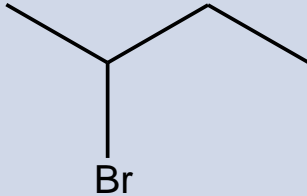
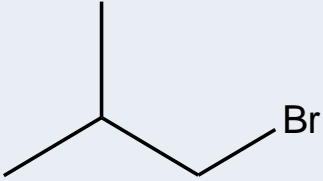
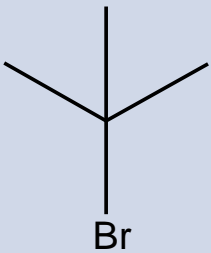
Anesthetic

2-Bromo-2-chloro-1,1,1-trifluoro-ethane



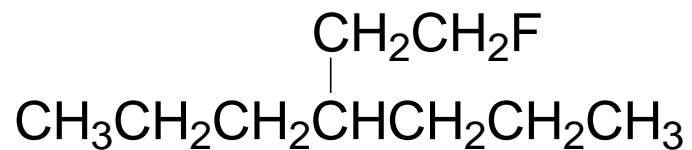
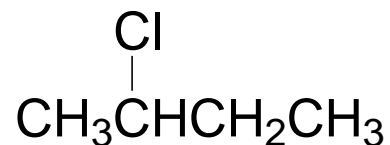
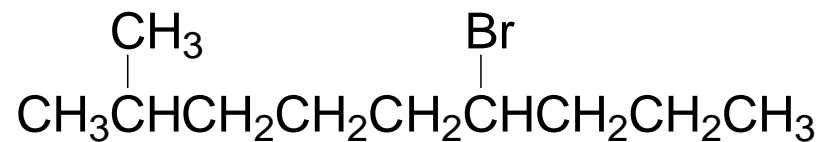
6-Bromo-3-(bromomethyl)-2,3,7-trichloro-7-methyl-1-octene

Common name	Structure	IUPAC name	No. of C atom
Methyl bromide		Bromomethane	1
Ethyl bromide		Bromoethane	2
n-Propyl bromide		1-Bromopropane	3
Isopropyl bromide		2-Bromopropane	

n-Butyl bromide		1-Bromobutane
sec-Butyl bromide		2-Bromobutane
Isobutyl bromide		1-Bromo-2-methylpropane
tert-Butyl bromide		2-Bromo-2-methylpropane

Q/ Give the structure and IUPAC name of n-, iso-, sec-, tert- and neo-pentyl chloride.

Q/ Give the common and IUPAC name of the following:



Physical properties of alkyl halide

- Because of greater molecular weight, haloalkanes have considerably higher boiling points than alkanes of the same number of carbons.

n-Pentane (36 °C) n-Pentyl chloride (108 °C)

- For a given alkyl group, the boiling point increases with increasing atomic weight of the halogen, so that a fluoride is the lowest boiling, an iodide the highest boiling.
- For a given halogen, b.p. rises with increasing number of carbon atoms.

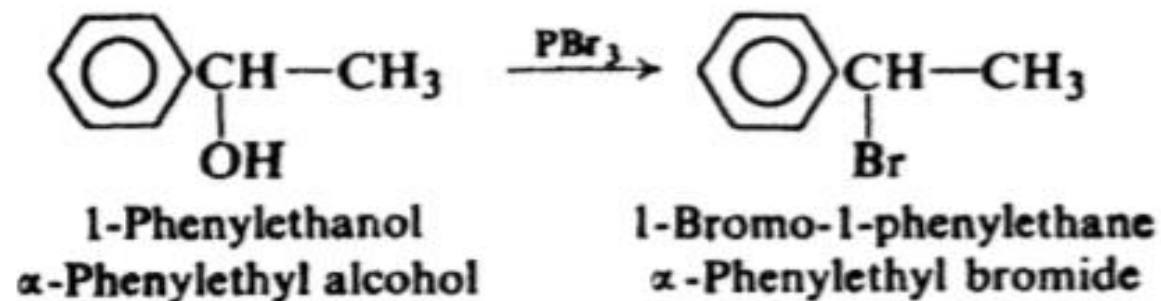
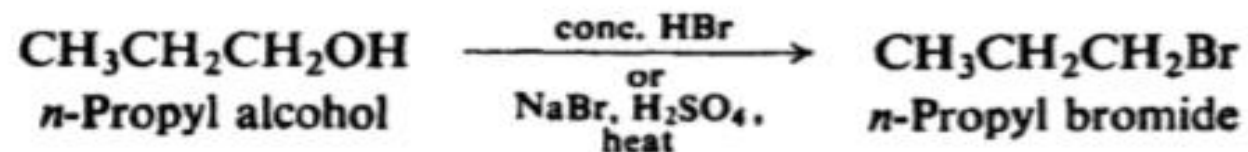
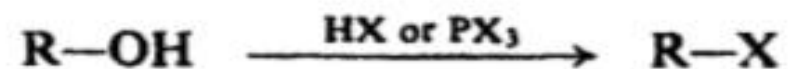
n-Propyl chloride (47) n-Butyl chloride (78.5)

- The branching lowers the b.p.
n-Butyl bromide (102) sec-Butyl bromide (91)
- In spite of their polarity, alkyl halides are insoluble in water, probably because of their inability to form hydrogen bonds. They are soluble in the typical organic solvents.
- Iodo, bromo, and polychloro compounds are more dense than water.

Preparation

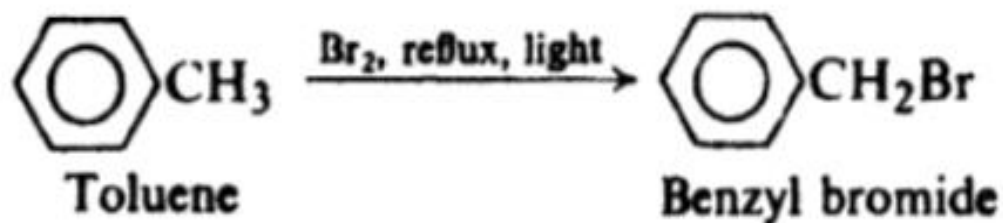
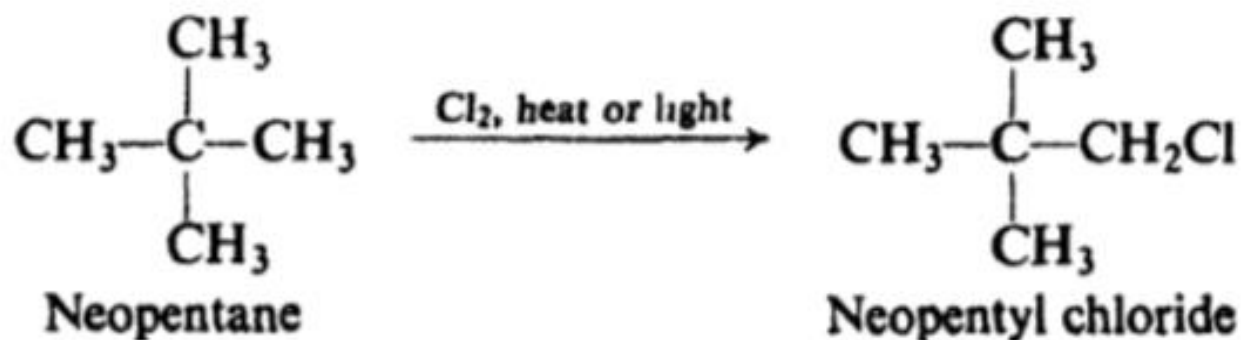
1- From alcohols

Alcohols react with hydrogen halides or phosphorus halides.



2- Halogenation of certain hydrocarbons.

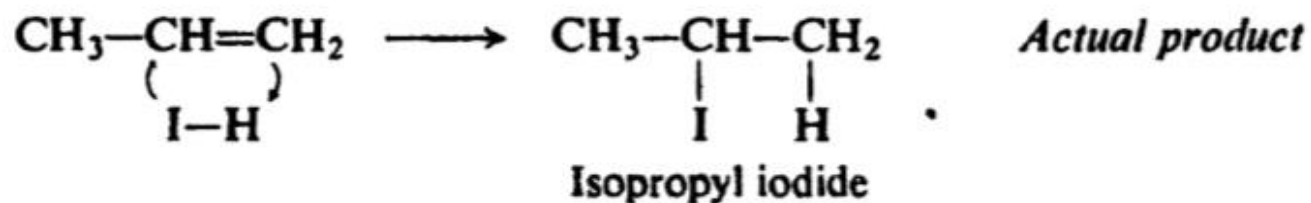
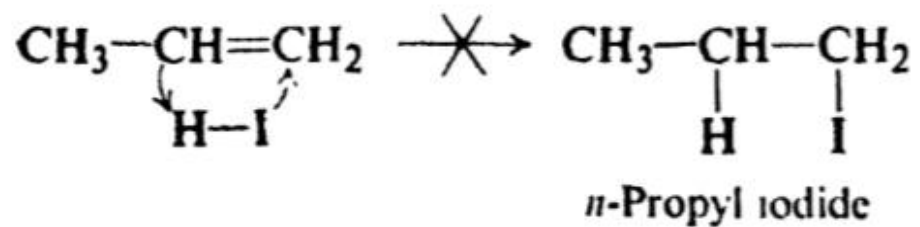
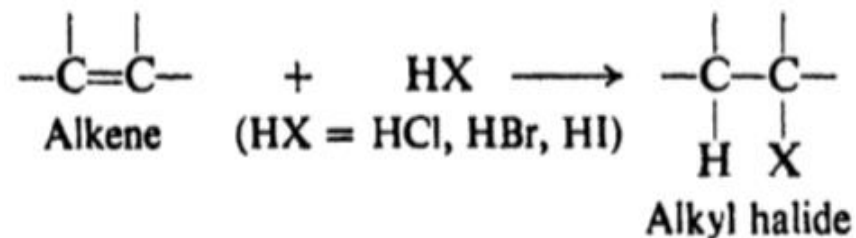
Under the influence of ultraviolet light, or at 250-400, chlorine or bromine converts **alkanes** into chloroalkanes (alkyl chlorides) or bromoalkanes (alkyl bromides).



3- Addition of hydrogen halides to alkenes.

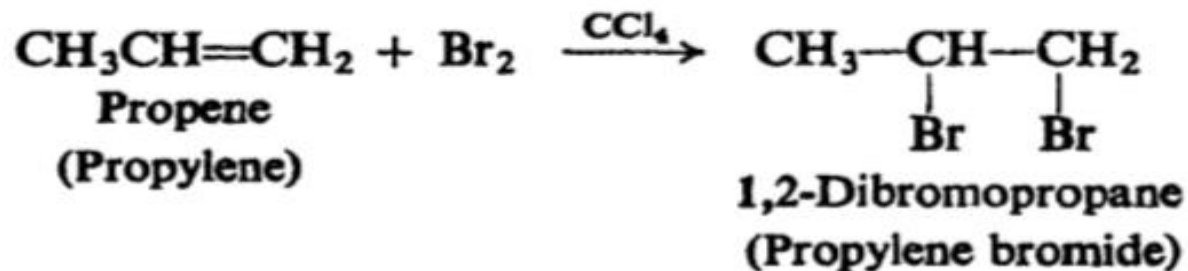
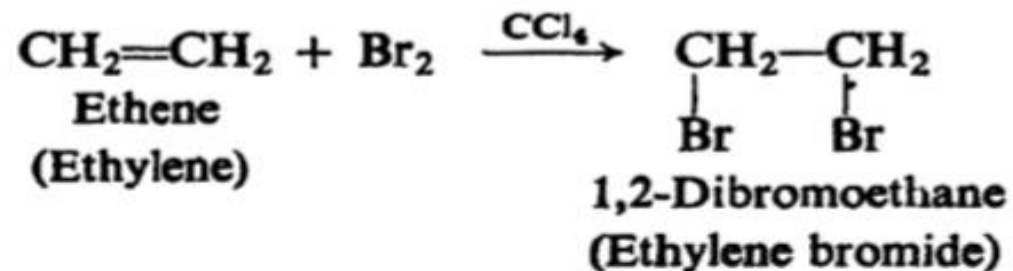
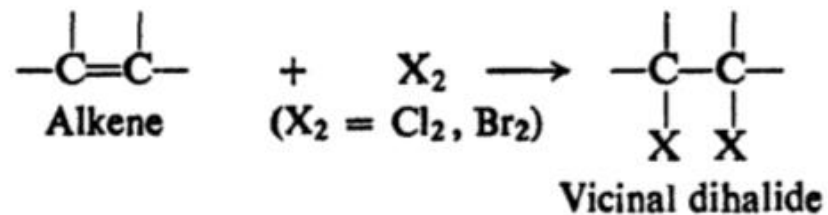
Markovnikov's rule

An alkene is converted by hydrogen chloride, hydrogen bromide, or hydrogen iodide into the corresponding alkyl halide.

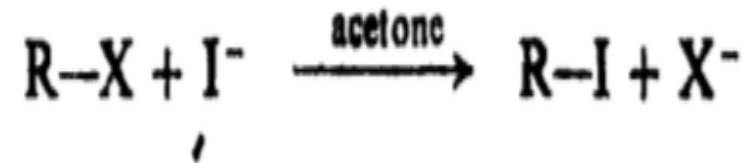


4- Addition of halogens to alkenes and alkynes

Alkenes are readily converted by chlorine or bromine into saturated compounds that contain two atoms of halogen attached to adjacent carbons.



5- Halide exchange (Finkelstein reaction).



An alkyl iodide is prepared from the corresponding bromide or chloride by treatment with a solution of sodium iodide in acetone, the less soluble bromide or chloride precipitates from solution and can be removed by filtration.

