



Ministry of higher education and scientific research  
AL-Mustaqbal University college Department of  
medical physics



# Organic Chemistry

## Lecture 2

# Alkanes

By

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# Alkanes

- Alkanes are the simplest type of organic compounds and member of a larger class of organic compounds called saturated hydrocarbons that contains **only carbon-carbon single bonds**. Alkanes have the general molecular formula  **$C_nH_{2n+2}$** .
- we can determine the number of hydrogen in the molecule and its molecular formula. For example, decane, with ten carbon atoms, must have  $(2 \times 10) + 2 = 22$  hydrogen atoms and a molecular formula of  $C_{10}H_{22}$ .

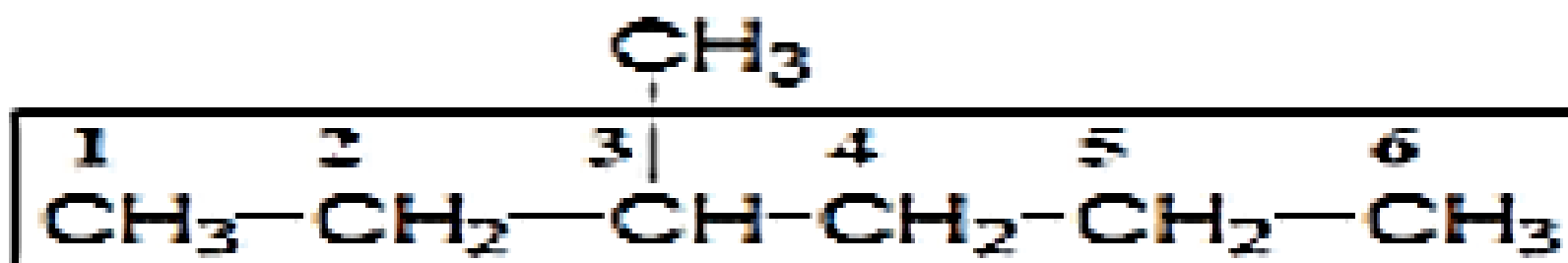
# Nomenclature of Alkanes and the IUPAC System

1. The name for an alkane with an unbranched chain of carbon atoms consists of a prefix showing the number of carbon atoms in the chain and the ending -ane. The simplest member of Alkane family is methane

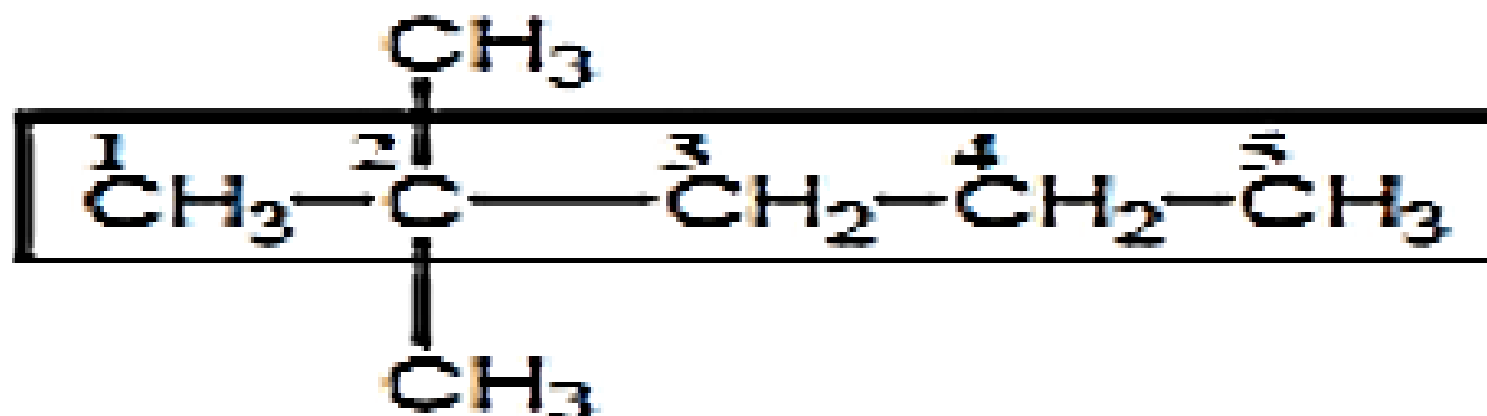
Molecular Formula	Structural formula	Name
CH <sub>4</sub>	CH <sub>4</sub>	Methane
C <sub>2</sub> H <sub>6</sub>	CH <sub>3</sub> – CH <sub>3</sub>	Ethane
C <sub>3</sub> H <sub>8</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>3</sub>	Propane
C <sub>4</sub> H <sub>10</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>3</sub>	Butane
C <sub>5</sub> H <sub>12</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>3</sub>	Pentane
C <sub>6</sub> H <sub>14</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>3</sub>	Hexane
C <sub>7</sub> H <sub>16</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>3</sub>	Heptane
C <sub>8</sub> H <sub>18</sub>	CH <sub>3</sub> – CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> –CH <sub>2</sub> – CH <sub>2</sub> –CH <sub>3</sub>	octane

2. For branched-chain alkanes, select the longest chain of carbon atoms as the parent chain; its name becomes the root name. If there is one substituent, number the parent chain from the end that gives the substituent the lower number.

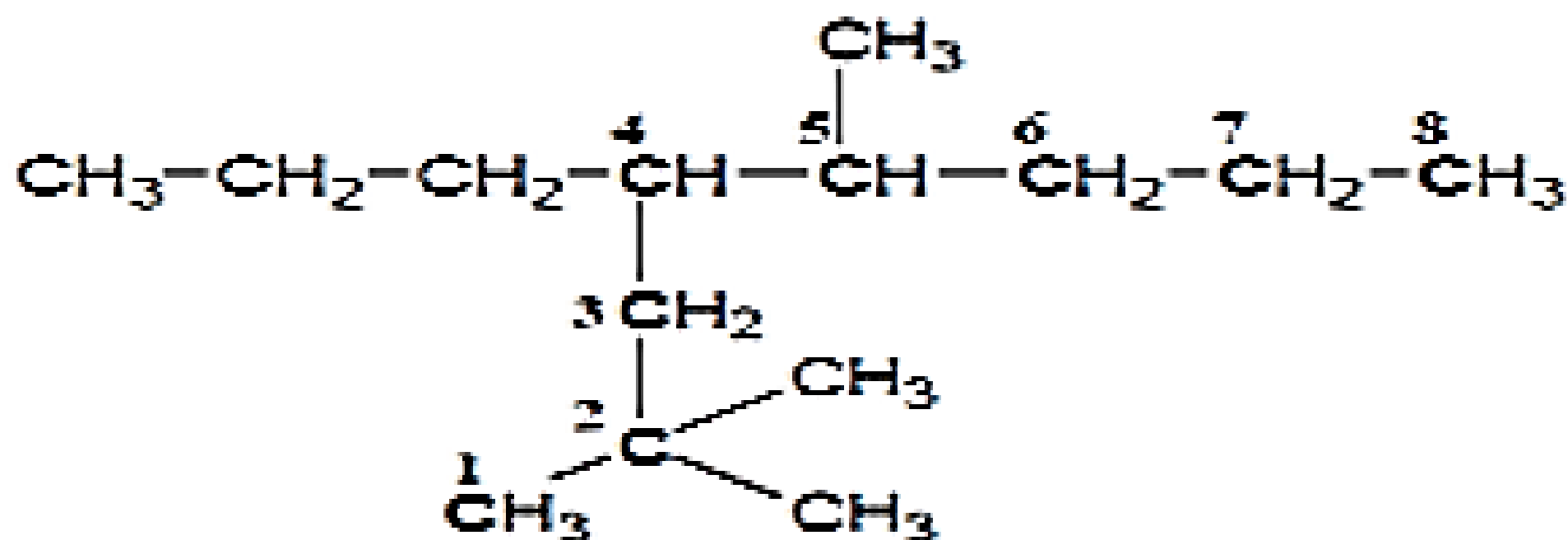
3- Give each substituent on the parent chain a name and a number. The number shows the carbon atom of the parent chain to which the substituent is bonded. Use a hyphen (-) to connect the number to the name.



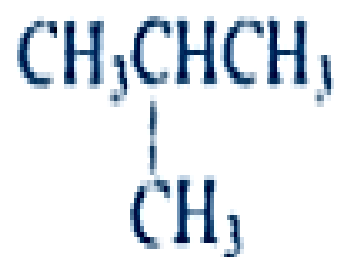
3-Methyl hexane



2,2-Dimethyl pentane



2,2,5-Trimethyl-4-propyl octane



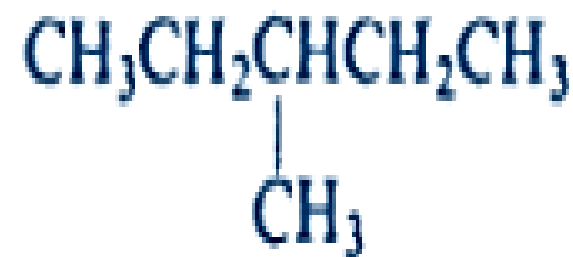
I

Methylpropane  
(Isobutane)



II

2-Methylpentane



III

3-Methylpentane

A substituent group derived from an alkane by the removal of a hydrogen atom is called an alkyl group; it is commonly represented by the symbol R. We name alkyl groups by dropping the -ane from the name of the parent alkane and adding the suffix-yl. The substituent derived from methane, for example, is methyl



Methyl



Ethyl



Propyl



iso-propyl



butyl



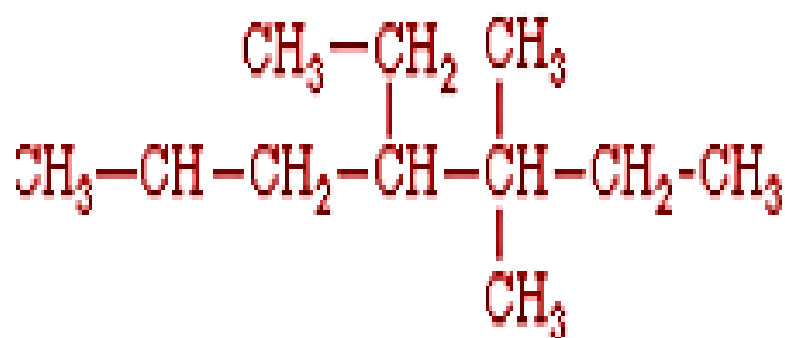
iso-butyl



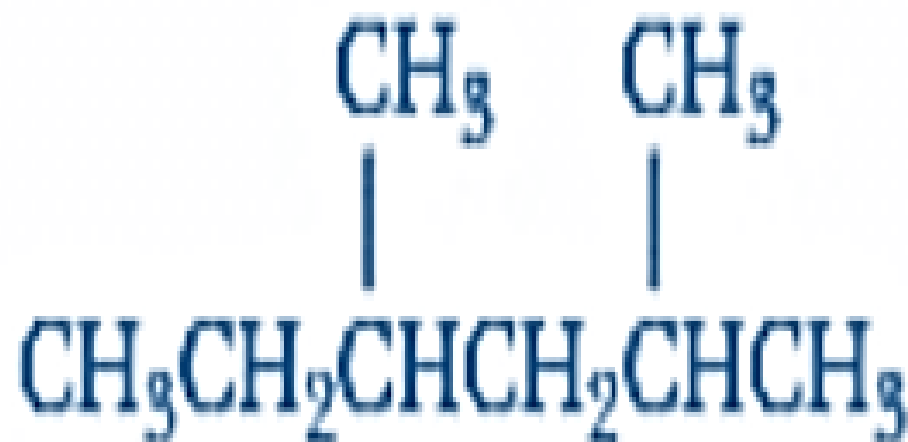
tert - butyl

If there are two or more identical substituents, number the parent chain from the end that gives the lower number to the substituent encountered first. The number of times the substituent occurs is indicated by the prefix di-, tri-, tetra-

**A comma is used to separate position numbers.**



4-ethyl-3,3-dimethylheptane



2,4-Dimethylhexane (not 3,5-dimethylhexane)



If there are two or more different substituents, list them in alphabetical order and number the chain from the end that gives the lower number to the substituent encountered first.



3-Ethyl-5-methylheptane (not 3-methyl-5-ethylheptane)

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F-

Foloro

Br-

Bromo

I-

Iodo

NO<sub>2</sub>-

Nitro

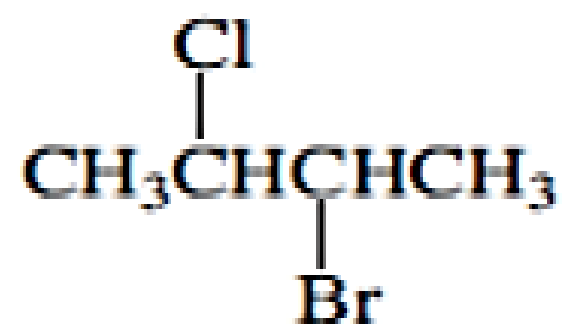
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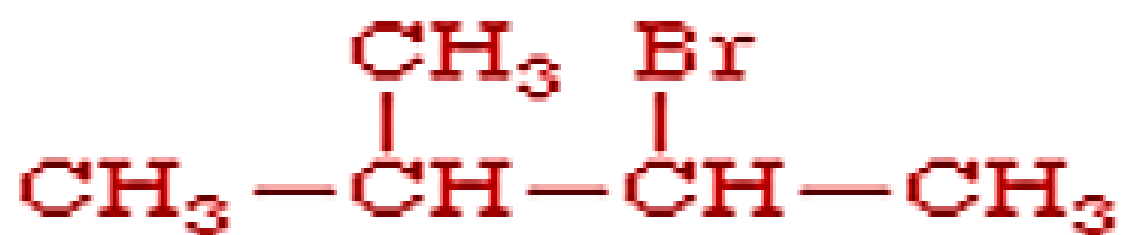
methyl chloride  
chloromethane



ethyl fluoride  
fluoroethane



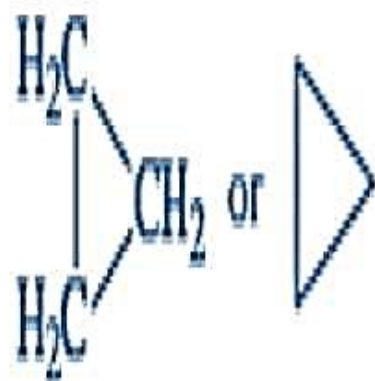
2-bromo-3-chlorobutane  
not  
3-bromo-2-chlorobutane



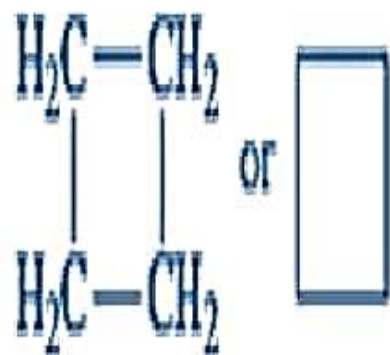
2-bromo-3-methylbutane

# Cyclo Alkanes

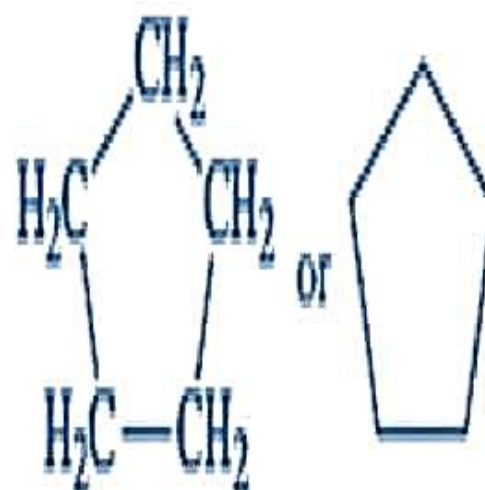
A hydrocarbon that contains carbon atoms joined to form a ring is called a cyclic hydrocarbon. When all carbons of the ring are saturated, the hydrocarbon is called a cycloalkane.



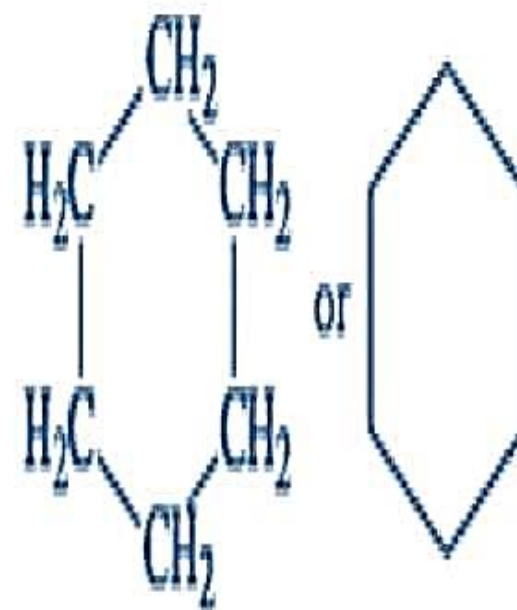
Cyclopropane



Cyclobutane



Cyclopentane



Cyclohexane

# Physical Properties of Alkanes

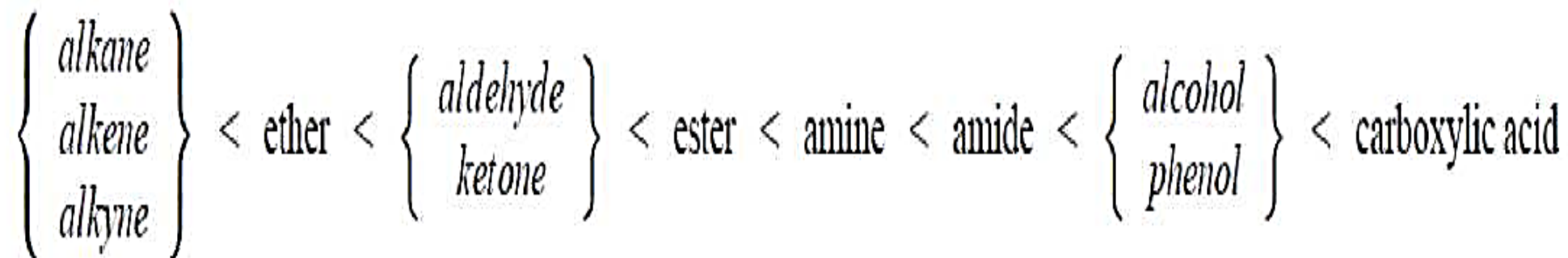
- The first four n-alkanes are **gases**, but, as a result of the rise in boiling point and melting point with increasing chain length, the next 13 (**C5-C17**) are **liquids**, and those- containing **18 carbons or more** are **solids** physical constants for a number of the n-alkanes., the boiling points and melting points rise as the number of carbons increases.
- The processes of boiling and melting require overcoming the intermolecular forces of a liquid and a solid; the boiling points and melting points rise because these intermolecular forces **increase** as the molecules get larger.

- We see that in every case a **branched-chain isomer** has a lower boiling point than a **straight-chain isomer**, and further, that the more numerous the branches, the lower the boiling point.

## Properties

Least Polar

Most Polar



Lowest b.p.

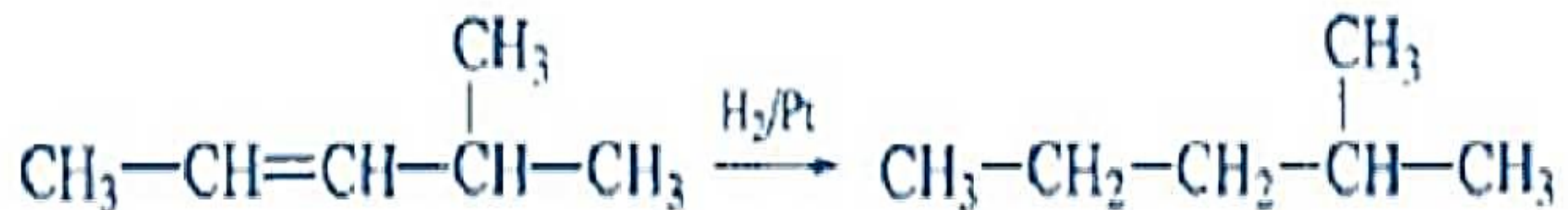
Highest b.p.

Lowest water solubility

Highest water solubility

# *Preparation of Alkane*

## 1) Hydrogenation of Alkene



## 2) Reduction with Alkyl Halide

A) Hydrolysis with Grignard reagent.



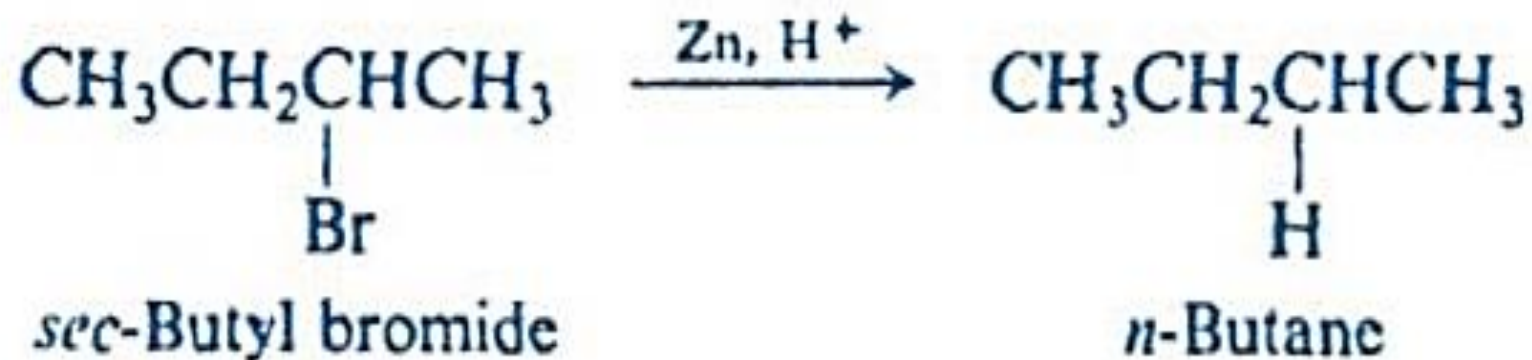
Example:



## b) Reduction with Metal and Acid



Example:



Thank  
you

