

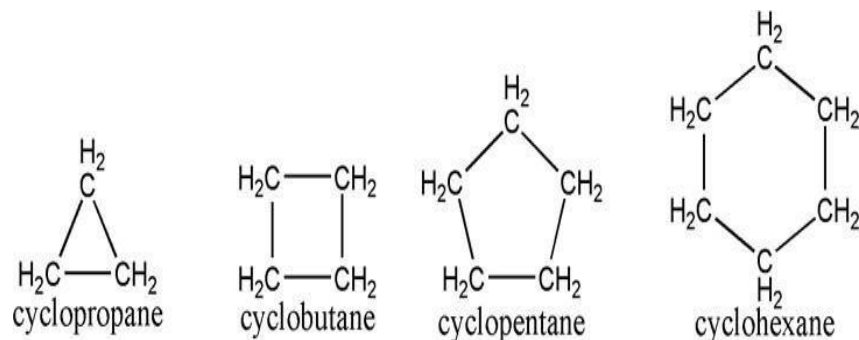
CYCLOALKANES

➤ CYCLOALKANES :

Hydrocarbons with three or more carbon atoms in the ring are called as cycloalkanes. (they are also called as cycloparaffins).

General Formula : $(CH_2)_n, n= 3,4,5,6$

EXAMPLES :



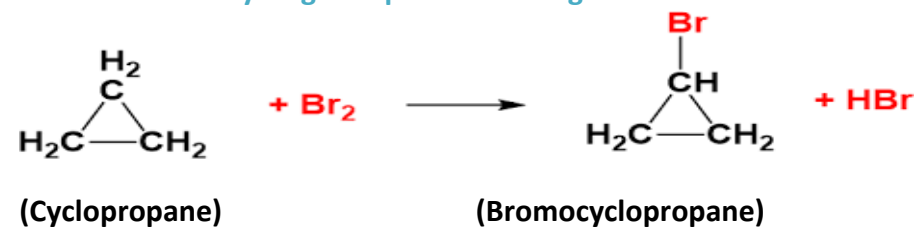
➤ PHYSICAL PROPERTIES

- 1) Similar to open chain alkanes
- 2) Higher boiling point than unbranched alkanes
- 3) Much higher melting point than their open-chain counterpart .

NAME	FORMULA	Mp/ °C	Bp/°C	Density(g/cm ³)
Cyclopropane	C ₃ H ₆	-127.6	-32.7	-
Cyclobutane	C ₄ H ₈	-80	13	-
Cyclopentane	C ₅ H ₁₀	-94	49.5	0.751
Cyclohexane	C ₆ H ₁₂	6.5	80.5	0.779
Cycloheptane	C ₇ H ₁₄	-12	117	0.811
Cyclooctane	C ₈ H ₁₆	13.5	148	0.834

a) SUBSTITUTION REACTION

In this reaction one hydrogen replaced but ring does not affected.



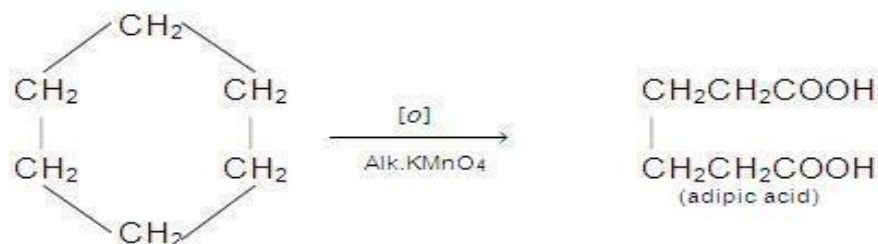
b) ADDITION REACTION (RING OPENING REACTION).

In this reaction bond will break and ring will open. higher cycloalkane does not give this reaction.



c) OXIDATION REACTION :

Cycloalkanes are oxidised by alkaline potassium permanganate (KMnO₄) gives dicarboxylic acid involving ring fission.



> STABILITY (Relative stabilities of cycloalkanes)

A) BAEYER'S STRAIN THEORY :

All cycloalkanes do not possess the same degree of stability as it depends on the heat of combustion,

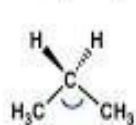
THE STABILITY OF CYCLOALKANE AND HEAT OF COMBUSTION OF INVERSELY PROPORTIONAL.

ALKANES	HEAT OF COMBUSTION PER METHYLENE GROUP(Kcal/mol)
n-Alkane	157.4
Cyclopropane	166.6
Cyclobutane	163.95
Cyclopentane	158.7
Cyclohexane	157.4
Cycloheptane	158.3
Cyclooctane	158.7

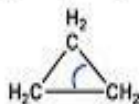
> THEORY :

Baeyer's theory based on all ring systems are planar derivation from normal tetrahedral angles results into unstable cycloalkanes. The large ring systems involve negative strain hence do not exist.

Bond angles in propane, cyclopropane, and cyclobutane

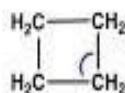


C-C-C bond angle 109.5°



interior bond angle 60°

(~ 49° less than ideal of 109°)
[see note at bottom of post]



interior bond angle 90°

(~ 19° less than ideal of 109°)

> DEVIATION :

cycloalkane	angle strain (d)
Cyclopropane	$+24^{\circ}44'$
Cyclobutane	$9^{\circ}44'$
Cyclopentane	$0^{\circ}44'$
Cyclohexane	$-5^{\circ}16'$
Cycloheptane	$-9^{\circ}33'$

LIMITATION OF BAEYER'S STRAIN THEORY

1) The limitation of Baeyer strain theory is that he assumed that all cycloalkanes are planar.

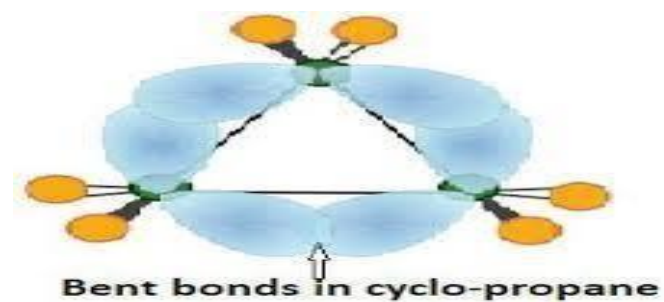
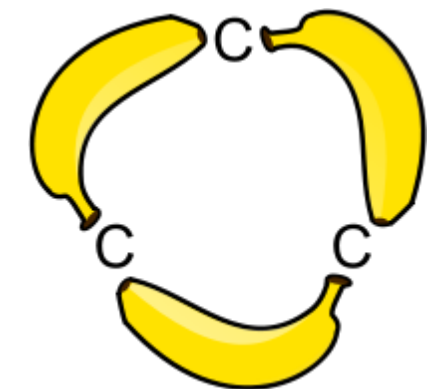
2) Baeyer was unable to explain the effect of angle strain in large ring systems.

3) According to Baeyer, cyclopentane should be much more stable than cyclohexane, but practically it is not.

4) Larger ring systems are not possible according to Baeyer as they have negative angle strain.

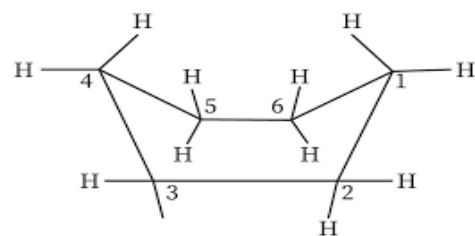
B) COULSON & MOFFITT'S MODIFICATION :

- It is also called as banana bond theory because bond is look like banana shape.

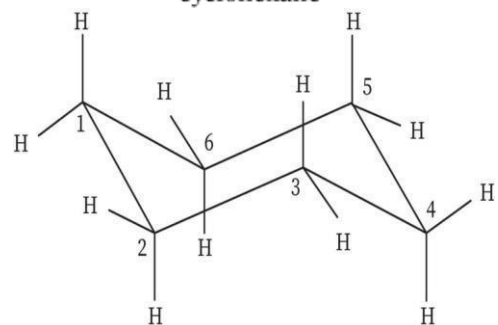


C) SACHS MOHR'S THEORY (THEORY OF STRAINLESS RINGS)

Sachse Mohr theory proposed the existence of two types of puckered strainless rings known as boat and chair form of cyclohexane.

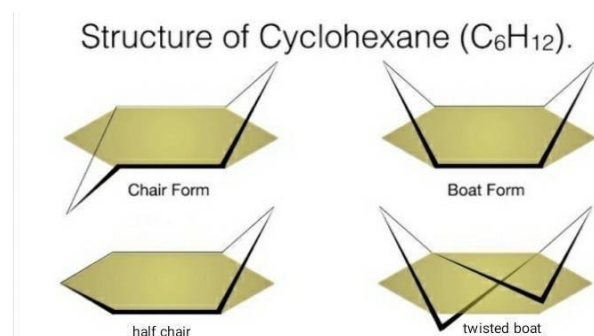


Boat conformation of cyclohexane

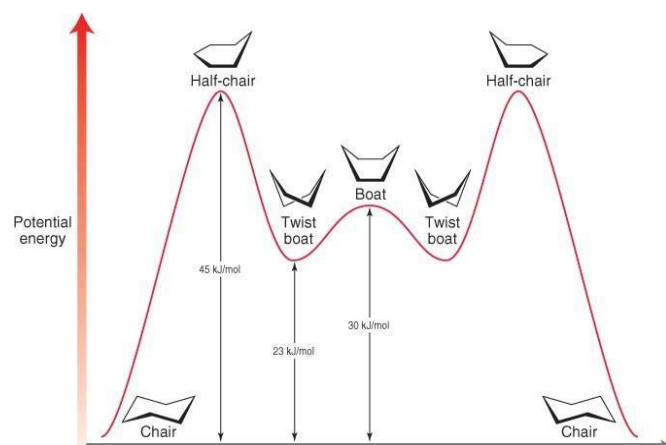


Chair confirmation of cyclohexane

CONFIRMATION OF CYCLOHEXANE:



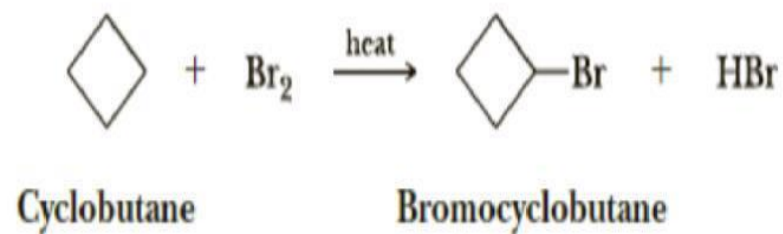
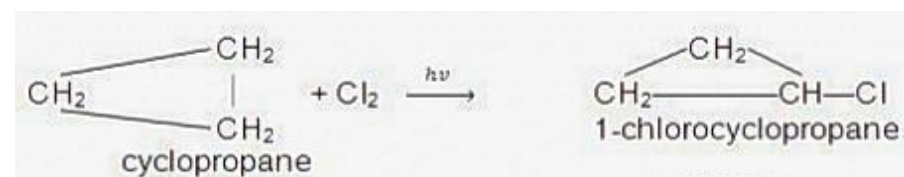
ENERGY PROFILE DIAGRAM



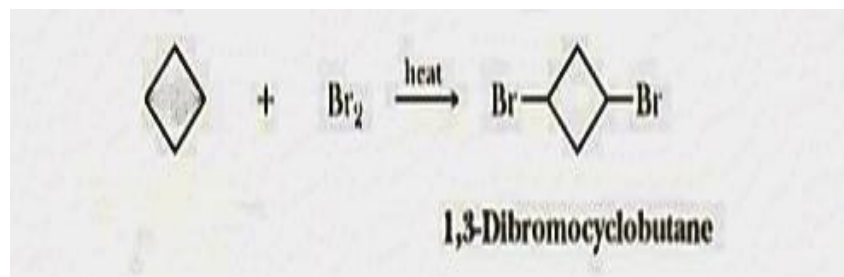
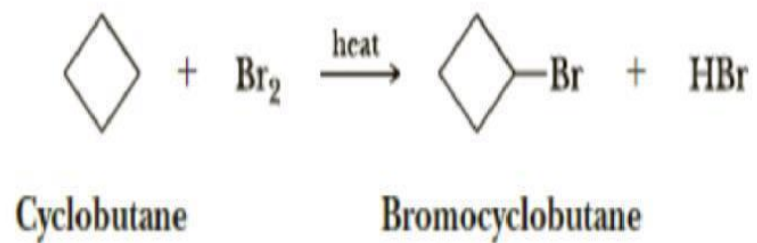
REACTION OF CYCLOPROPANE AND CYCLOBUTANE :

1) HALOGENATION :

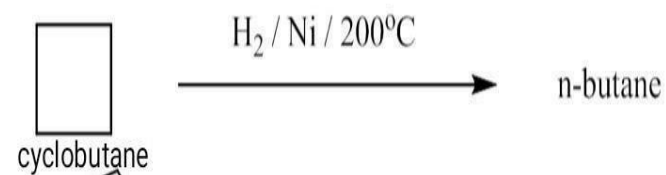
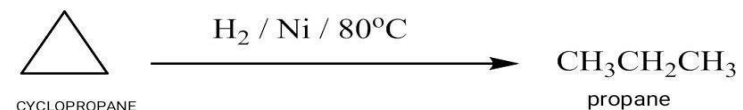
a) PHOTOHALOGENATION:



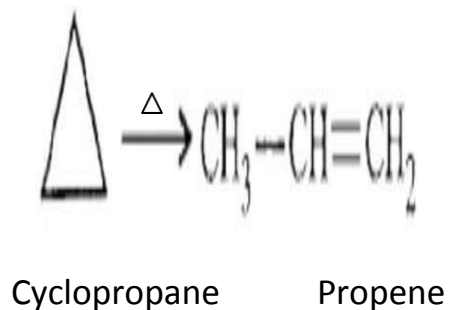
B) CATALYTIC HALOGENATION :



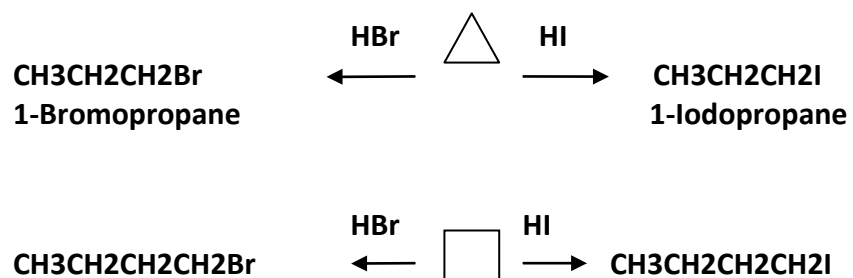
2) CATALYTIC HYDROGENATION



3) EFFECT OF HEAT :

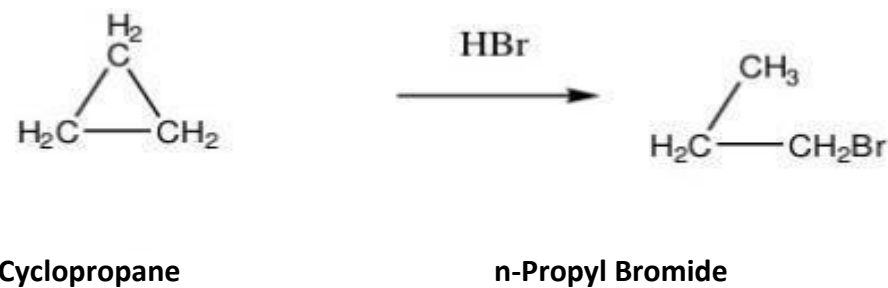


4) REACTION WITH HYDROGEN HALIDES :

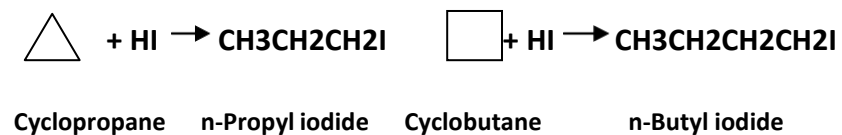


5) ADDITION REACTION :

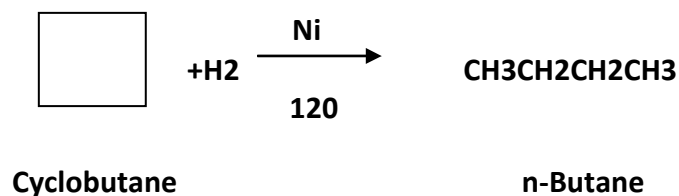
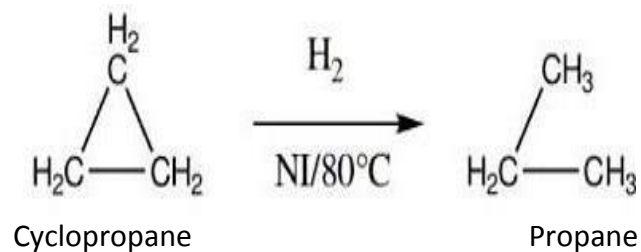
i) ADDITION OF HYDROGEN BROMIDE :



ii) ADDITION OF HYDROGEN IODIDE :



iii) ADDITION OF HYDROGEN :



REFERENCE :

1)Textbook Of Organic Chemistry Arjun Bahl & B.S Bahl Page No :[593 – 597]

2) Textbook Of Pharmaceutical Organic Chemistry-Ii By Pv Publication Page No : [164-183]

3)By Google :..

<https://www.google.com/search?q=cycloalkanes+pharmaceutical+organic+chemistry+pdf&og=cycloalkanes>

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