PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-1**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. Introduction To Organic Chemistry (Basics of Class 11th)

2. Questions

Fundamental of Organic Chemistry
(Quick Recap of Class 11th)

MY SHIMMERING STARS

#SHOURYA'SGALAXY

SYLLABUS

1. HALOALKANES & HALOARENES
2. ALCOHOL PHENOL & ETHER
3. ALDEHYDE , KETONES & CARBOXYLIC ACID
4. AMINES
5. BIOMOLECULES

INSTRUCTIONS BEFORE STARTING

1. CREATE SEPARATE NOTEBOOK FOR EACH CHAPTER
2. CREATE QUICK RECAP DAILY
3. SOLVE HOMEWORK DAILY
4. BE CONSISTENT
5. CREATE CHEATSHEET AFTER EVERY CHAPTER

START

BASICS (11TH CLASS)

Hydrocarbon (H+C)

REPRESENTATION OF ORGANIC COMPOUNDS

1. Molecular Formula

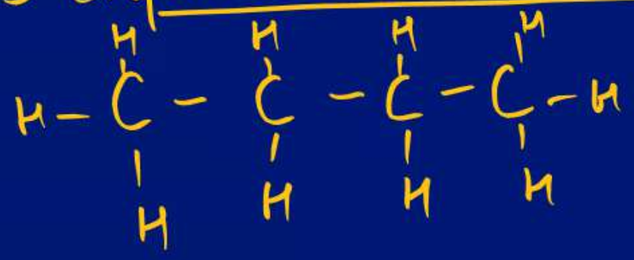
CH_4

$C_6H_{12}O_6$

Exact no of atoms present in compound

Ex. C_4H_{10}

3. Expanded Structural Formula



All bonds are Represented.

2. Condensed Structural Formula

$H_3C-H_2C-H_2C-CH_3$

When only C-C bonds are represented.

4. Bond Line Notation

Cl2
hν

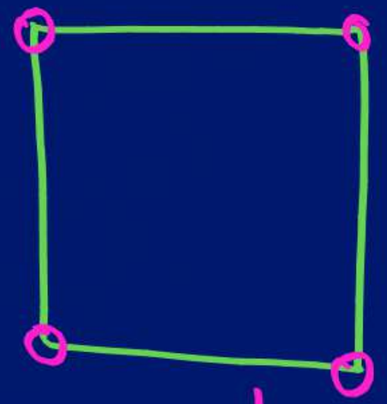
QUESTIONS

$C_6H_{12}O_6$ (Glucose → Aldehyde $-CHO$ or Fructose) → Ketone $-\overset{O}{\overset{\|}{C}}-$

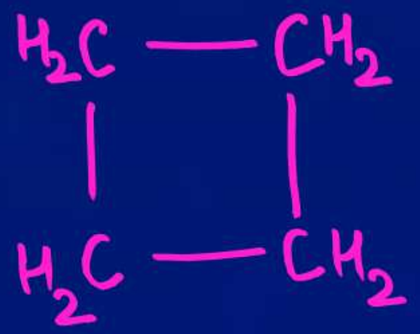
1. Molecular Formula : $C_6H_{12}O_6$ ✓

2. Condensed S.F : $CH_3-CH_2-CH_2-CH_2$ } ✗

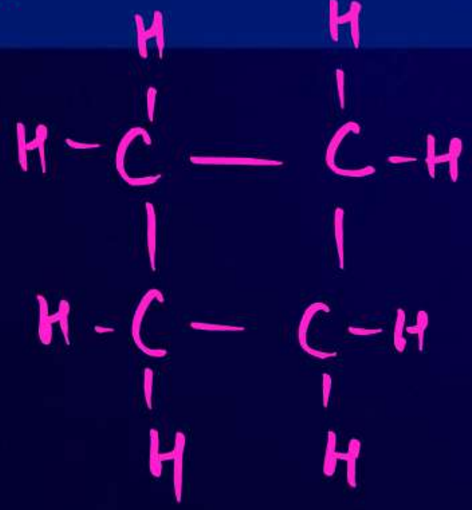
QUESTIONS



→ C.S.F : ?



E.S.F ?

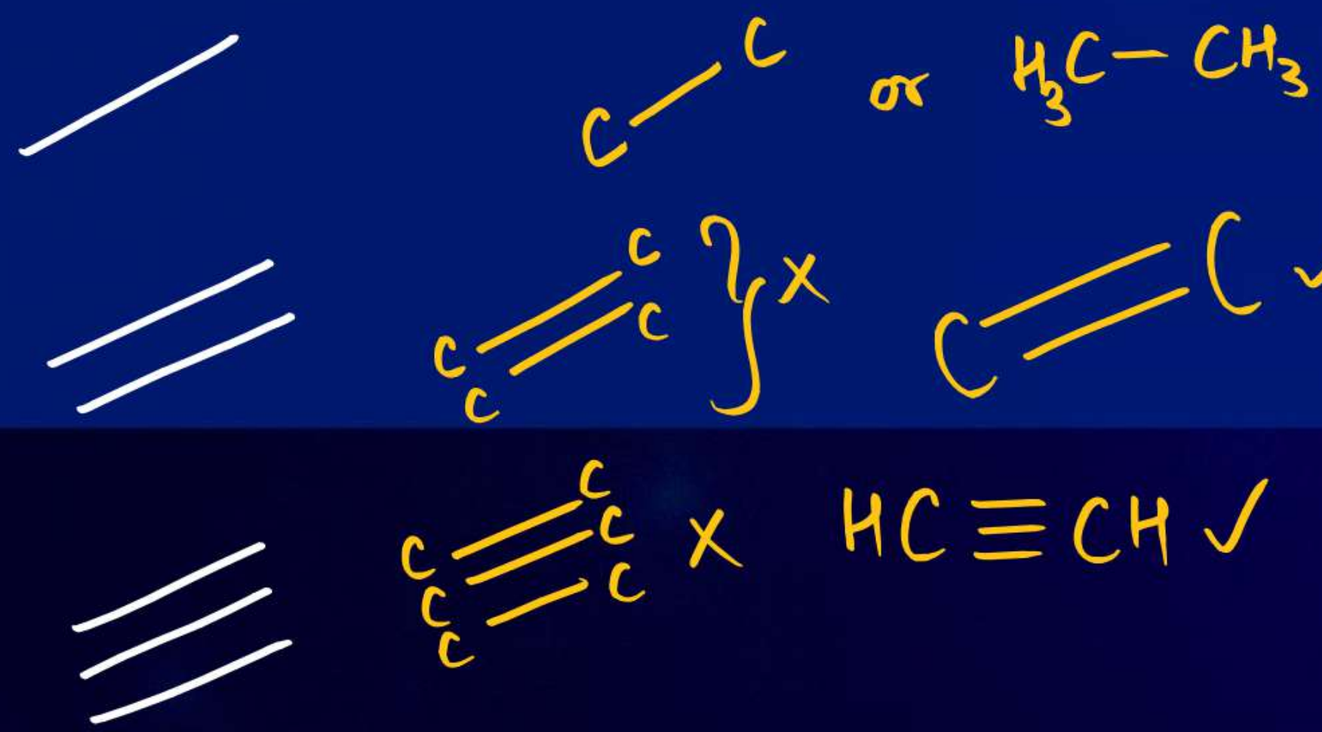


Molecular F.

C_4H_8

QUESTIONS

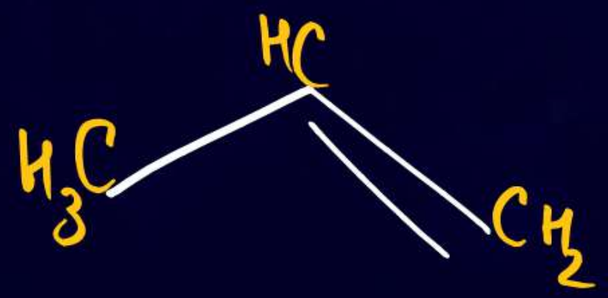
Convert Bond Line Notation — Condensed structural Form.



or H_3C-CH_3

$H_2C=CH_2$

$HC\equiv CH$



$CH_3-CH=CH_2$

BASICS (11TH CLASS)

HYBRIDISATION

Hybridisation Rule

$\sigma + \alpha p$ (sigma bond)		% s character	Fraction
4	sp^3	$\frac{100}{4} = 25\%$	$\frac{1}{4}$
3	sp^2	$100 \times \frac{1}{3} = 33\%$	$\frac{1}{3}$
2	sp	$\frac{100}{2} = 50\%$	$\frac{1}{2}$

Lone pair

e- which do not participate in bonding.

Ex. $CH_3\ddot{N}H_2$

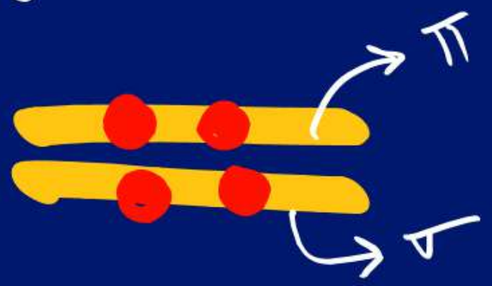
Ex. $H_2\ddot{O}$

BASICS (11TH CLASS)

NO OF BONDS

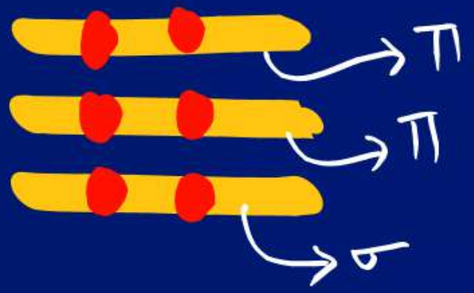
$\boxed{\sigma \text{ bond}}$

Single bond → 1σ $2e^-$



$4e^-$

Double bond → $1\sigma + 1\pi$



Triple bond → $1\sigma + 2\pi$

$6e^-$

QUESTIONS

A sp3 hybrid orbital contains:

$\frac{1}{4}$

1. ¼ s character
2. ½ s character
3. 1/3 s character
4. 2/3 s character

BASICS (11TH CLASS)

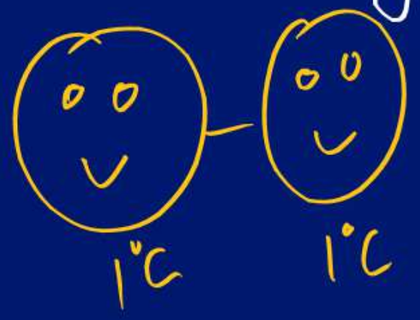
DEGREE OF CARBON

1. Primary Carbon (1° C)

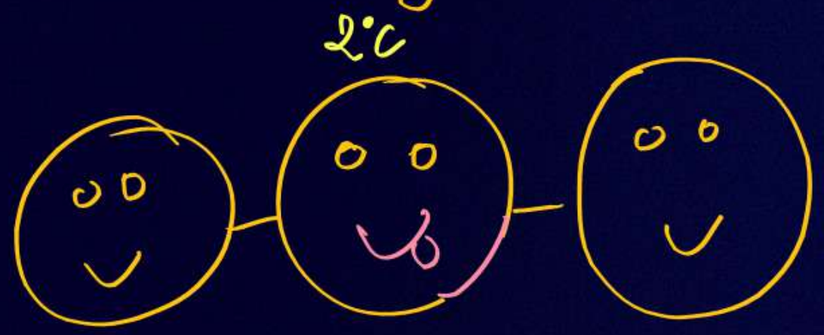
When a carbon is connected to only one Carbon atom.

Ex. CH_3-CH_3

1°C 1°C



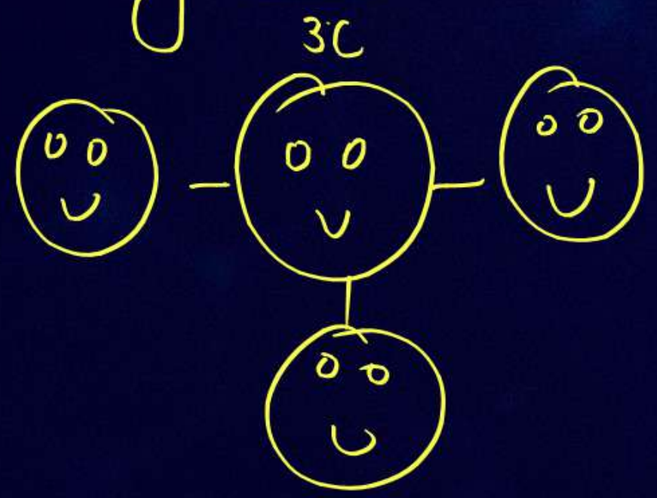
2. Secondary Carbon (2°) C



When a carbon atom is connected to 2 Carbon atom

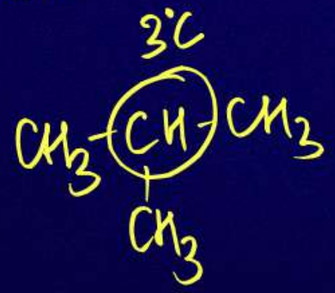
$$\underset{1^\circ C}{CH_3}-\underset{2^\circ C}{CH_2}-\underset{1^\circ C}{CH_3}$$

3. Tertiary Carbon (3°C)

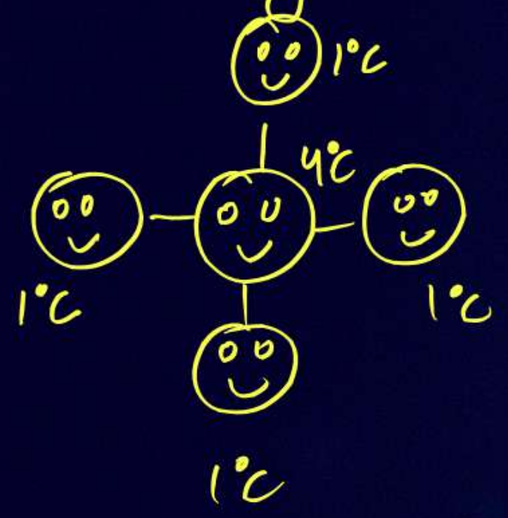


When a carbon atom is Connected to 3 Carbon atom

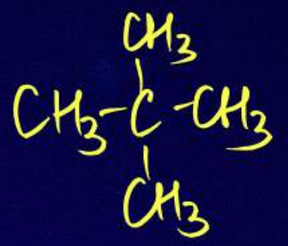
ex.



4. Quaternary Carbon (4°C)



When a carbon atom is connected to 4 C atom.



Valency = 4

↓

Combining capacity of any element

CH_4

or CH_3-X

↓

Superprimary Carbon

BASICS (11TH CLASS)

DEGREE OF HYDROGEN

Hydrogen Jis Carbon se juda hai, vo uski degree hai.

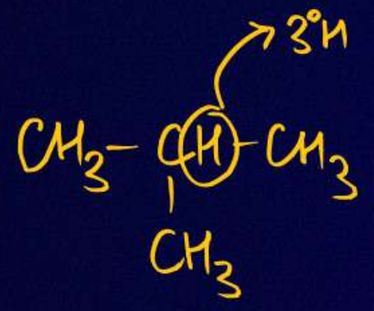
Degree of carbon will determine degree of hydrogen.

→ PRIMARY HYDROGEN (1°H) → CH_3-CH_3 (1°C, 1°H) Hydrogen attached to 1°C.

1°H = 6

→ Secondary hydrogen (2°H) → $CH_3-CH_2-CH_3$ (2°C, 2°H) 2°H = 2 Hydrogen attached to 2°C.

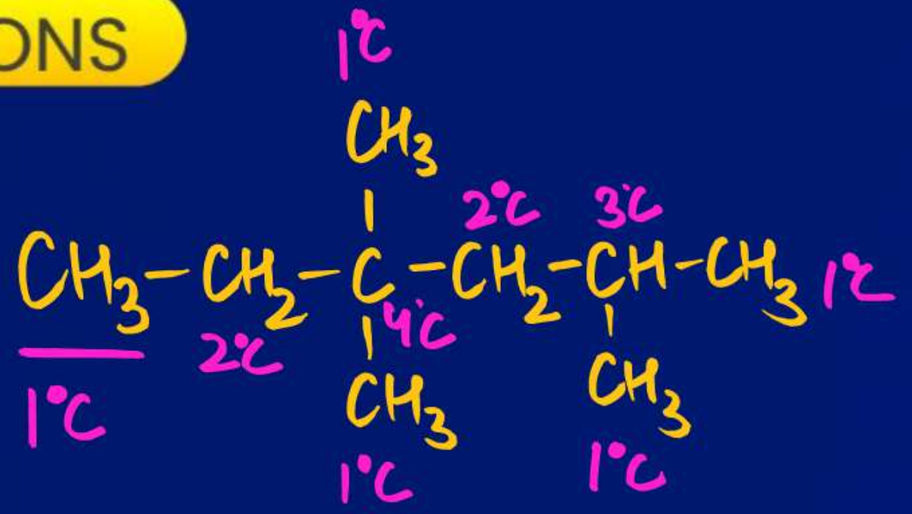
3° Tertiary Hydrogen (3°H)



$3^{\circ}H = 1$

Hydrogen attached to 3°C.

QUESTIONS

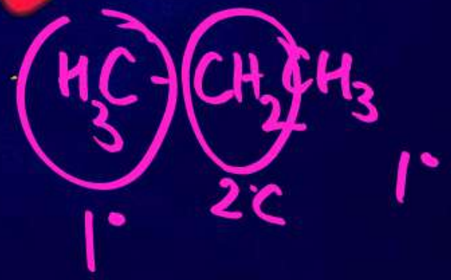


1°C → 1°H → 3
5 → 3×5 = 15 1°H

2°C → 2
2 → 2×2

Calculate 1°C, 2°C, 3°C, 4°C, 1°H, 2°H, 3°H ?

5 2 1 1 15 4 1



RECAP

O.C

C + H : HYDROCARBON + DERIVATIVES

Molecular Fox

C_4H_{10}

C.S.F

$CH_3-CH_2-CH_2-CH_3$

E.S.F

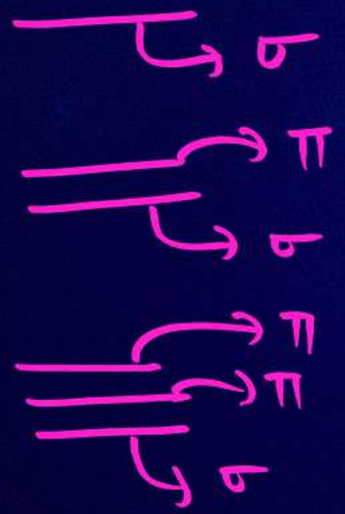
B.L.N

σ + lp

4 sp^3

3 sp^2

2 sp



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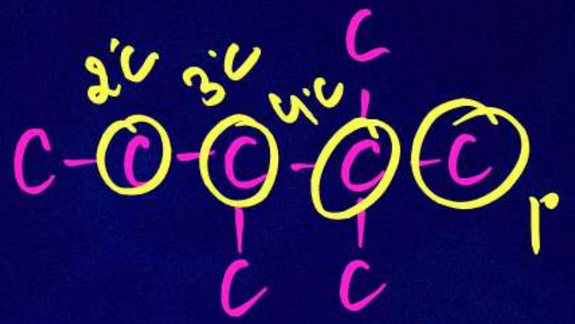


$C^{\circ} \longrightarrow H^{\circ}$

BASICS (11TH CLASS)

11th & 12th

DEGREE OF ALKYL HALIDE

HALOALKANE

HALOGEN

F, Cl, Br, I

PRIMARY ALKYL HALIDE (PRIMARY HALOALKANE)

X is attached to 1°C

CH_3CH_2Cl

1°C

SECONDARY ALKYL HALIDE (2° HALOALKANE)

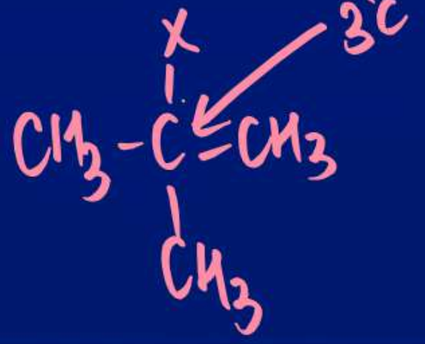
X attached to 2°C

$CH_3-CH(Cl)-CH_3$

2°C

TERTIARY ALKYL HALIDE (3° HALOALKANE)

X attached to 3°C



QUESTIONS

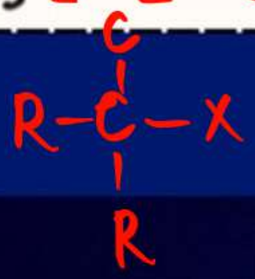
Which of the following is 1° alkyl halide?

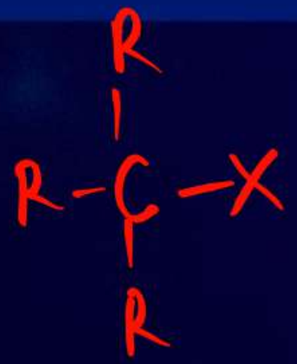
(1) $R-CH_2-X$ 1°

(2) R_2CHX 2°

(3) R_3C-X 3°

(4) $R-H$ ×





R = alkyl group

BASICS (11TH CLASS)

IUPAC NOMENCLATURE

Left ⟶ Right

bond b/w C & C
C-C ⇒ ane, C=C ⇒ ene
C≡C ⇒ yne

Senior Functional gp

2° prefix + 1° PREFIX + WORD ROOT + 1° SUFFIX + 2° SUFFIX

2° prefix → Juniormost F.gp / extra gp / Side chain

1° PREFIX → Cyclic Compound → cyclo

WORD ROOT → No of carbons in Main chain / parent chain

C_1 = meth, C_2 = eth, C_3 = prop, C_4 = but, C_5 = pent, C_6 = hex, C_7 = hept, C_8 = oct, C_9 = non, C_{10} = dec, C_{11} = undec, C_{12} = dodec

HOMEWORK

1) Revise
2) Complete Notes
3) DPP solve except IUPAC

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-2**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. Introduction To HALOALKANES & HALOARENES

2. CLASSIFICATION & IUPAC NAMING

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

QUESTIONS

C4H9X is a

1. Pri-alkyl halide
2. Sec-alkyl halide
3. Ter-alkyl halide
4. Primary, sec and tertiary alkyl halide

C_4H_9X

(i) $CH_3-CH_2-CH_2-\overset{1^\circ C}{CH_2}-X$ 1° alkyl halide

(ii) $CH_3-CH_2-\overset{2^\circ C}{\underset{\underset{X}{|}}{CH}}-CH_3$ 2° alkyl halide

(iii) $H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{X}{|}}{C}}-CH_3$ $\rightarrow 3^\circ C$ Tertiary alkyl halide

$X - C \rightarrow 1^{\circ}C$ 1° alkyl halide

$2^{\circ}C$ 2° ——

$3^{\circ}C$ 3° ——

BASICS (11TH CLASS)

IUPAC NOMENCLATURE

COMPOUND STRUCTURE	2° PREFIX +	1° PREFIX +	WORD ROOT +	1° SUFFIX +	2° SUFFIX
1. $\underset{1}{CH_3}-\underset{2}{CH_3}$	×	×	eth +	ane	×
			ethane		
2. $\underset{1}{CH_3}-\underset{2}{CH_2}-\underset{3}{CH_3}$	×	×	prop +	ane	×
			propane		

IUPAC NOMENCLATURE

COMPOUND STRUCTURE	2° PREFIX +	1° PREFIX +	WORD ROOT +	1° SUFFIX +	2° SUFFIX
3. $\boxed{\overset{1}{CH_3}-\overset{2}{CH}(\overset{1}{CH_3})-\overset{3}{CH_3}}$	2-methyl	×	prop	+ ane	×

CH_3 → alkyl group → word Root

$\boxed{\text{2-methylpropane}}$

BASICS (11TH CLASS)

IUPAC NOMENCLATURE

COMPOUND STRUCTURE	2° PREFIX +	1° PREFIX +	WORD ROOT +	1° SUFFIX +	2° SUFFIX
✓ 4 $\overset{3}{CH_3}-\overset{2}{CH_2}-\overset{1}{CH_2}-Br$ ✗ (1, 2, 3)		1-bromo ✗	prop +	ane	✗

$\boxed{\text{1-bromopropane}}$

br → bromo

F → fluoro

Cl → chloro

I → iodo

BASICS (11TH CLASS)

IUPAC NOMENCLATURE

COMPOUND STRUCTURE	2° PREFIX	+ 1° PREFIX	+ WORD ROOT	+ 1° SUFFIX	+ 2° SUFFIX
5. $CH_3-\underset{CH_3}{CH}-CH_2-Br$	1-bromo-2-methyl	×	prop	+ ane	+ ×

bromo

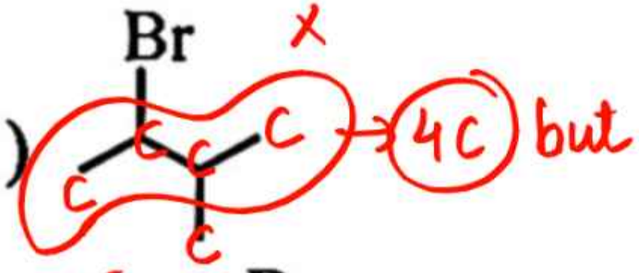
methyl

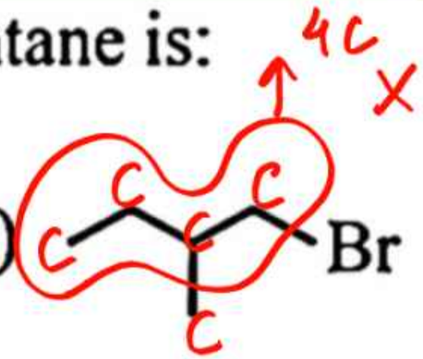
alphabetical order

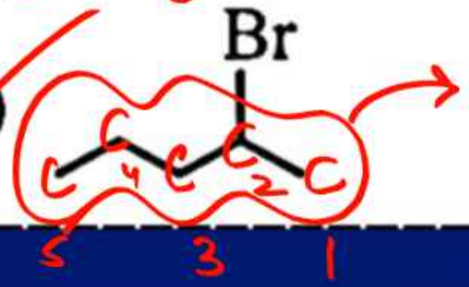
1-bromo-2-methylpropane

QUESTIONS

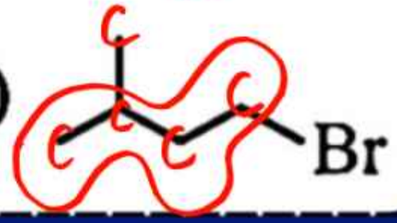
The structure of 2 - Bromopentane is:

(1) 

(2) 

(3) 

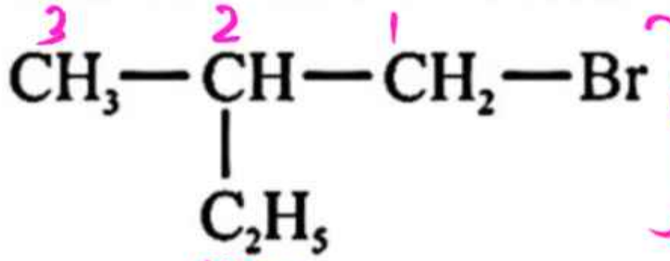
pentane

(4) 

QUESTIONS

[CUET 2023]

Which is the correct IUPAC name for:

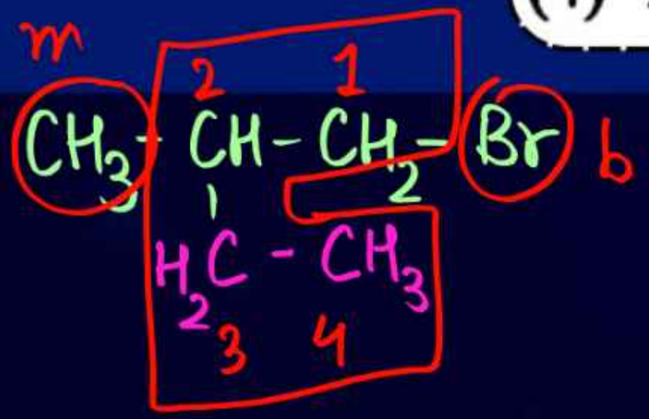


(1) 1-Bromo-2-ethylpropane

(2) 1-Bromo-2-ethyl-2-methylethane

(3) 1-Bromo-2-methylbutane

(4) 2-Methyl-1-bromobutane

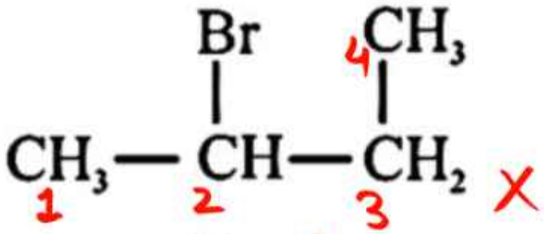


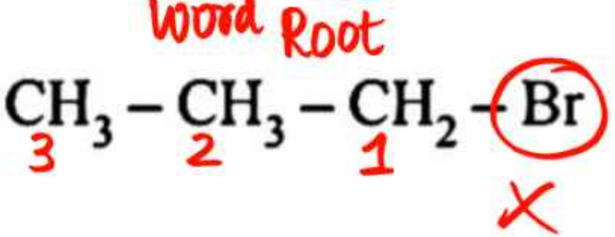
QUESTIONS

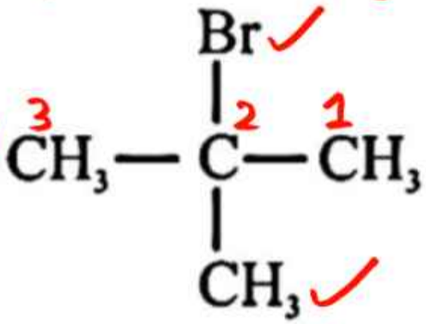
8

The structure of 2 - Bromo - 2 - methyl propane is:

Word Root

(1) 

(2) 

(3) 

(4) None of these

QUESTIONS

9.

The IUPAC name of the compound $(CH_3)_2CH-CH_2-CH_2Br$ is

1-Bromopentane ✗

1-Bromo-3-methylbutane ✓

2-Methyl-4-bromobutane

4-Ethyl-2-methylhexane ✗

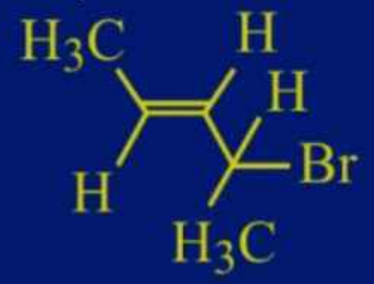
$(CH_3)_2CH-CH_2-CH_2-Br$

$$\overset{4}{CH_3}-\overset{3}{\underset{\underset{CH_3}{|}}{CH}}-\overset{2}{CH_2}-\overset{1}{CH_2}-Br$$

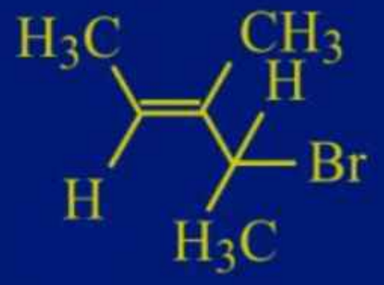
QUESTIONS

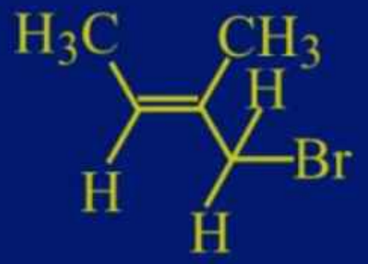
Write IUPAC names of the following: (10.)

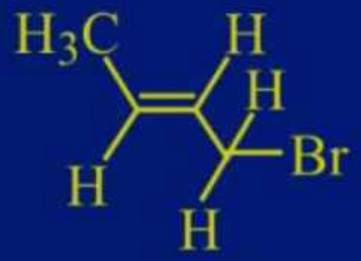
Example of Ncert (6.2)

(i) 

(ii)

iii 

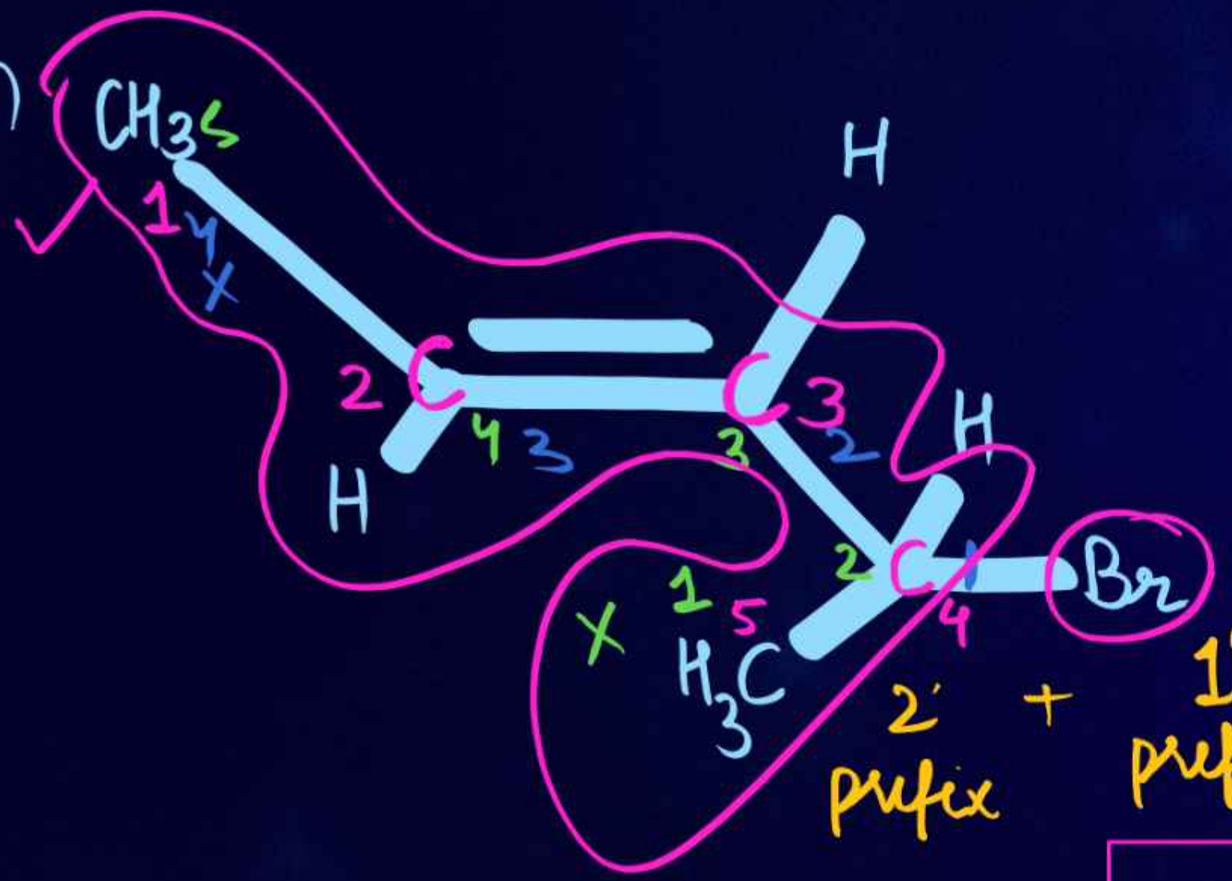
iv 

v  (C.B.S.E. 2008)

(vi) (C.B.S.E. 2010, 2011, 2012)

NCERT

(i)



Multiple Bond > Prefix (br, F, Cl, I)

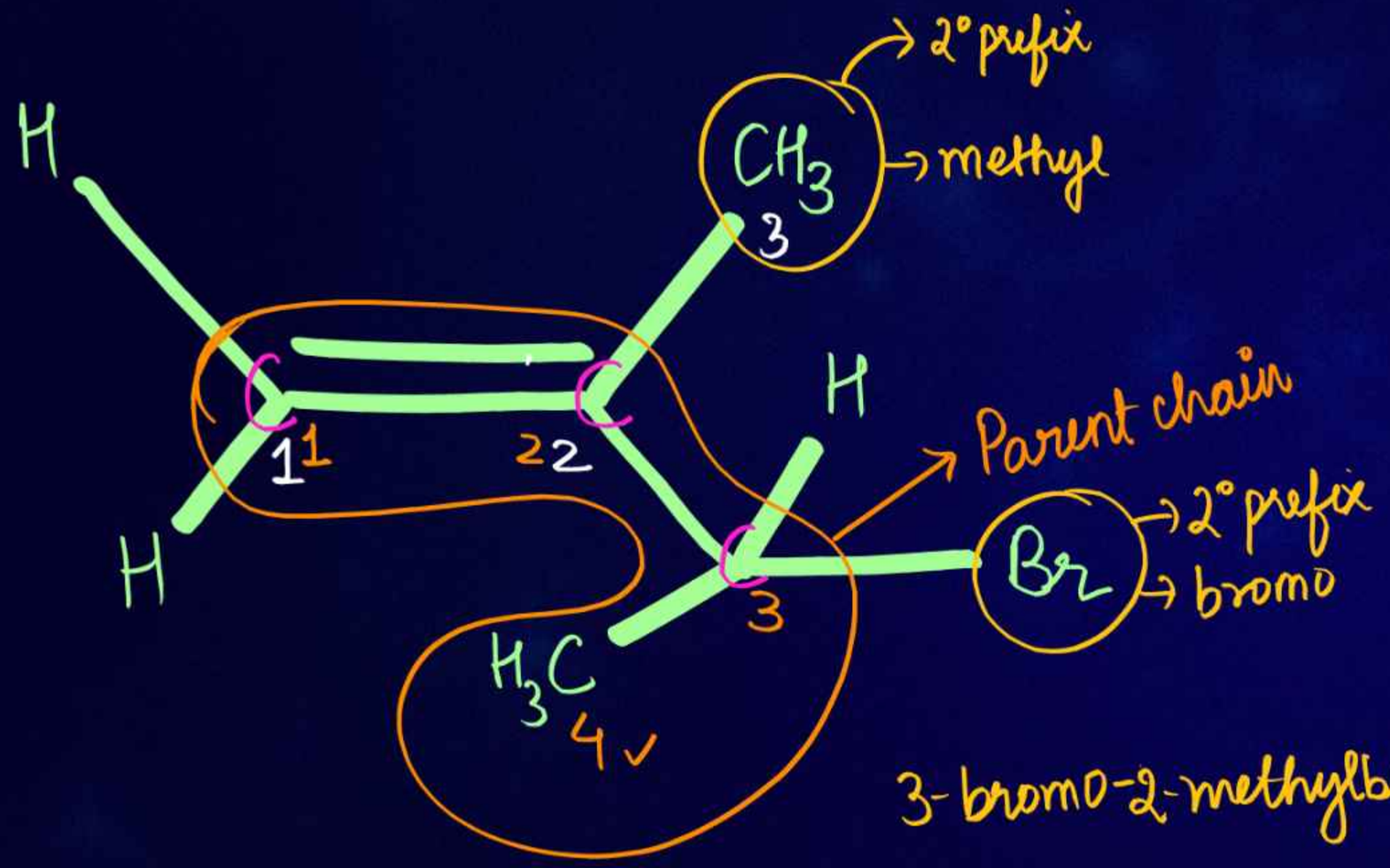
↓

less no

2° prefix + 1° prefix + WORD ROOT + 1° Suffix + 2° Suffix

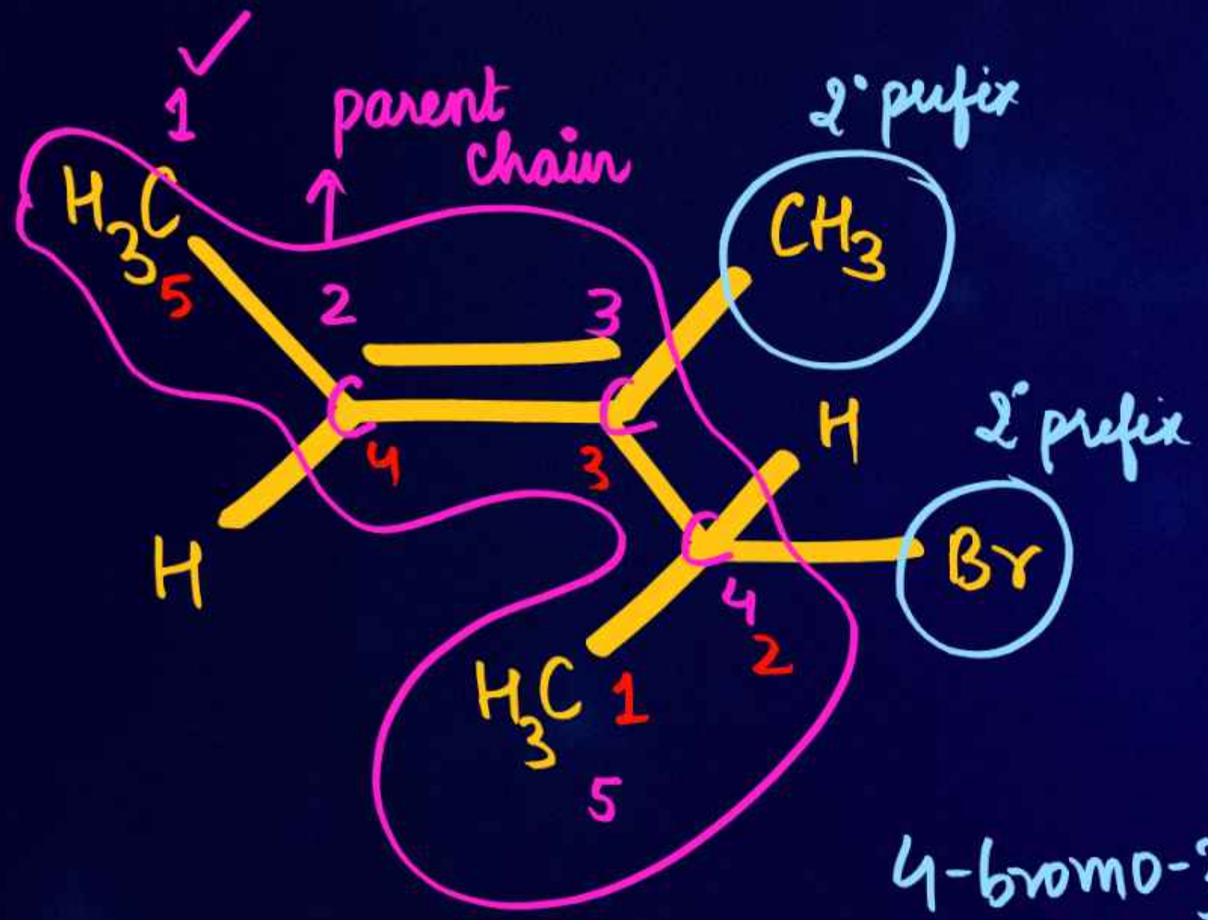
$\boxed{\text{4-bromopent-2-ene}}$

(ii)



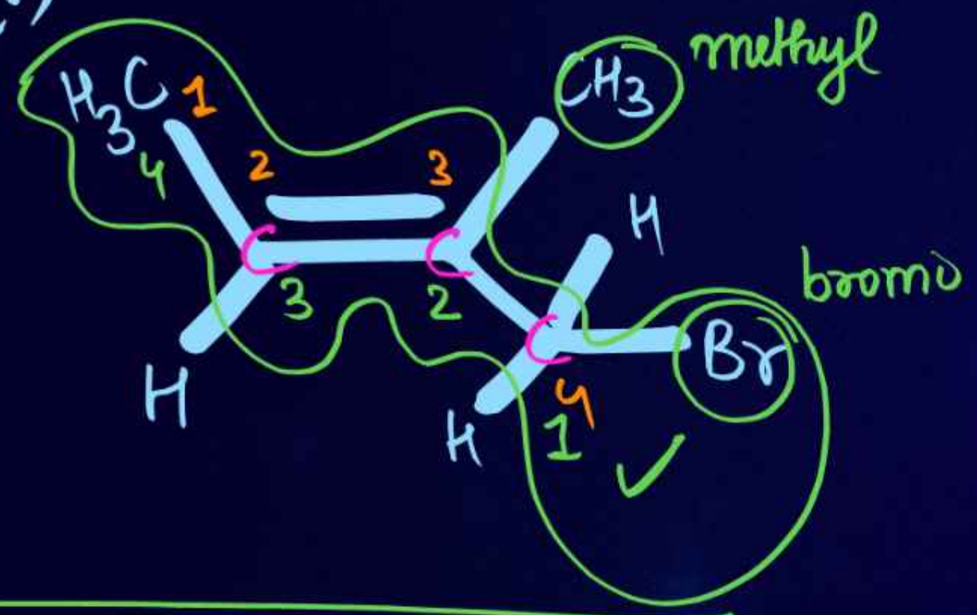
3-bromo-2-methylbut-1-ene

(iii)



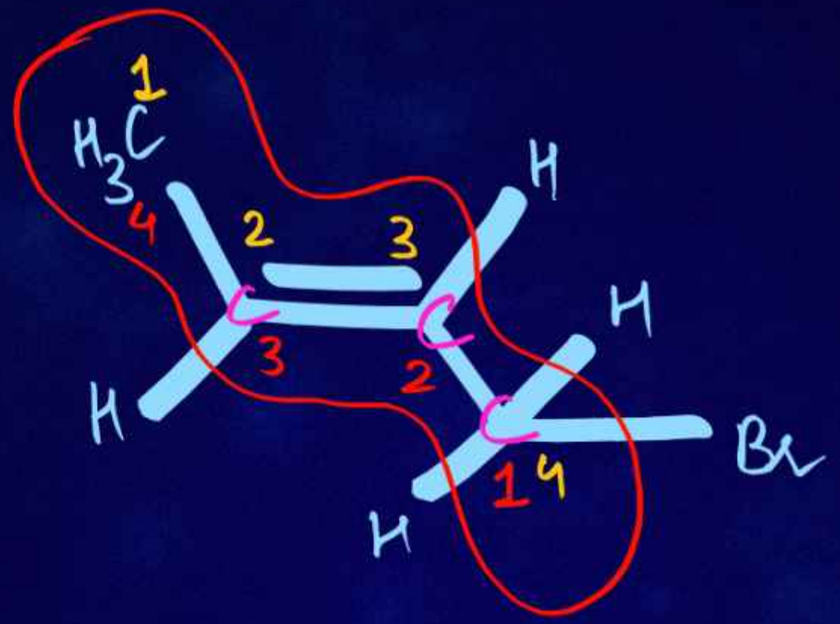
4-bromo-3-methylpent-2-ene

(iv)



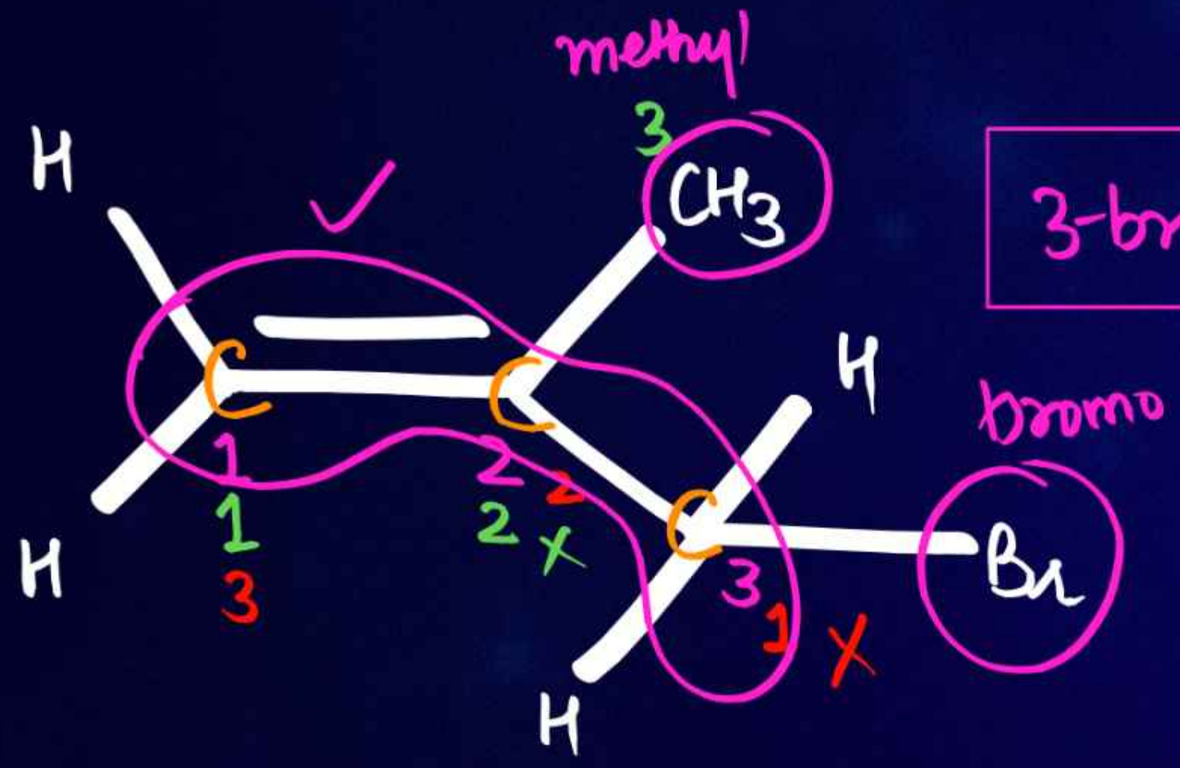
1-bromo-2-methylbut-2-ene

(v)



1-bromo but-2-ene

(vi)



3-bromo-2-methyl prop-1-ene

COMMON NAMES (word → no of C (Total))

n

Straight chain

Ex. n-hexane
- hexa → 6C
- ane → C–C

$H_3C-CH_2-CH_2-CH_2-CH_2-CH_3$

n-pentane
- pent → 5C
- ane → C–C

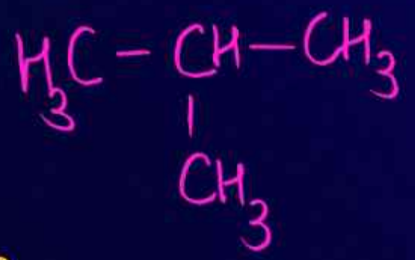
$CH_3-CH_2-CH_2-CH_2-CH_3$

iso

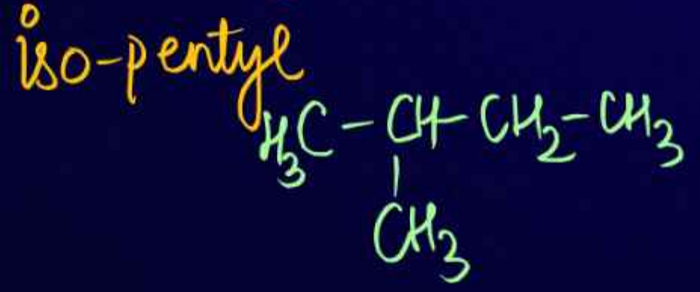
CH_3 gp Branch

generally 2nd C

iso-butyl



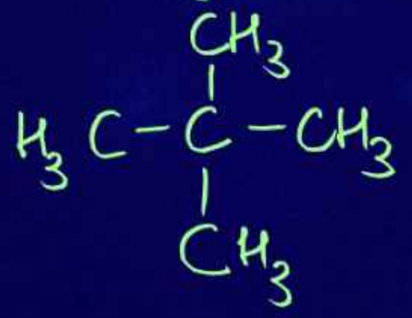
iso-pentyl



neo

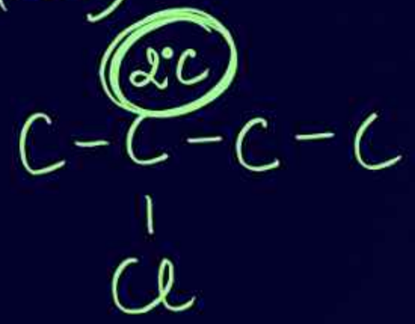
double branching

neo-pentyl



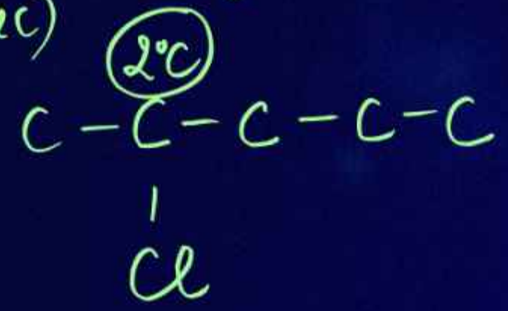
2°-butylchloride

(sec)

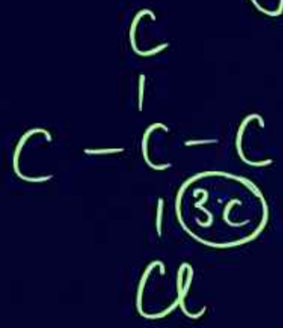


2°-pentylchloride

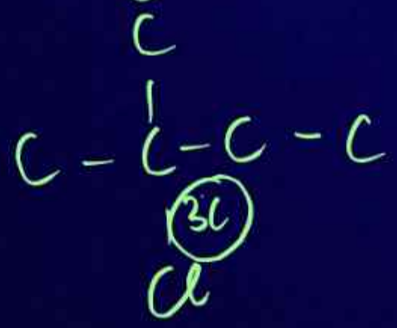
(sec)



3°-butylchloride



3°-pentylchloride

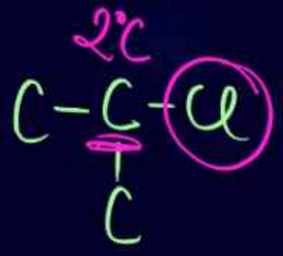


QUESTIONS

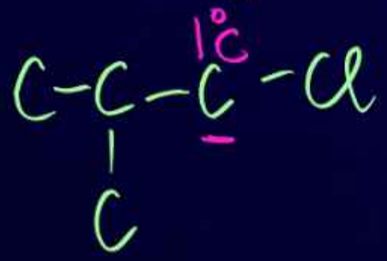
Which among the given halides is 2°?

1. Isopropyl chloride
2. Isobutyl chloride
3. n-propyl chloride
4. n-pentyl chloride

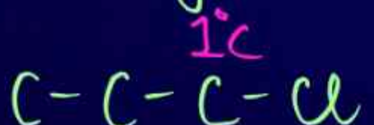
1. Isopropylchloride

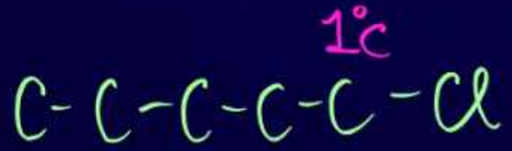


2. Isobutylchloride



3. n-propylchloride



4. 

QUESTIONS

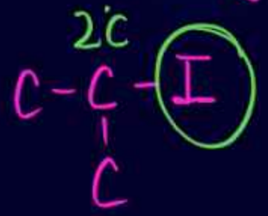
1°

12

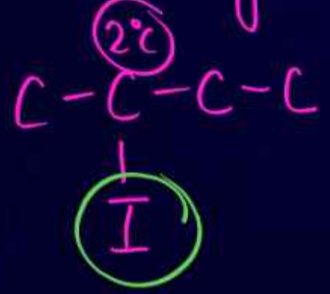
Which of the following is a primary halide?

1. iso-Propyl iodide
2. sec-Butyl iodide
3. tert-Butyl bromide
4. neo-Hexyl chloride

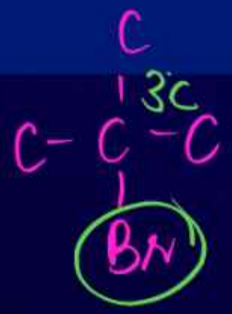
1. Iso-propyliodide



2. sec-butyliodide



3.



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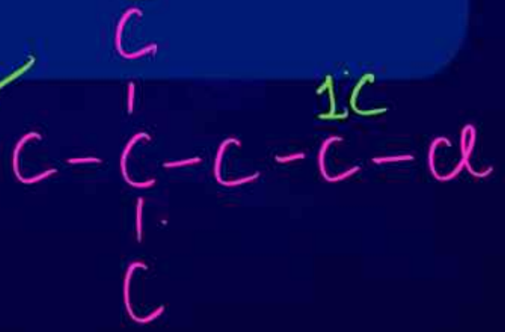


HALOALKANES & HALOARENES

Halogen — Aliphatic Hydrocarbon (open chain)

$$CH_3-CH_3 \xrightarrow[+X]{-H} CH_3CH_2X$$

Aliphatic hydrocarbon

(X = F, Cl, Br, I)

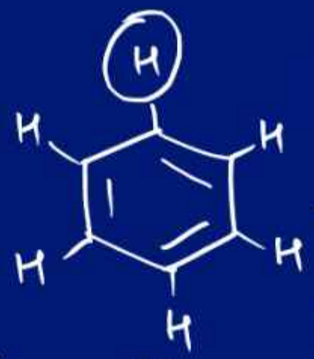
Haloalkane or ★ alkyl halide

$4\sigma \rightarrow sp^3$

When hydrogen is replaced by any halogen atom in aliphatic hydrocarbon, haloalkane is obtained.

X (Halogen) is attached to sp^3 hybridised Carbon atom.

Halogen — Aromatic hydrocarbon



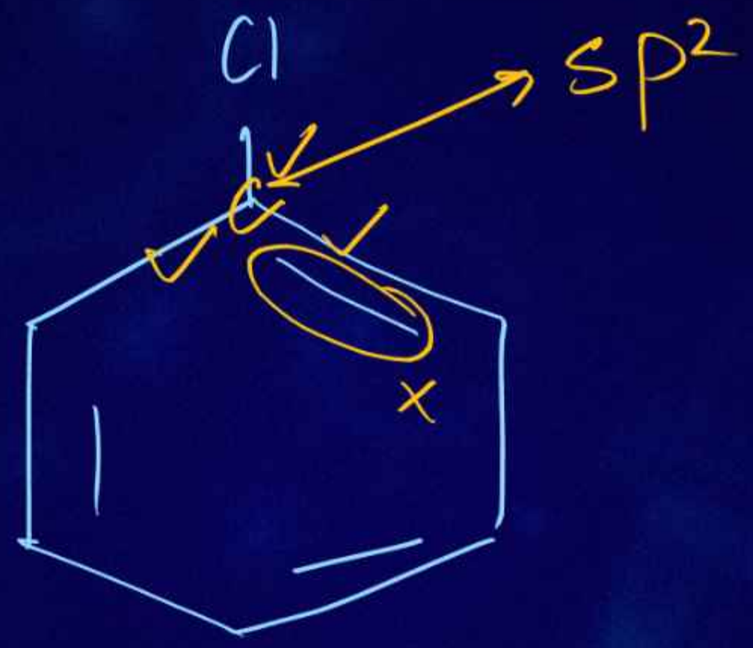
$$\xrightarrow[+X]{-H}$$

Aromatic hydrocarbon

(X = F, Cl, Br, I)

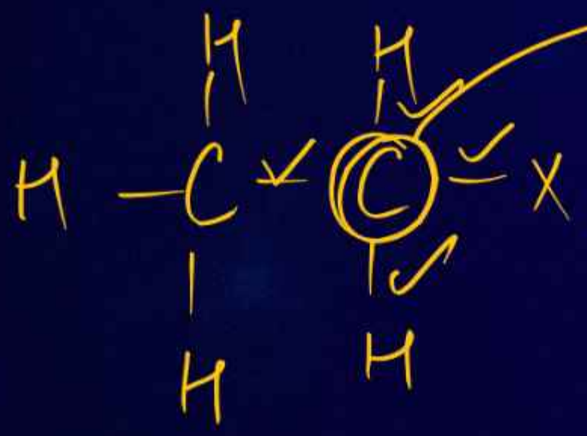
Haloarene or aryl halide

When hydrogen atom is replaced by halogen atom in aromatic hydrocarbon, aryl halide is formed. X is attached to sp^2 hybridised C atom.


Cl
sp²

FTAFT REVISION

CH_3CH_2X



$\rightarrow sp^3$

QUESTIONS

The IUPAC name of tertiary butyl chloride is

1. 2-Chloro-2-methyl propane
2. 3-Chlorobutane
3. 4-Chlorobutane
4. 1, 2-Chloro-3-methyl propane

Homework

Q1.

QUESTIONS

Classify the following compounds as primary, secondary and tertiary halides.

(i) 1-Bromobut-2-ene

(ii) 4-Bromopent-2-ene

(iii) 2-Bromo-2-methylpropane

Q2

Homework

- (i)-secondary, (ii)-tertiary, (iii)-primary
- (i)-secondary, (ii)-primary, (iii)-tertiary
- (i)-primary, (ii)-tertiary, (iii)-secondary
- (i)-primary, (ii)-secondary, (iii)-tertiary

Surprise :- This week

↳ 1st dec - Shourya's galaxy

↓

IUPAC

Leaderboard

1. Rohit Rajput
2. Sunny Kumar
3. Mohammad Asif Raza
4. Sejal
5. Nirab Jyoti Chaudhary
6. Vaishnavi Agarwal
7. Shifa Khan
8. Umang Sharma
9. Chahat Agarwal
10. Shagun Singh Nda

HOMEWORK

1) Complete Notes
2) 2 HW Questions
3) DPP-1 solve completely
4) Revision :- by drawing structures + name } again

12

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-3**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. NOMENCLATURE OF HALOARENES
   Classification Part - 02
2. CLASSIFICATION OF HALOALKANES
3. NATURE OF C-X BOND

MY SHIMMERING STARS

#SHOURYA'SGALAXY

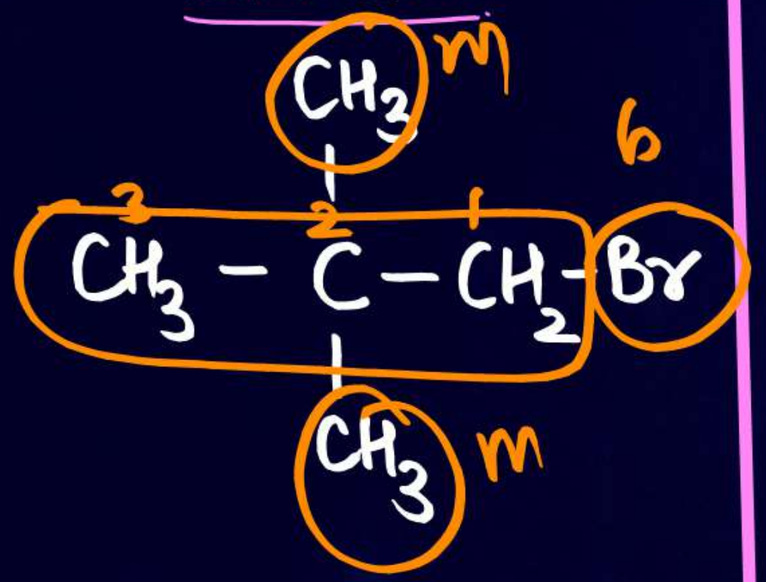
START

BASICS (11TH CLASS)

IUPAC NOMENCLATURE

Structure	Common Name	IUPAC
# $CH_3CH_2CH(Cl)CH_3$ $CH_3-\underset{4}{CH_3}-\underset{3}{CH_2}-\underset{2}{CH}(Cl)-\underset{1}{CH_3}$ (2°C)	Sec. butyl chloride (2°C) ← Cl	2-chloro butane

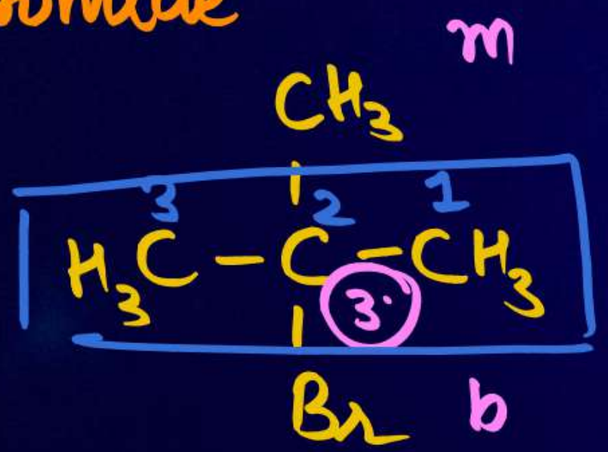
IUPAC NOMENCLATURE

Structure	Common Name	IUPAC
	neo-pentyl bromide	1-bromo-2,2-dimethylpropane

IUPAC OF HALOALKANES

- # tert. butyl bromide

3°



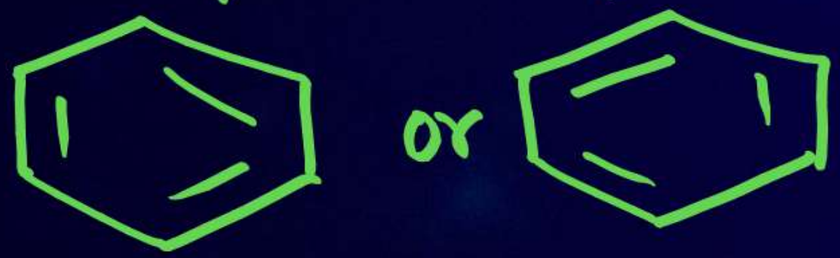
2-bromo-2-methylpropane

NAMING OF HALOARENES

Halogen (X = Cl, Br, I, F)

Aromatic Compound

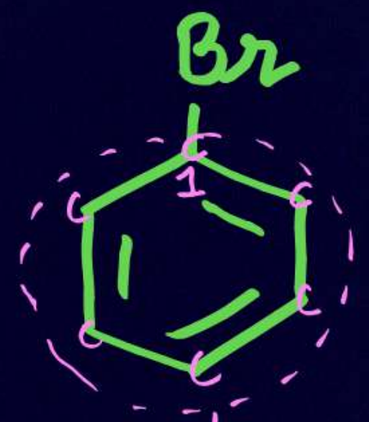
RESONATING



or

RESONANCE HYBRID

#

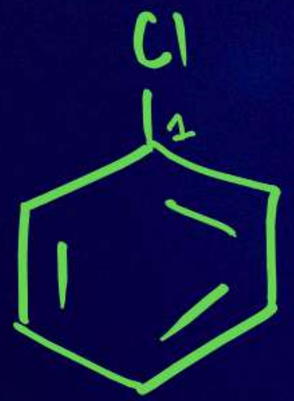


bromobenzene ⟵ Common Name

1-bromobenzene ⟵ IUPAC Name

$\underbrace{\text{1° prefix} + \text{Word Root} + \text{1° suffix}}_{\text{Benzene}}$

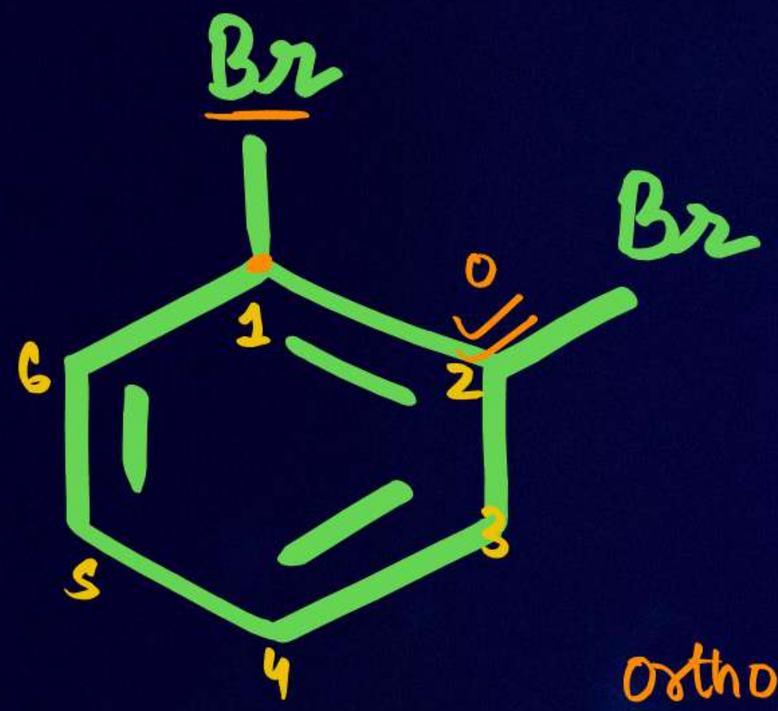
#



Common Name → chlorobenzene

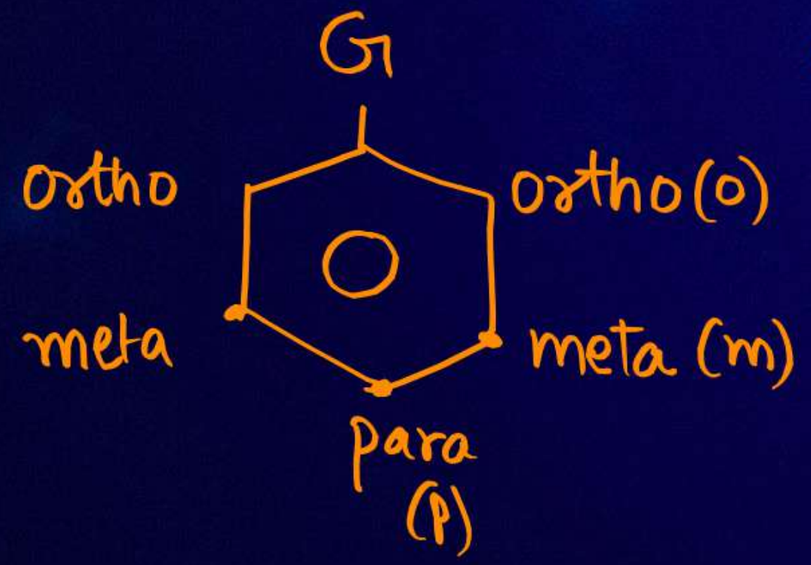
IUPAC Name → 1-chlorobenzene

#



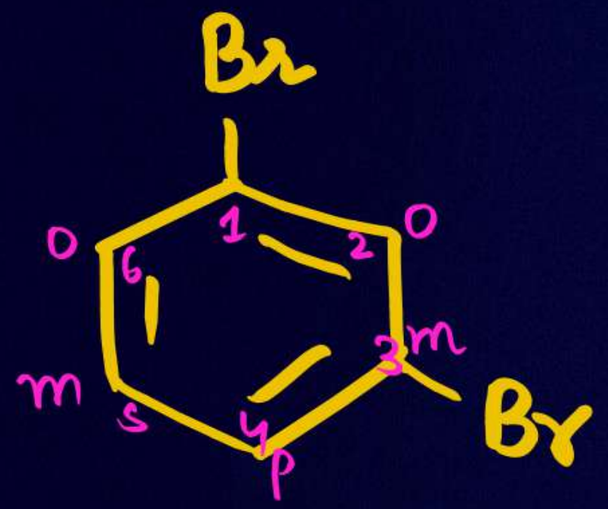
C/N - ortho di bromobenzene
or
o-dibromobenzene

IUPAC - 1,2-dibromobenzene



Common Name.

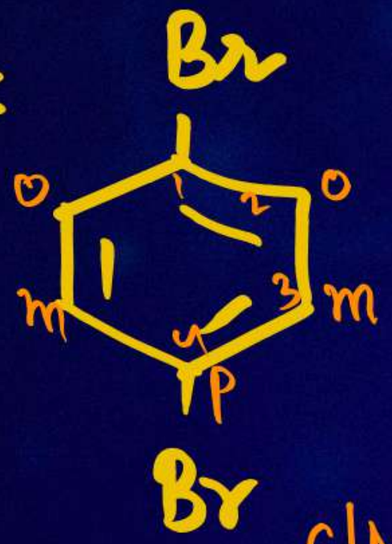
#



C|N → m-dibromobenzene

IUPAC → 1,3-dibromobenzene

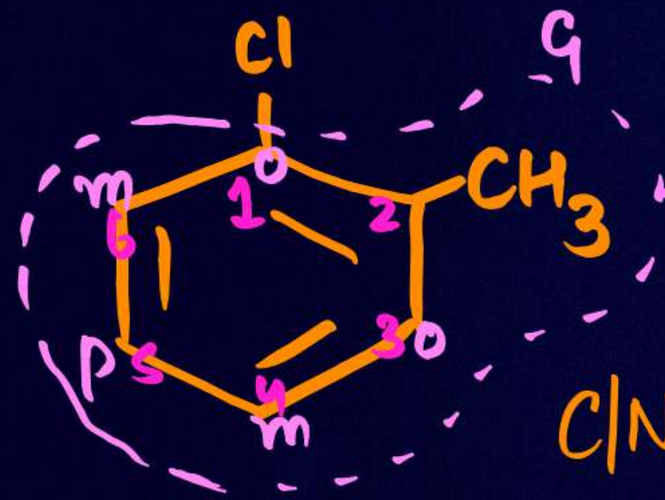
#



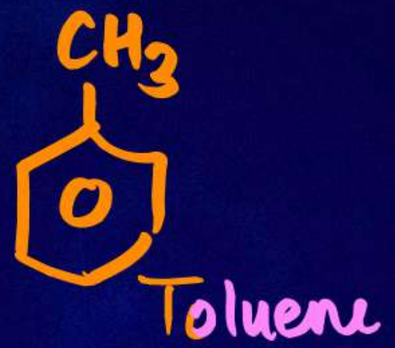
C|N → p-dibromobenzene

IUPAC → 1,4-dibromobenzene

#



→ Toluene



Toluene

C|N → o-chlorotoluene

IUPAC → 1-chloro-2-methylbenzene

or

1-chlorotoluene

CLASSIFICATION OF HALOALKANES

Based on no of halogen atoms present

1. MONOHALOALKANE
2. DIHALOALKANE
3. TRIHALOALKANE

OR

4. POLY

Based on degree of Carbon

1. PRIMARY HALOALKANE
2. SECONDARY HALOALKANE
3. TERTIARY HALOALKANE

Based on hybridisation of Carbon atom to which X is attached.

$C_{sp^3}-X$

1. ALLYLIC HALIDE
2. BENZYLIC HALIDE

$C_{sp^2}-X$

1) VINYLIC
2) ARYL

BASED ON NO OF HALOGEN ATOMS PRESENT IN COMPOUND

1. Monohaloalkane or Monoalkylhalide

When only one halogen atom is present in a compound.

Example : CH_3CH_2Br , $CH_3\underset{\underset{Br}{|}}{CH}CH_3$, $CH_3-CH_2-\overset{\overset{Br}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

2. Dihaloalkane or dialkylhalide

When two halogen atoms are present in a compound.

Example : $CH_3\underset{\underset{Br}{|}}{CH}-Br$, $CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-Br$

3) Trihaloalkane

↓

3 X atoms

Ex. $\underset{\underset{X}{|}}{CH_2}-\underset{\underset{X}{|}}{CH}-\underset{\underset{X}{|}}{CH_2}$

2 Compound having x

Dihaloalkane

Geminal dihalide

or

gem. dihalide

or

geminal haloalkane

$CH_3-HC(Br)-Br$

When both the halogen atoms are present on same carbon.

Vicinal dihalide

or

vic. dihalide

or

vicinal dihaloalkane

$CH_2(Br)-CH_2(Br)$

When both the halogen atoms are present on adjacent carbon atom.

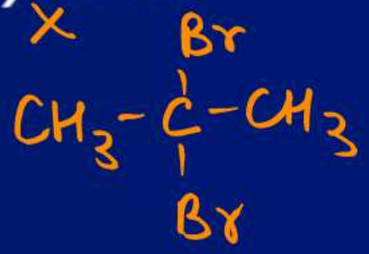
It is vic. dihalide.

QUESTIONS

13

Gem-dibromide is

1. CH3CH(Br)OH(Br)CH3
2. CH3CBr2CH3
3. CH2(Br)CH2CH2
4. CH2BrCH2Br



CLASSIFICATION OF HALOALKANES

Based on degree of Carbon atom.

1. Primary Alkyl halide (1°)

When halogen atom is present at 1°C. Ex. $CH_3CH_2\underset{1^\circ C}{CH_2}Cl$

2. Secondary Alkyl halide (2°)

When halogen atom is present on 2°C Ex. $CH_3-\underset{2^\circ C}{CH}(I)-CH_3$

3. Tertiary Alkyl halide (3°)

When halogen atom is present on 3°C. Ex. $CH_3-\overset{CH_3}{\underset{3^\circ C}{C}}(Br)-CH_3$

Based on hybridisation of Carbon atom to which X is attached

(A) When halogen is attached to sp^3 hybridised C atom

que pucha jata hai :)

(i) Allylic halide

allylic C

$H_2C=CH-CH_2-X$

When halogen atom is attached to a Carbon atom (sp^3 hybridised) is further attached to double-bonded C. The Compound is Allylic halide.

Carbon to which halogen is attached, is called allylic Carbon.

(a) Primary allylic halide

$H_2C=CH-\underset{(1^\circ C)}{CH_2}-X$

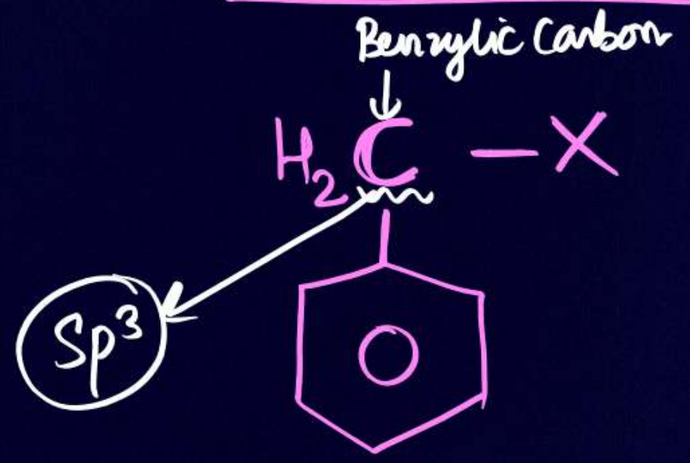
(b) Secondary allylic halide

$H_2C=CH-\underset{(2^\circ)}{CH}(CH_3)-X$

(c) Tertiary allylic halide

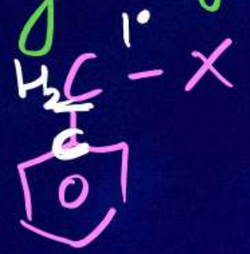
$H_2C=CH-\underset{(3^\circ C)}{C}(CH_3)_2-X$

(ii) BENZYLIC HALIDE

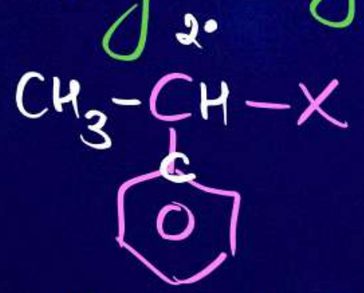


When halogen atom is attached to a carbon which is further (sp^3) attached to benzene Ring. Compound obtained is Benzylic Halide.

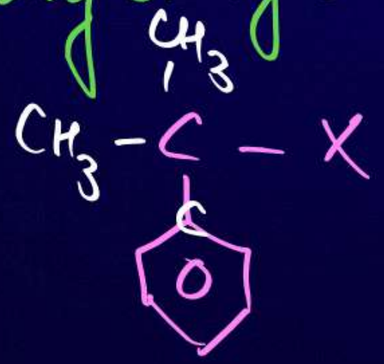
(a) Primary Benzylic Halide



(b) Secondary Benzylic Halide



(c) Tertiary Benzylic Halide



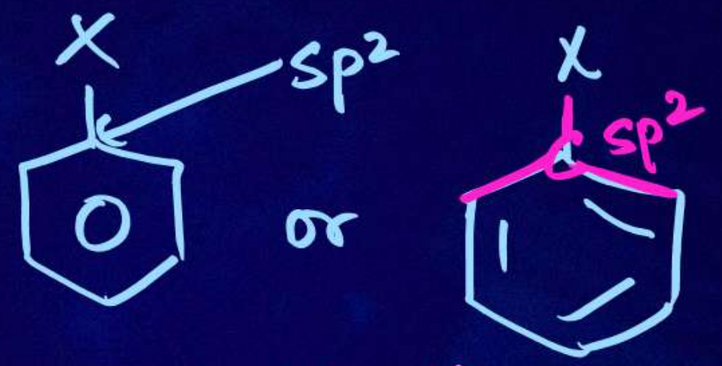
(B.) X attached to sp^2 hybridised C atom

(i) VINYLIC HALIDE

$$H_2C = \underset{sp^2}{CH} - X$$

When halogen atom is attached to a Carbon atom (sp^2) which is itself creating a double bond.

(ii) Arylhalide or Haloarene



When halogen is directly attached to Benzene Ring.

FTAFT REVISION

QUESTIONS

What are haloalkanes and haloarenes? Give their classification.

When one or more hydrogen atoms of aliphatic or aromatic hydrocarbon are replaced by halogen atom(s), alkyl halide (haloalkane) and aryl halide (haloarene) are formed respectively.

Classification: Haloalkanes and haloarenes may be classified as follows:

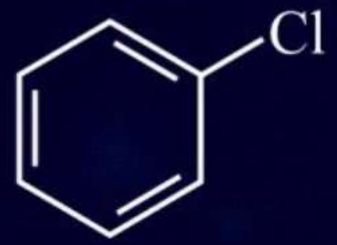
(I) On the basis of number of halogen atoms: Depending upon number of halogen atoms (F, Cl, Br, I) they are classified as mono, di or poly halogen compounds. For example,

QUESTIONS

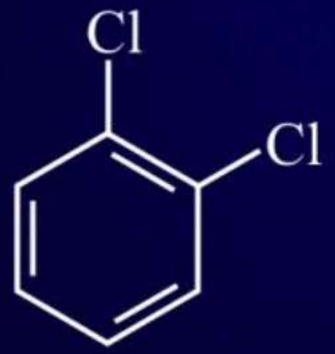
(a) C_2H_5Cl
Chloroethane

(b) CH_2Cl
|
CH_2Cl
1,2-Dichloroethane

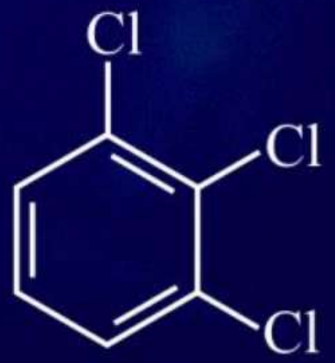
(c) CH_2Cl
|
CH_2Cl
|
CH_2Cl
1, 2, 3 - Trichloropropane

(d) 

chlorobenzene

(e) 

1,2-Dichlorobenzene
(m-Dichlorobenzene)

(f) 

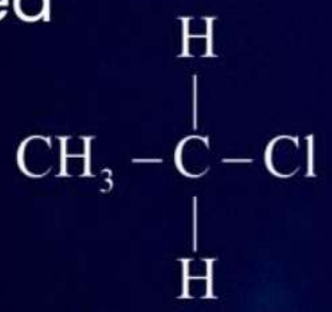
1,2,3-Trichlorobenzene

d, e, f are types of aryhalide or haloarene in which-X is attach to an aromatic

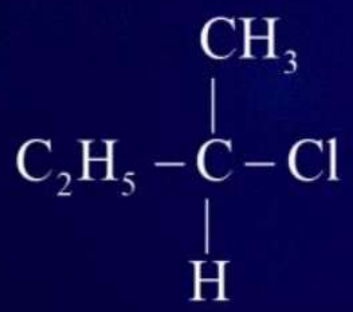
QUESTIONS

Compounds containing sp3C–X bond (X = F, Cl, Br, I)

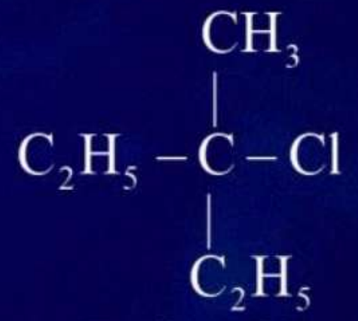
(a) Alkyl halides or haloalkanes (R–X): They are classified as primary, secondary and tertiary according to the nature of carbon to which halogen is attached



Primary (1°)



Secondary (2°)

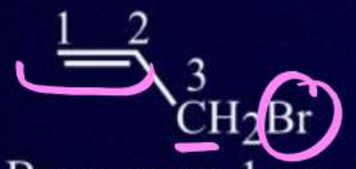


Tertiary (3°)

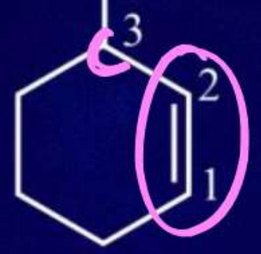
(b) Allylic halides: In these compounds halogen atom is bonded to an sp3 hybridised carbon atom next to carbon-carbon double bond (C=C) i.e. to an allylic carbon.

QUESTIONS

Allylic halides: In these compounds halogen atom is bonded to an sp3 hybridised carbon atom next to carbon-carbon double bond (C=C) i.e. to an allylic carbon.

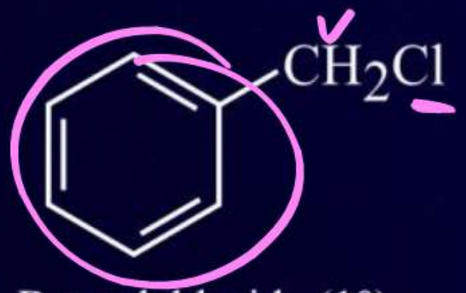


3-Bromoprop-1-ene (1°)
(Allyl bromide)

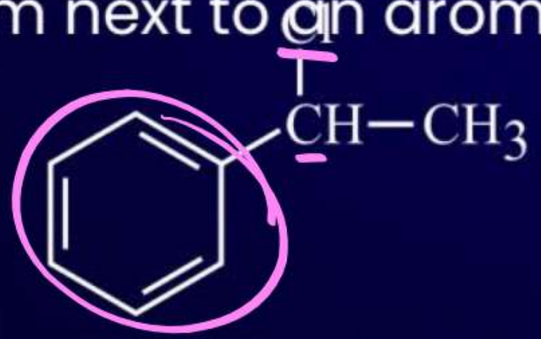


3-Chloro-cyclohex-1-ene (2°)

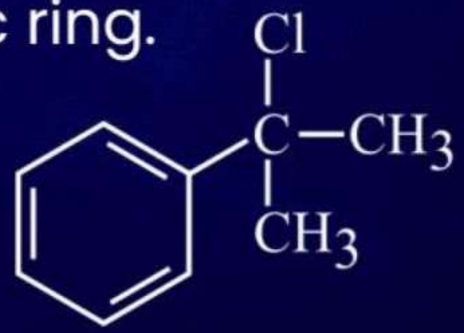
(c) Benzylic halides: In these compounds the halogen atom is bonded to an sp3. hybridised carbon atom next to an aromatic ring.



Benzylchloride (1°)



1-chloro-1-phenyl ethane (2°)



2-chloro-2-phenyl propane (3°)

QUESTIONS

(iii) Compounds containing sp2 C—X bond

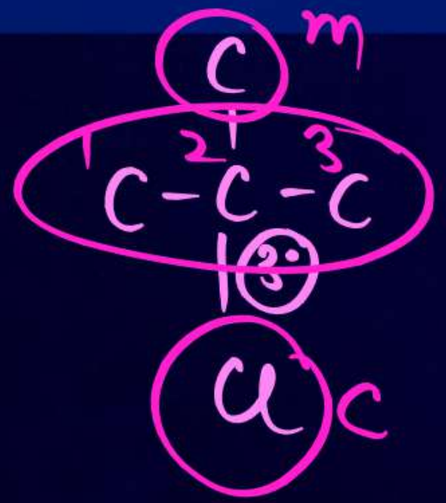
(a) Vinylic halides: In these compounds halogen atom is bonded to an sp2 hybrdised carbon atom of a carbon-carbon double bond (C=C).

1-Chlorocyclohex-1-ene

QUESTIONS

The IUPAC name of tertiary butyl chloride is

1. 2-Chloro-2-methyl propane
2. 3-Chlorobutane
3. 4-Chlorobutane
4. 1, 2-Chloro-3-methyl propane



Homework

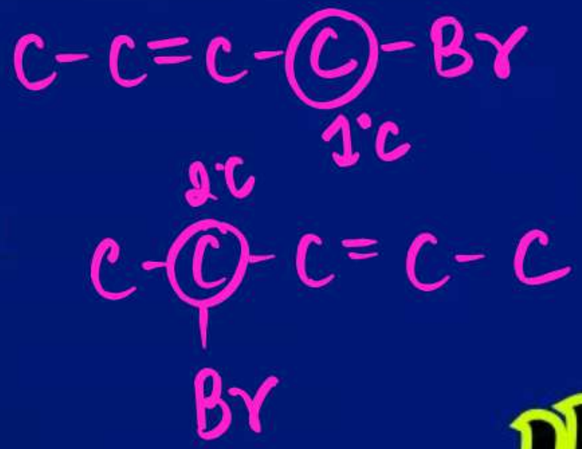
QUESTIONS

Classify the following compounds as primary, secondary and tertiary halides.

(i) 1-Bromobut-2-ene

(ii) 4-Bromopent-2-ene

(iii) 2-Bromo-2-methylpropane



Homework

- (i)-secondary, (ii)-tertiary, (iii)-primary
- (i)-secondary, (ii)-primary, (iii)-tertiary
- (i)-primary, (ii)-tertiary, (iii)-secondary
- (i)-primary, (ii)-secondary, (iii)-tertiary

QUESTIONS

Which of the following is not an allylic halide?

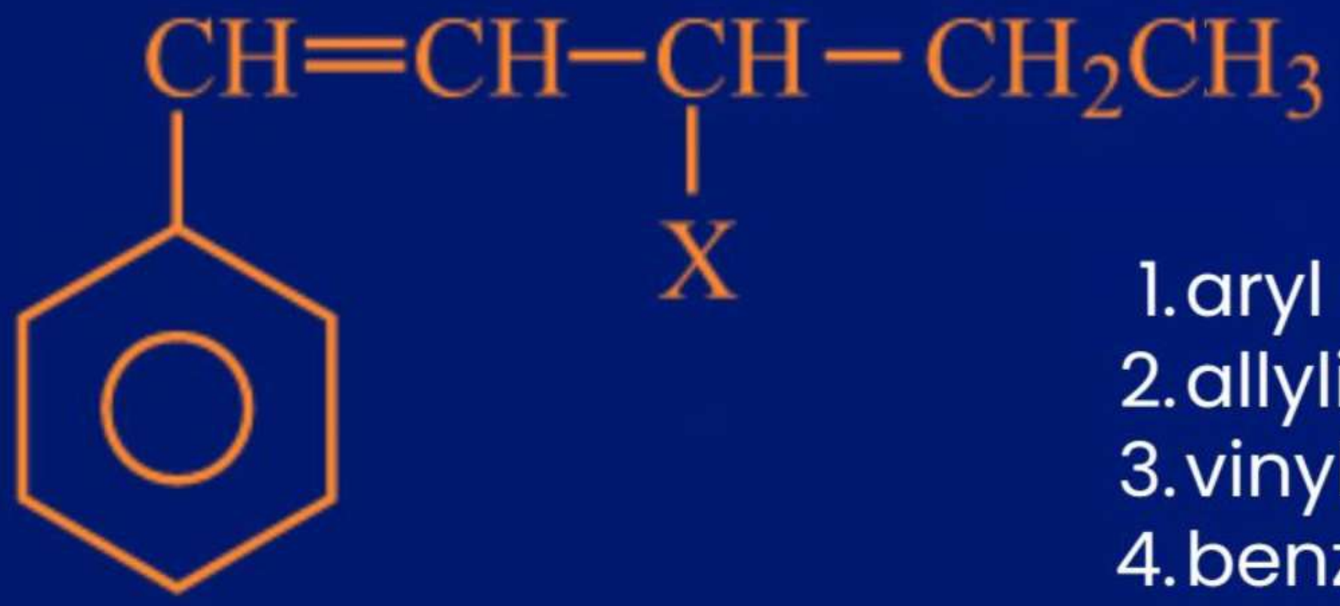
1. 4-Bromopent-2-ene
2. 3-Bromo-2-methylbut-1-ene
3. 1-Bromobut-2-ene
4. 4-Bromobut-1-ene

Q1.

Homework

QUESTIONS

The given compound is an example of



1. aryl halide
2. allylic halide
3. vinylic halide
4. benzylic halide

Q2.

Homework

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-4**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. ISOMERISM
2. NATURE OF C-X BOND
3. METHODS OF PREPARATION OF HALOALKANES

MY SHIMMERING STARS

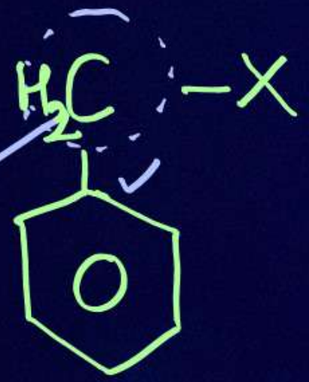
#SHOURYA'SGALAXY

START

Doubts

1) Benzylic Halide

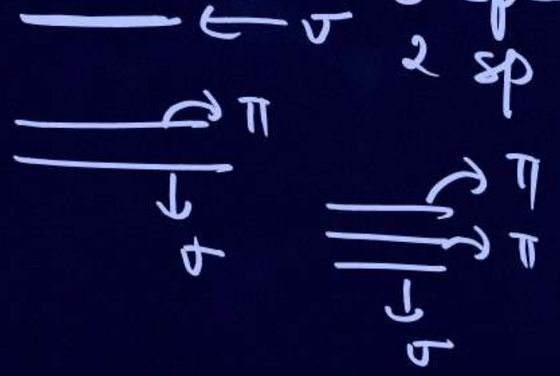
$C_{sp^3}-X$



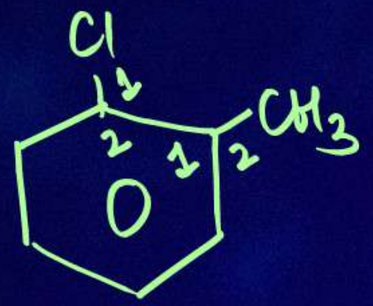
sp^3

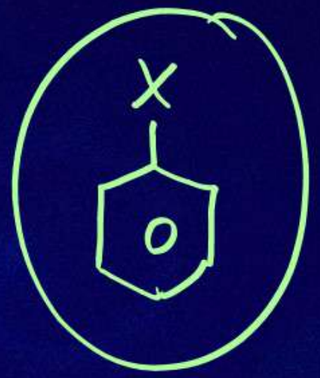
$\sigma + 2p$

4 sp^3
3 sp^2
2 sp

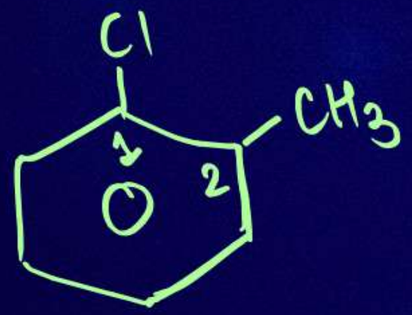


2)

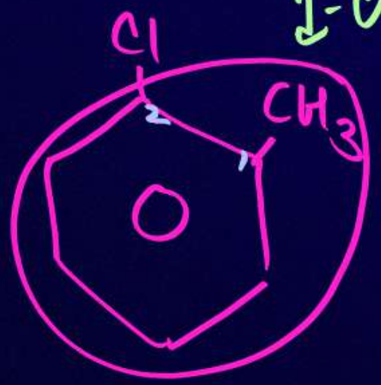




= Haloarene
or
Aryl Halide



1-chloro-2-methylbenzene
or
2-chlorotoluene

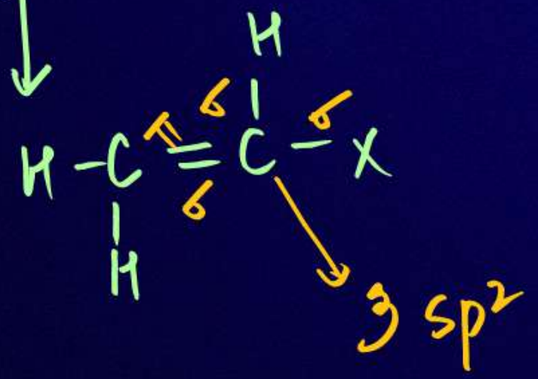


3) Vinylic Halide

$C - X$

sp^2

$H_2C = CH - X$



ISOMERISM

same parts

When two compounds have same Molecular Formula but atleast one property is different.

Isomerism

- Structural Isomerism
  1. Chain isomerism
  2. Positional isomerism
  3. Functional isomerism
  4. Ring-chain isomerism
  5. Metamerism
  6. Tautomerism
- Stereoisomerism
  1. Geometrical
  2. optical

1. STRUCTURAL ISOMERISM

CHAIN ISOMERISM

↓ Same Molecular Formula different size of parent chain / Side chain.

Ex. $CH_3CH_2CH_2CH_2-Br$ & $CH_3-CH(CH_3)-CH_2-Br$

4 3 2 1

3 2 1

Main chain / Parent chain

↓

4C

Molecular Formula: C_4H_9Br

Parent chain = 3C

Side chain = 1C

C_4H_9Br

2. POSITIONAL ISOMERISM

Same Molecular Formula

different position of Multiple Bond | Functional gp | Extra gp - Br, F, Cl, I

Example :

$\overset{4}{C}H_3\overset{3}{C}H_2\overset{2}{C}H_2\overset{1}{C}H_2Br$

$\overset{1}{C}H_3\overset{2}{C}H(Br)CH_2CH_3$

Molecular Formula C_4H_9Br

C_4H_9Br

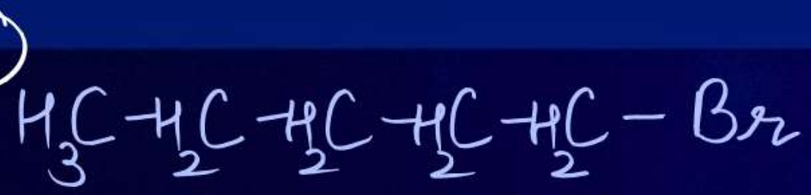
QUESTIONS

NCERT

Example 6.1 Draw the structures of all the eight structural isomers that have the molecular formula $C_5H_{11}Br$. Name each isomer according to IUPAC system and classify them as primary, secondary or tertiary bromide.

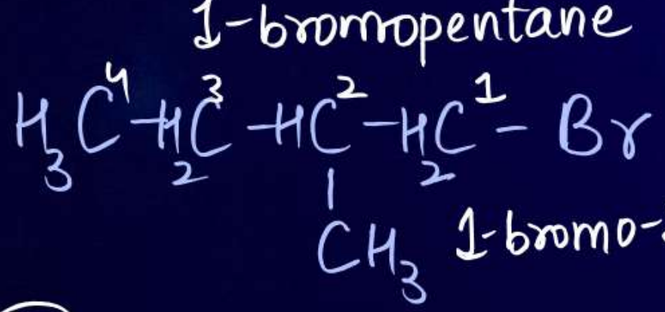
$C_5H_{11}Br$ ✓

I



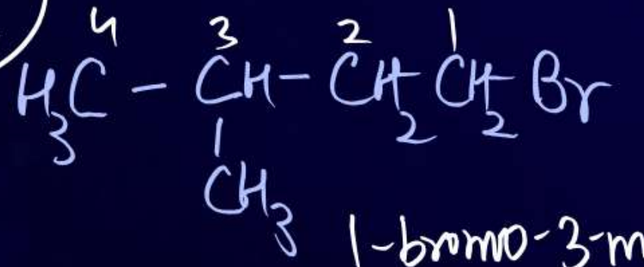
1-bromopentane

II



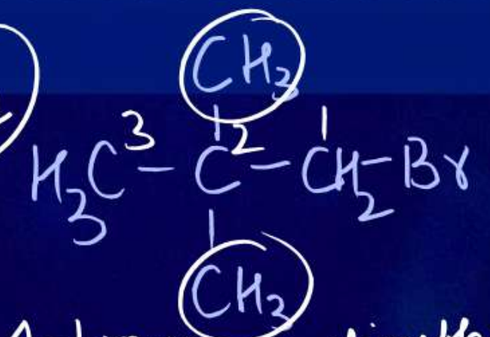
1-bromo-2-methyl butane

III



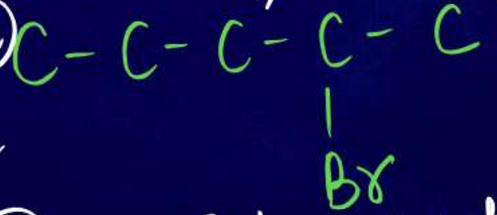
1-bromo-3-methylbutane

IV



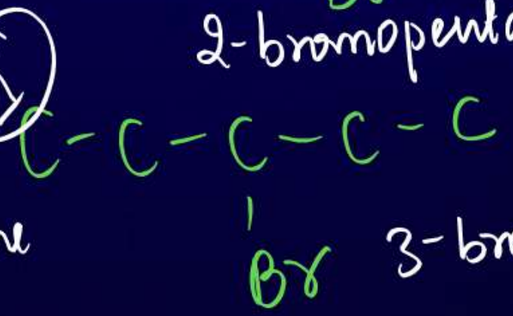
1-bromo-2,2-dimethylpropane

V



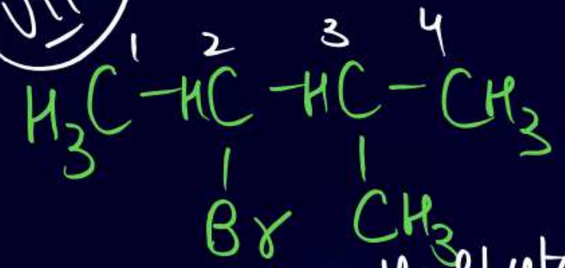
2-bromopentane

VI



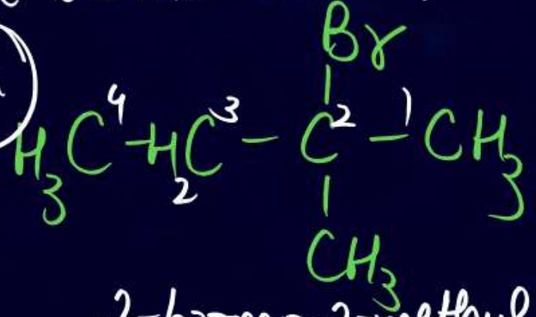
3-bromopentane

VII



2-bromo-3-methylbutane

VIII



2-bromo-2-methylbutane

NATURE OF C–X BOND

C– X

Carbon – Halogen

Bond

Haloalkane CH_3CH_2Br

Haloarene

EN (Electronegativity)

+δ −δ

+ −

C ••– X

(More EN)

$\overset{+\delta}{C}$ –•• $X^{-\delta}$

EN is the tendency to attract shared pair of electron towards itself. Due to difference in EN, partial charges develop on both atoms.

C – X

TOP

(Dirya) C – F

C – Cl

C – Br

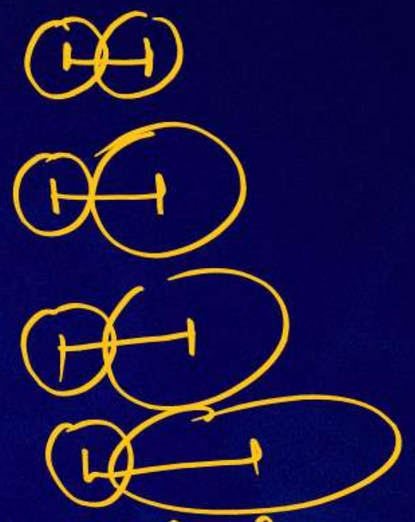
(disha) C – I

BOTTOM

Size of Halogen ↑

Shells ↑

Radius ↑



Q. What is the Order of Bond length?

C-F < C-Cl < C-Br < C-I

(size ↑ or Radius ↑)

It is the Minimum amount of Energy Required to break a Bond.

Q. What is the order of Bond dissociation Energy

C-I < C-Br < C-Cl < C-F

Q. What is the order of Dipole Moment (μ) ?

C–F
C–Cl
C–Br
C–I

size ↑
EN ↓

$\mu = q \times d$ (distance)

→ negligible (calculated in pm)

(charge)
↓
due to EN difference

$q \downarrow \mu \downarrow$

$q \downarrow$ EN $\downarrow$ $\mu \downarrow$

size ↑ $d \uparrow$ $\mu \uparrow$

C–F > C–Cl > C–Br > C–I } ✗

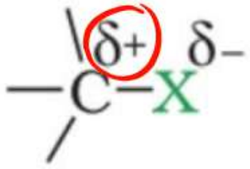
Exception C–Cl > C–F > C–Br > C–I due to e^- gain enthalpy of Cl.

NCERT HIGHLIGHT

163 pg no

Halogen atoms are more electronegative than carbon, therefore, carbon-halogen bond of alkyl halide is polarised; the carbon atom bears a partial positive charge whereas the halogen atom bears a partial negative charge.

poles generate (charges)
(+ −)



As we go down the group in the periodic table, the size of halogen atom increases. Fluorine atom is the smallest and iodine atom is the largest. Consequently the carbon-halogen bond length also increases from C—F to C—I. Some typical bond lengths, bond enthalpies and dipole moments are given in Table 6.2.

METHODS OF PREPARATION OF HALOALKANES

1. FROM ALCOHOL

$(R-OH)$

alkyl gp (C वाला gp)

CH_3-X or $(R-X)$

Methods

$$R-OH \xrightarrow[\substack{(2)\ PX_3,\ PX_5 \\ (3)\ SOCl_2}]{(1)\ HX + ZnCl_2} R-X$$

1. From alcohol

(a) By Hydrogen Halide (H-X)

$$R\text{-}OH \xrightarrow[\text{(X=Cl)}+\ ZnCl_2]{H\text{-}X} R\text{-}X + H_2O$$

(X=Cl)

Ex. $$CH_3CH_2OH \xrightarrow[ZnCl_2]{HCl} CH_3CH_2Cl + H_2O$$

1° alcohol

1-chloroethane

Imp Points

:- 1) $ZnCl_2$ is used as dehydrating agent.
(anhy. $ZnCl_2$)
Removal H_2O

2) HCl with $ZnCl_2$ is called 'LUCAS REAGENT'.

3) This process is called 'GROOVE's PROCESS'.

$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow[ZnCl_2]{HCl} CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 + H_2O$

2° alcohol

2-chloropropane

★ # $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH \xrightarrow[\Delta]{HCl} CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-Cl + H_2O$

3` alcohol

2-chloro-2-methylpropane

Q.

$$CH_3-CH_2-CH_2-OH \xrightarrow[ZnCl_2]{HCl} CH_3CH_2CH_2Cl + H_2O$$

1-chloropropane

Q.

$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CH_3 \xrightarrow[ZnCl_2]{HCl} CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-CH_3 + H_2O$$

2-chlorobutane

Q.

$$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_2-CH_3}{|}}{C}}-OH \xrightarrow[\Delta]{HCl} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_2-CH_3}{|}}{C}}-Cl + H_2O$$

2-chloro-2-methylbutane

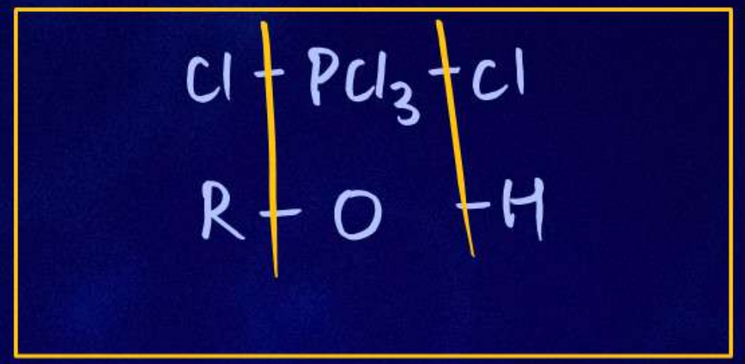
When HCl reacts with 1° & 2° alcohol in the presence of $ZnCl_2$ (dehydrating agent) it yields Haloalkane.

This process is groove's process & HCl + $ZnCl_2$ together forms Lucas Reagent.

In case of 3° alcohol on heating with HCl, Haloalkane is obtained.

(2) By PX_3 & PX_5

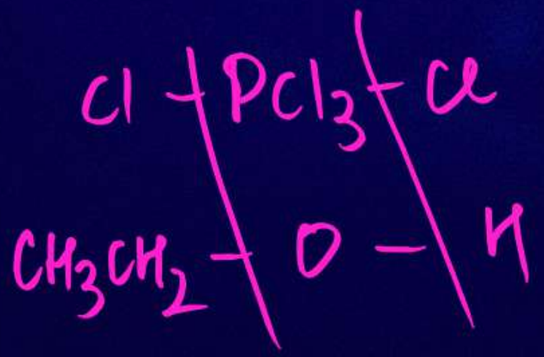
phosphorous trihalide — phosphorous pentahalide



$$R\text{-}OH + PCl_5 \longrightarrow R\text{-}Cl + POCl_3 + HCl$$

(phosphorous pentachloride)

$$CH_3CH_2OH + PCl_5 \longrightarrow CH_3CH_2Cl + POCl_3 + HCl$$



FTAFT REVISION

HOMEWORK

1) Complete Notes
2) Revise Rx by working it 5 times
(Bol bol Kr)

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-5**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. METHODS OF PREPARATION OF HALOALKANES
2. METHODS OF PREPARATION OF HALOARENES

Physical Properties of Haloalkanes

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

METHODS OF PREPARATION OF HALOALKANES

Recap

1. FROM ALCOHOL

OH group

(a) Reaction with H-X (Hydrogen Halide)

H-Cl (Hydrogen-chloride)

$$R\text{-}OH + H\text{-}Cl \xrightarrow[\text{dehydrating agent}]{ZnCl_2} R\text{-}Cl + H_2O$$

Removal H_2O

$HCl + ZnCl_2$

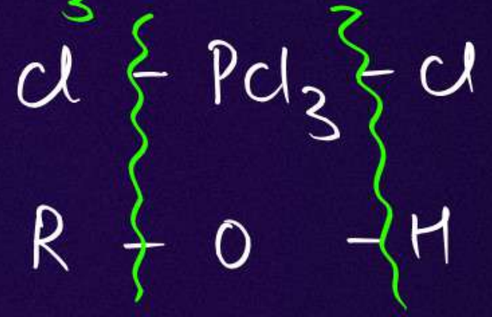
Lucas Reagent

② By PCl_5

(Phosphorus pentachloride)

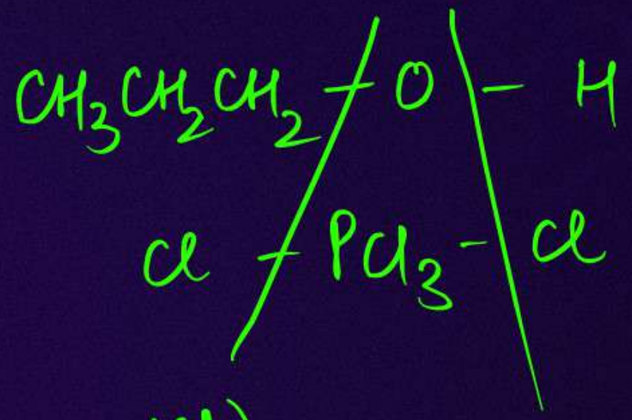
$$R\text{-}OH + PCl_5 \longrightarrow R\text{-}Cl + POCl_3 + HCl$$

Alkyl group



Ex. $CH_3CH_2CH_2\underline{OH} + PCl_5 \longrightarrow CH_3CH_2CH_2Cl + POCl_3 + HCl$

propanol



When alcohol Reacts with phosphorous pentachloride, it will yield haloalkane (alkyl halide) phosphoryl chloride ($POCl_3$), and HCl is produced.

METHODS OF PREPARATION OF HALOALKANES

1. FROM ALCOHOL

(c) By reacting with Phosphorous trichloride (PCl_3)

$$3\ R\text{-}OH + PCl_3 \longrightarrow 3\ R\text{-}Cl + H_3PO_3$$

phosphorus acid

Example

$$3\ CH_3CH_2OH + PCl_3 \longrightarrow 3\ CH_3CH_2Cl + H_3PO_3$$

1-Chloroethane

CH_3CH_2OH
$CH_3CH_2OH + PCl_3$
CH_3CH_2OH

R-OH ✓
R-OH PCl_3
R-OH

Q17.

$$3\,CH_3CH_2CH_2OH + PCl_3 \longrightarrow 3\,CH_3CH_2CH_2Cl + H_3PO_3$$

1-chloropropane

Q18.

$$CH_3CH_2CH_2OH + PCl_5 \longrightarrow CH_3CH_2CH_2Cl + POCl_3 + HCl$$

$Cl - PCl_3 - Cl$

1-chloropropane

Q19.

$$CH_3CH_2CH_2OH + HCl \xrightarrow{ZnCl_2} CH_3CH_2CH_2Cl + H_2O$$

1-chloropropane

Jaha se OH jayga Halogen(X) vahi Ayga.

Galaxy Trick 1

(d) Reaction with Thionylchloride

$$R\text{-}OH + \underset{\text{Thionyl chloride}}{SOCl_2} \longrightarrow \underset{\text{Haloalkane (pure)}}{R\text{-}Cl} + SO_2\uparrow_{(g)} + HCl_{(g)}\uparrow$$

When Alcohol reacts with thionyl chloride it yields Haloalkane (pure) along with SO_2 & HCl. Both SO_2 and HCl are gases and escapes only pure R-Cl is left behind. This process is called 'Darzen's Process'. This is the Best Method | Suitable for preparation of R-X from R-OH

$R\text{-}OH + HBr \xrightarrow{H_2SO_4} R\text{-}Br + H_2O$

$R\text{-}OH + H\text{-}I \xrightarrow{H_3PO_4} R\text{-}I + H_2O$

$R\text{-}OH \xrightarrow[(X = Br, Cl)]{\text{Red } P + X_2} R\text{-}X + H_3PO_3$ (same as PX_3)

X_2

NCERT HIGHLIGHT

Pg 164

'OH' R-OH R-X

The hydroxyl group of an alcohol is replaced by halogen on reaction with concentrated halogen acids, phosphorus halides or thionyl chloride. Thionyl chloride is preferred because in this reaction alkyl halide is formed along with gases SO_2 and HCl. The two gaseous products are escapable, hence, the reaction gives pure alkyl halides. The reactions of primary and secondary alcohols with HCl require the presence of a catalyst, $ZnCl_2$. With tertiary alcohols, the reaction is conducted by simply shaking the alcohol with concentrated HCl at room temperature. Constant boiling with HBr (48%) is used for preparing alkyl bromide. Good yields of R—I may be obtained by heating alcohols with sodium or potassium iodide in 95% orthophosphoric acid. The order of reactivity of alcohols with a given haloacid is 3°>2°>1°. Phosphorus tribromide and triiodide are usually generated *in situ* (produced in the reaction mixture) by the reaction of red phosphorus with bromine and iodine respectively.

HX PX3 PX5 SOCl2 R-Br

Chp 2 Mechanism

Red P + Br_2 + I_2

MOP OF R–X FROM ALCOHOL

1. By Lucas Reagent

$R\text{-}OH + HCl \xrightarrow{ZnCl_2} R\text{-}Cl + H_2O$

(1° alcohol) or (2° alcohol)

(dehydrating agent)

2. By HCl

3° alcohol

$R\text{-}C(R)(R)\text{-}OH + HCl \xrightarrow{\cancel{ZnCl_2}} R\text{-}C(R)(R)\text{-}Cl + H_2O$

3. By HBr

$R\text{-}OH + HBr \xrightarrow{H_2SO_4} R\text{-}Br + H_2O$

4. By HI

$R\text{-}OH + HI \rightarrow R\text{-}I + H_2O$

5. By PCl_5

$PCl_5 + R\text{-}OH \rightarrow R\text{-}Cl + POCl_3 + HCl$

6. By PCl_3

$PCl_3 + 3\,R\text{-}OH \rightarrow 3\,R\text{-}Cl + H_3PO_3$

7. By Thionyl chloride (pure)

$SOCl_2 + R\text{-}OH \rightarrow R\text{-}Cl + SO_2 + HCl$

(Best Method)

8. By Red P + X_2 (Br, I, Cl) or Red P + Br_2 or Red P + I_2

(same Rx as PX_3)

$R\text{-}OH + \text{Red P} + X_2 \rightarrow R\text{-}X + H_3PO_3$

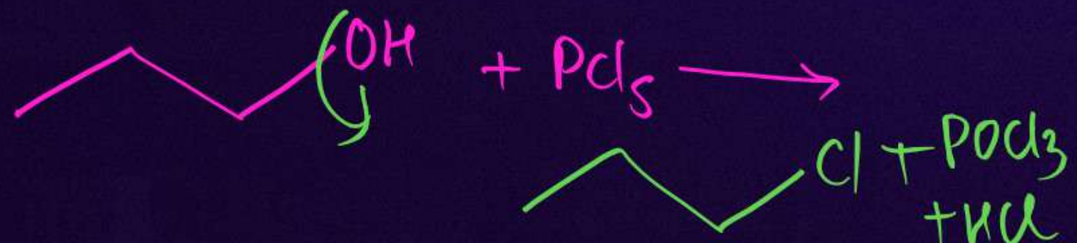
Galaxy Test -01 (8 Marks)

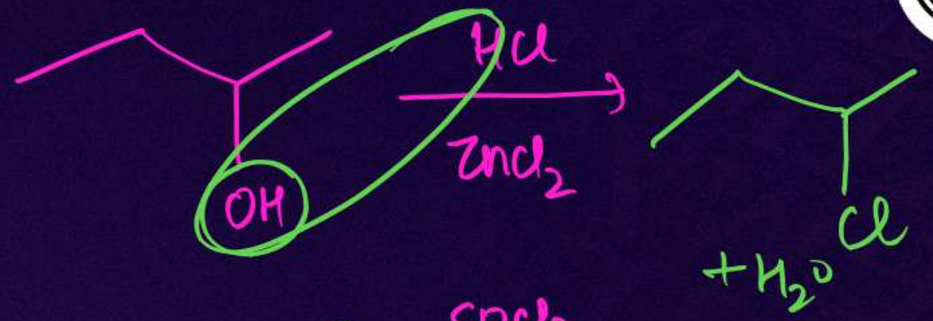
Complete the Following Rx.

1) $CH_3-\underset{\underset{CH_3}{|}}{CH}-OH + HCl \xrightarrow{ZnCl_2} CH_3-\underset{\underset{CH_3}{|}}{CH}-Cl + H_2O$

2-chloropropane

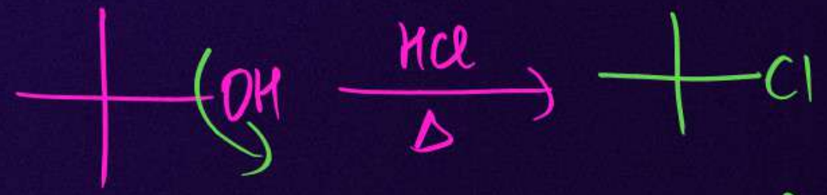
2) $CH_3-\underset{\underset{CH_3}{|}}{CH}-OH + HBr \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{CH}-Br + H_2O$

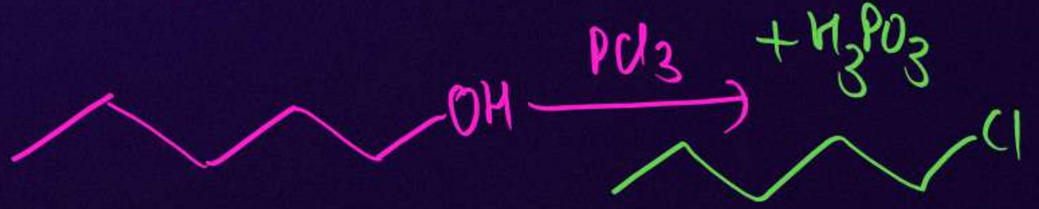
3) 

4) 

5) $CH_3-CH_2-CH_2-OH \xrightarrow{SOCl_2} CH_3CH_2CH_2Cl + SO_2 \uparrow + HCl \uparrow$

6) $CH_3-CH_2-OH \xrightarrow[I_2]{Red\ P} CH_3-CH_2-I$

7) 

8) 

METHODS OF PREPARATION OF HALOALKANES

2. FROM HYDROCARBON

- Saturated (C–C) alkane
- unsaturated
  - alkene =
  - alkyne ≡

(a) From Alkanes

$Cl, Br - ?$

$Cl_2 - Br_2$ ✓ → diatomic Form

Example →

$$CH_4 \xrightarrow[h\nu]{Cl_2 / Br_2} CH_3Cl \xrightarrow[h\nu]{Cl_2} CH_2Cl_2 \xrightarrow[h\nu]{Cl_2} CHCl_3 \xrightarrow[h\nu]{Cl_2} CCl_4$$

Methane

→ Halogenation Reaction : Addition of Halogen (X_2)

X (F, Cl, Br, I)

addition

→ It occurs in the presence of sunlight

→ It follows free Radical substitution Mechanism.

FREE RADICAL SUBSTITUTION MECHANISM -

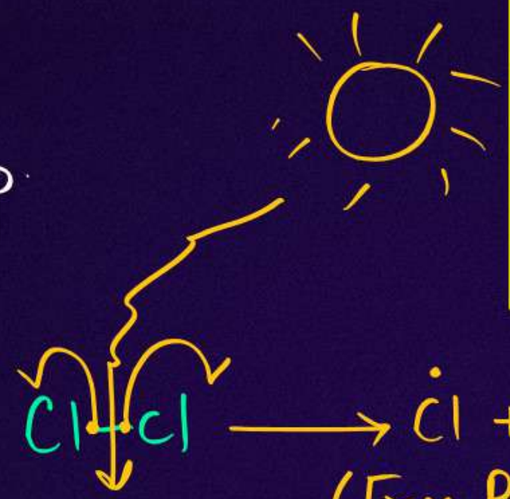
1) Chain Initiation step
2) Chain propagation step
3) Chain Termination step

Galaxy T-2

Jab Jab C in danger
↳ Cl_2 will come ($\dot{C}$)

Jab C is not in danger
$P \rightarrow R$

1) Chain Initiation step



$$Cl-Cl \longrightarrow \dot{Cl} + \dot{Cl}$$

(Free Radical)

2) Chain propagation step

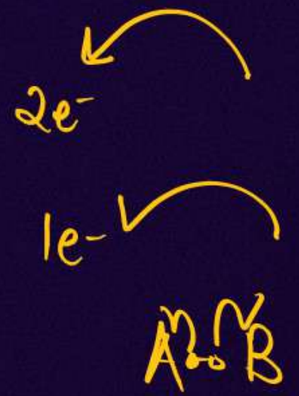
$$H_3C-H + \dot{Cl} \longrightarrow HCl + \dot{C}H_3$$

$$\dot{C}H_3 + Cl-Cl \longrightarrow CH_3Cl + \dot{Cl}$$

$\dot{H}$ radical
↓
unstable

$$A-A \downarrow \dot{A} + \dot{A}$$

Free Radical



(no much diff EN)

$$Cl-CH_2-H + \dot{Cl} \longrightarrow HCl + \dot{C}H_2Cl$$

$$\dot{C}H_2Cl + Cl-Cl \longrightarrow CH_2Cl_2 + \dot{C}l$$

$$H\underset{\underset{Cl_2}{|}}{C}-H + \dot{C}l \longrightarrow HCl + \dot{C}HCl_2$$

$$\dot{C}HCl_2 + Cl-Cl \longrightarrow CHCl_3 + \dot{C}l$$

$$Cl_3C-H + \dot{C}l \longrightarrow \dot{C}Cl_3 + HCl$$

$$\dot{C}Cl_3 + Cl-Cl \longrightarrow CCl_4 + \dot{C}l$$

3) Chain termination

$$\dot{C}l + \dot{C}l \rightarrow Cl_2$$

$$\dot{C}l + \dot{C}H_3 \rightarrow CH_3Cl$$

$$\dot{C}H_3 + \dot{C}H_3 \longrightarrow CH_3-CH_3$$

(ethane)

traces

HOMEWORK

2 times Mechanism.

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-6**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. METHODS OF PREPARATION OF HALOALKANES (MOP Part - 02)

PART 2 + HALOARENES

Physical Properties

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

METHODS OF PREPARATION OF HALOALKANES

2. FROM HYDROCARBON

(a) From Alkanes

→ Halogenation occurs (Addition of X_2)

→ It follows free Radical Substitution Mechanism

(i) chain initiation step

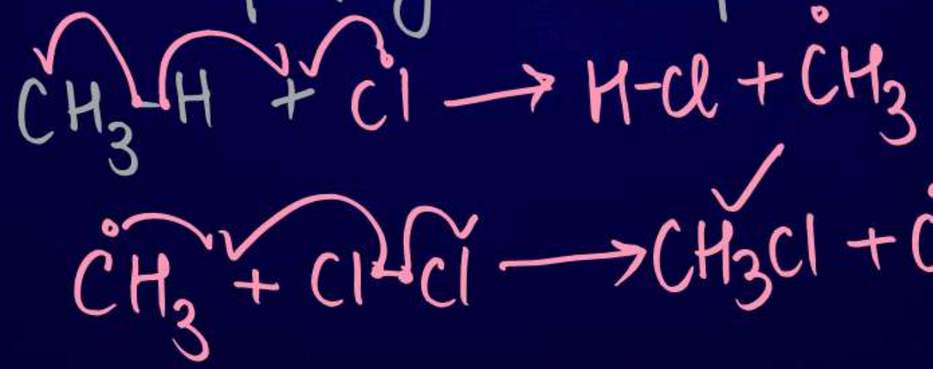
(ii) chain propagation

(iii) chain termination

(i) chain Initiation step

$\dot{Cl} + \dot{Cl}$ Radical

(ii) chain propagation step



$$Cl-CH_2-H + \dot{C}l \longrightarrow \dot{C}H_2Cl + HCl$$

$$\dot{C}H_2Cl + Cl-Cl \longrightarrow CH_2Cl_2 + \dot{C}l$$

$$Cl-\underset{\underset{Cl}{|}}{C}H-H + \dot{C}l \longrightarrow \dot{C}HCl_2 + HCl$$

$$\dot{C}HCl_2 + Cl-Cl \longrightarrow CHCl_3 + \dot{C}l$$

$$Cl_3C-H + \dot{C}l \longrightarrow \dot{C}Cl_3 + HCl$$

$$\dot{C}Cl_3 + Cl-Cl \longrightarrow CCl_4 + \dot{C}l$$

(iii) Termination step

$$\dot{Cl} + \dot{Cl} \longrightarrow Cl_2$$

$$\dot{CH_3} + \dot{Cl} \longrightarrow CH_3Cl$$

$$\dot{CH_3} + \dot{CH_3} \longrightarrow CH_3-CH_3$$

Ethane or C_2H_6
(traces)

QUESTION

The reagent used in the following reaction is

$CH_3CH_2CH_2CH_3 \longrightarrow CH_3CH_2CH_2CH_2Cl + CH_3CH_2CHClCH_3$

[NTA CUET 2022]

1. Cl_2/UV light
2. Cl_2 in dark
3. Cl_2 in the presence of copper in dark
4. $KCl + H_2SO_4$

QUESTION

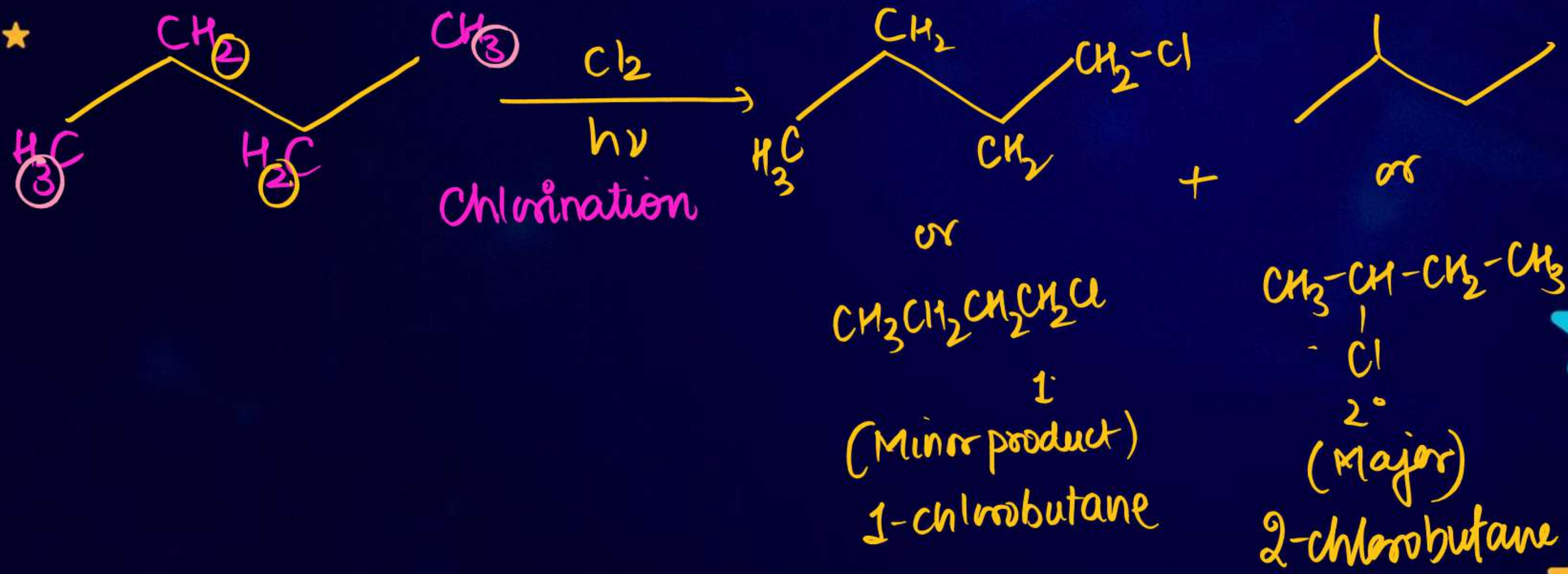
$C_3H_8 + Cl_2 \xrightarrow{\text{Light}} C_3H_7Cl + HCl$ is an example of which of the following types of reactions?

1. Substitution
2. Elimination
3. Addition
4. Rearrangement

METHODS OF PREPARATION OF HALOALKANES

2. FROM HYDROCARBON

$3^\circ > 2^\circ > 1^\circ$



METHODS OF PREPARATION OF HALOALKANES

2. FROM HYDROCARBON

* $CH_3-CH_3 \xrightarrow[h\nu]{Br_2} CH_3CH_2Br + HBr$

(BROMINATION)

1-bromoethane

IODINATION

$$CH_4 + I_2 \rightleftharpoons CH_3I + HI$$

Reversible Rx
Hence iodination is not possible
product will convert
back into Reactant

$$HI + HIO_3 \longrightarrow I_2 + H_2O$$

METHODS OF PREPARATION OF HALOALKANES

2. FROM HYDROCARBON

- Fluorination is not possible in alkanes, because the Reaction is highly vigorous.

(b) From Alkenes

unsaturated hydrocarbons
(C = C)

(i) By addition of HX (Hydrogen Halide).

Ethene

$$\underset{H}{CH_2} = \underset{Cl}{CH_2} + HCl \longrightarrow CH_3-CH_2-Cl$$

1-chloroethane

symmetrical alkene

$$CH_3-\overset{H}{CH} = \overset{Br}{CH}-CH_3 \xrightarrow{HBr} CH_3CH_2\underset{Br}{CH}-CH_3$$

but-2-ene

2-bromobutane

$$CH_3-CH=CH_2 + \overset{+}{H}\overset{-}{Cl} \longrightarrow CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 + CH_3CH_2CH_2Cl$$

(Major product) (Minor)

unsymmetrical alkene

(Molecule to be added)

Markovnikov's Rule → The -ve part of the addendum will go to that double bond carbon atom which has less no of hydrogen atom.

Q. $$CH_3-CH=\underset{\underset{CH_3}{|}}{C}-CH_3 \xrightarrow{\overset{+}{H}\overset{-}{Cl}} CH_3CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{Cl}{|}}{C}}-CH_3 + CH_3-\underset{\underset{Cl}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$$

(Major) (Minor)

Q. $CH_3-CH=CH_2 \xrightarrow{\overset{+}{H}\overset{-}{Br}} CH_3-\underset{\underset{Br}{|}}{CH}-CH_3 + CH_3CH_2CH_2Br$

2-bromopropane (Major) + 1-bromopropane (Minor)

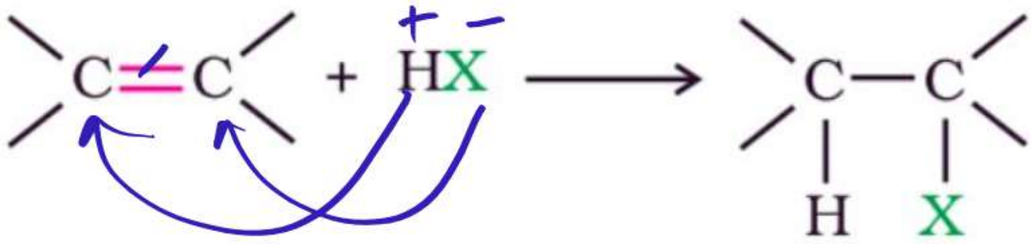
Q. $CH_3-CH=CH_2 \xrightarrow[\text{peroxide}]{\overset{+}{H}\overset{-}{Br}} CH_3CH_2CH_2Br + CH_3\underset{\underset{Br}{|}}{CH}-CH_3$

(Major) (Minor)

Antimarkovnikov Rule → The -ve part of addendum will go to that double bonded C atom which has More no of hydrogen atom.

NCERT HIGHLIGHT

(i) *Addition of hydrogen halides*: An alkene is converted to corresponding alkyl halide by reaction with hydrogen chloride, hydrogen bromide or hydrogen iodide.

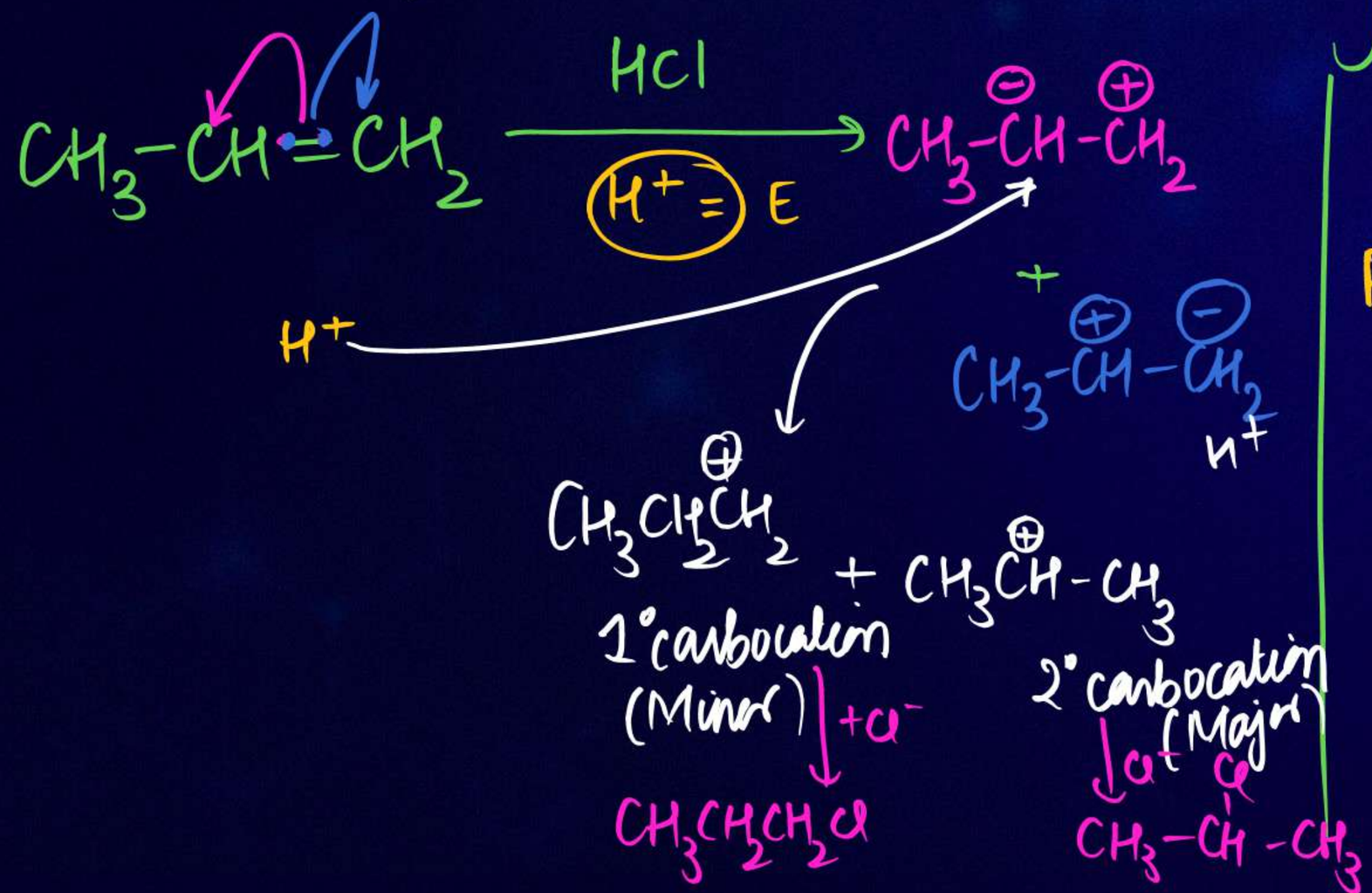


Propene yields two products, however only one predominates as per Markovnikov's rule. (Unit 13, Class XI)

$$CH_3CH = CH_2 + H{-}I \longrightarrow \underset{\text{minor}}{CH_3CH_2CH_2I} + \underset{\text{major}}{CH_3CHICH_3}$$

Mechanism of Markovnikov Rule -

It Follows 'ELECTROPHILIC ADDITION Rx'.



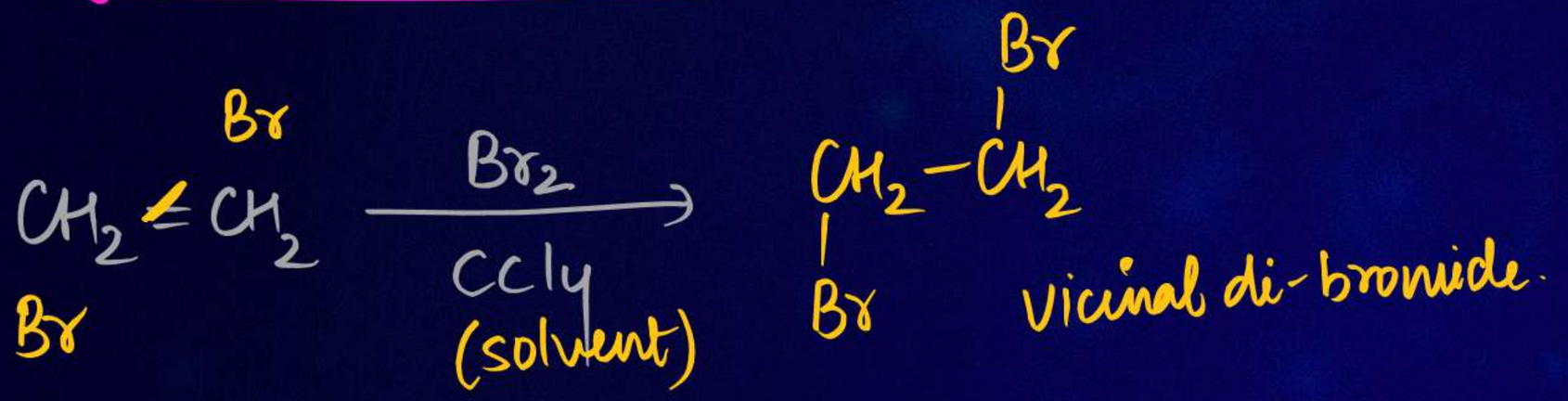
MCQ Que.

Electrophile

e^- loving

Represent E^+

(ii) By addition of Halogens



NCERT HIGHLIGHT

unsaturation test

(ii) *Addition of halogens:* In the laboratory, addition of bromine in CCl_4 to an alkene resulting in discharge of reddish brown colour of bromine constitutes an important method for the detection of double bond in a molecule. The addition results in the synthesis of *vic*-dibromides, which are colourless (Unit 9, Class XI).

Pg 165.

3. HALOGEN EXCHANGE REACTION

FINKELSTEIN RX

$$\overset{+}{R}-\overset{-}{X} + \overset{+}{Na}\overset{-}{I} \xrightarrow[\text{acetone}]{\text{dry}} RI + NaX$$

(X = Cl, Br)

alkyl iodide

Ex. $\overset{+}{CH_3}-\overset{-}{Cl} + \overset{+}{Na}\overset{-}{I} \xrightarrow[\text{acetone}]{\text{dry}} CH_3I + NaCl$

NaCl & NaBr obtained are precipitated & Favours forward Rx

NAMING RX

SWARTZ RX

$$\overset{+}{R}-\overset{-}{X} + \overset{+}{Ag}\overset{-}{F} \longrightarrow R-F + AgX$$

(Metallic Fluoride
Hg_2F_2, CoF_2 etc)

$R-F$ ↓ Alkyl Fluoride

When haloalkane reacts with heavy Metal fluorides it yield alkyl fluoride

QUESTION

What is the name of the following reaction?

$$CH_3CH_2CH_2Br \xrightarrow[\text{Dry acetone}]{NaI} CH_3CH_2CH_2I + NaBr$$

1. Sandmeyer reaction
2. Gattermann reaction
3. Finkelstein reaction
4. Swarts reaction

MOP OF R–X

1. Alcohol

$R\text{-}OH + NaBr + H_2SO_4$

$\downarrow$

$R\text{-}Br + NaHSO_4 + H_2O$

HW

2. By Hydrocarbon

a) By HX

Markovnikov Rule

-ve will go to C which has less H atom.

HBr + peroxide (Antimarkovnikov)

-ve part will go to More H atom C.

(b) By addition of X_2

$CH_2=CH_2 \xrightarrow[CCl_4]{Br_2}$ vic. dibromide

(c) Alkane

Chlorination / Br_2

$h\nu$

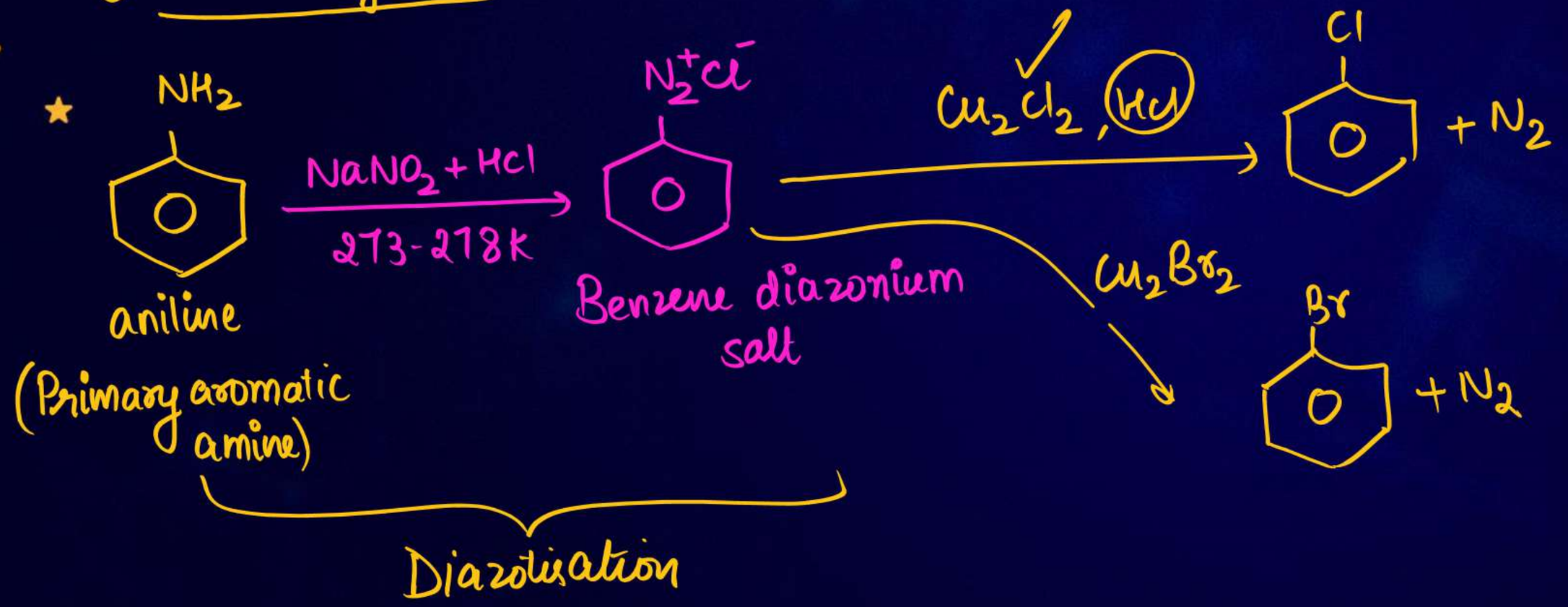
3. Halogen Exchange Rx

(a) $NaI + RX \xrightarrow[\text{dry acetone}]{} RI + NaX$ (Finkelstein)

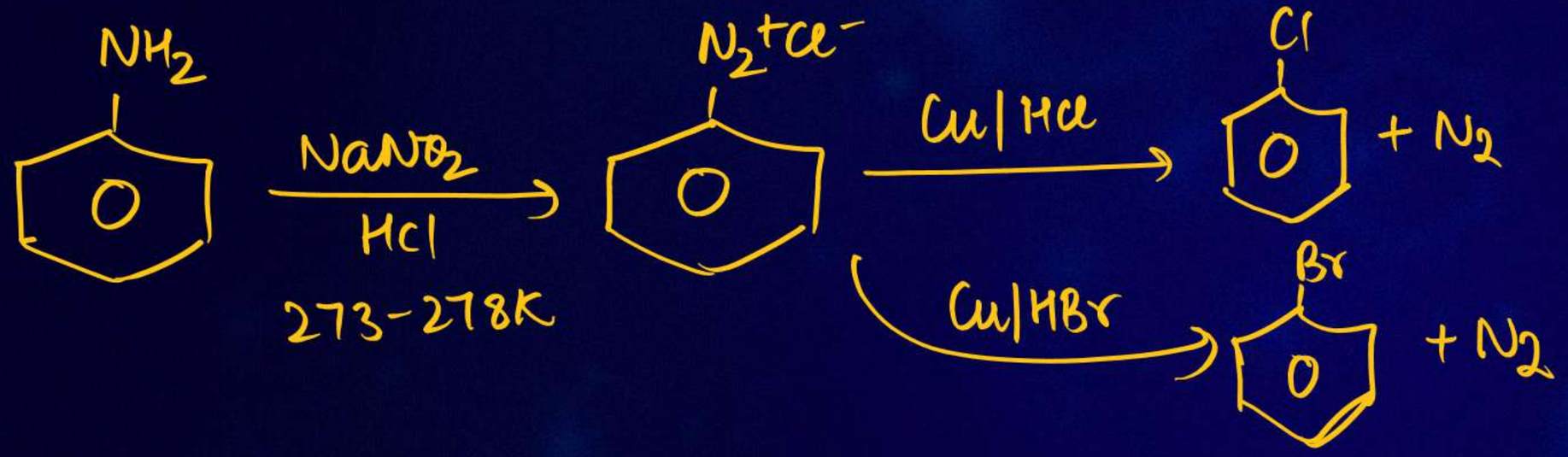
$R\text{-}X + AgF \rightarrow R\text{-}F + AgX$ (Swartz Rx)

METHODS OF PREPARATION OF HALOARENES

1. Sandmayer Rx



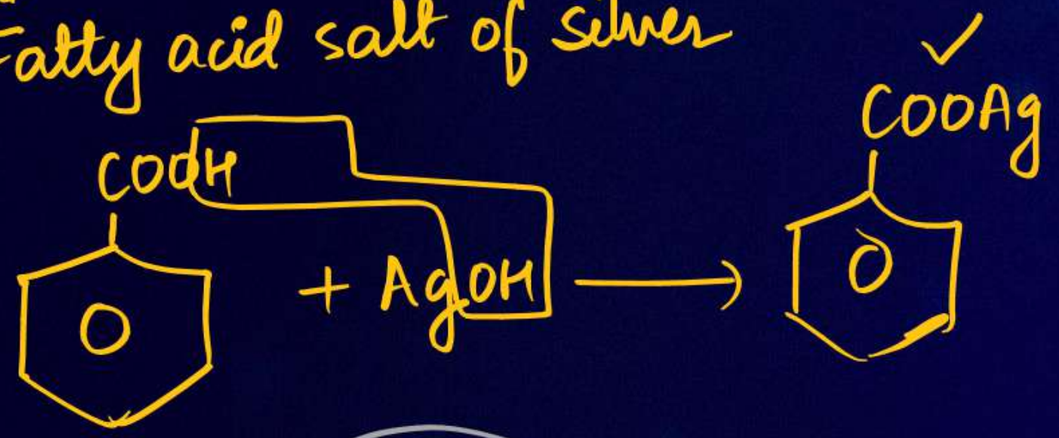
Gattermann Rx

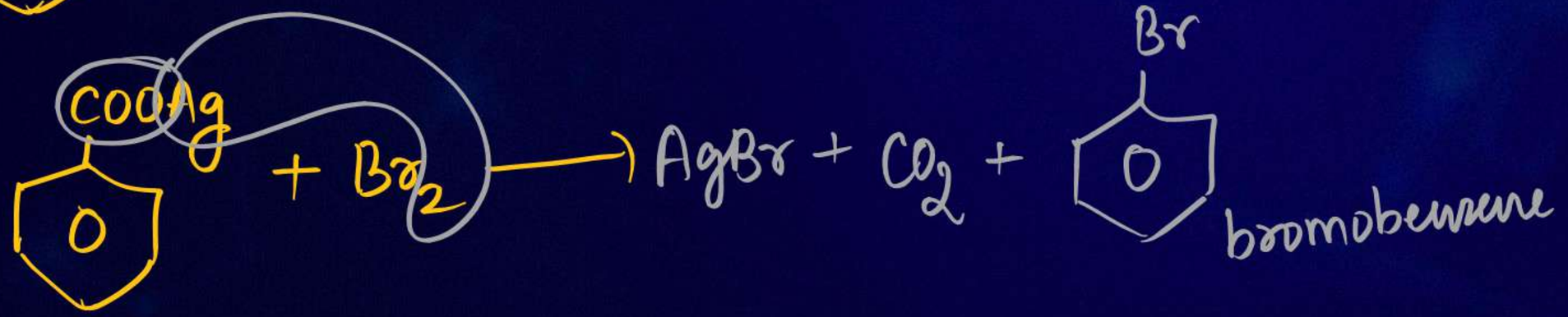


3. Hunsdiecker Rx.

↓

Fatty acid salt of silver





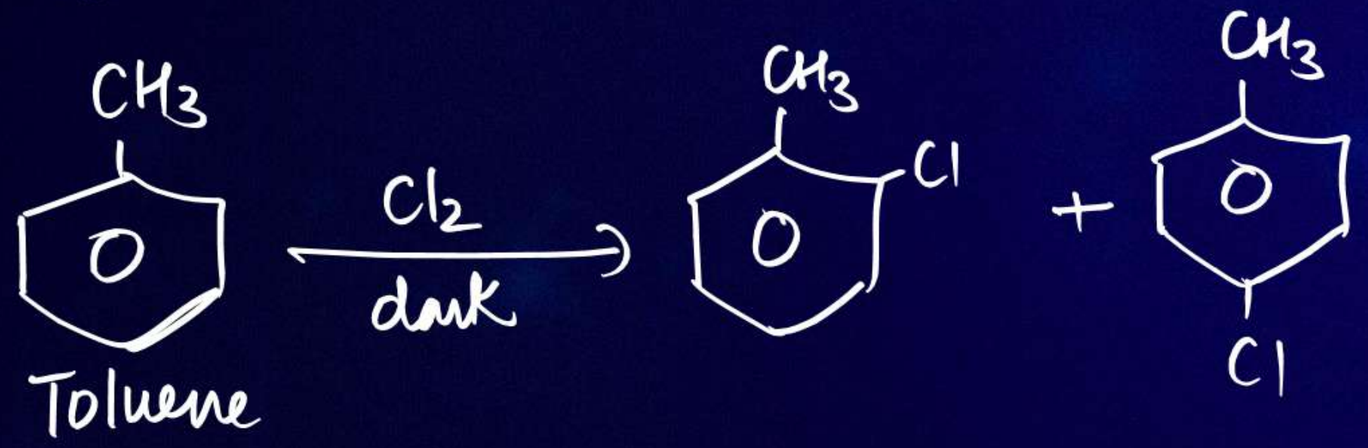
$$RCOOAg + Br_2 \longrightarrow AgBr + CO_2 + R\text{-}Br$$

$$RCOOAg + I_2 \longrightarrow R\text{-}I \times$$

$$2\begin{matrix} RCOOAg \\ RCOOAg \end{matrix} \quad I_2$$

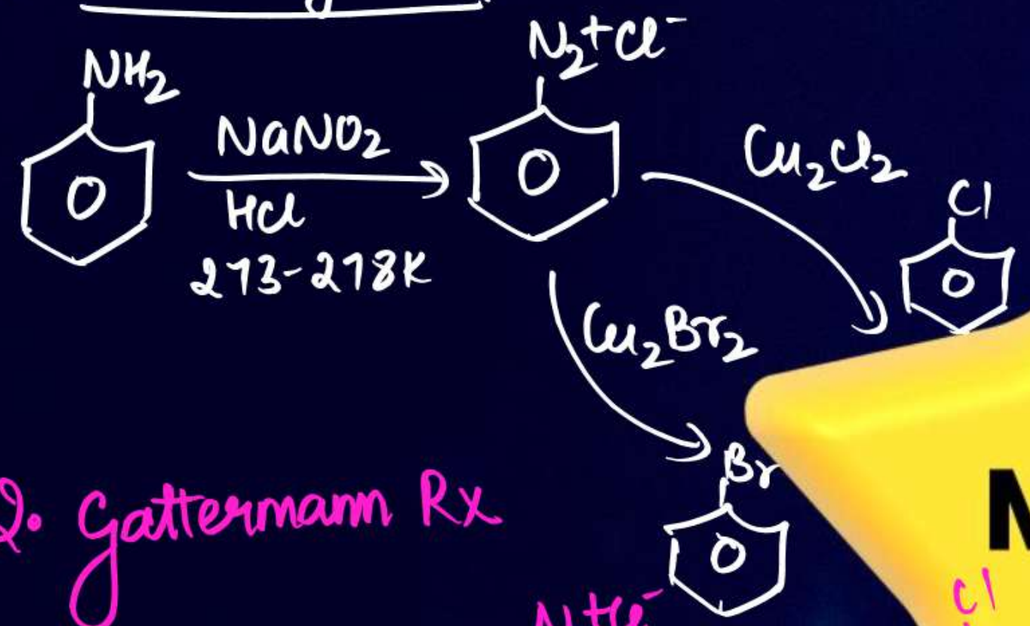
R–I is not formed as 2 molecules of RCOOAg react together.

4. Direct Halogenation

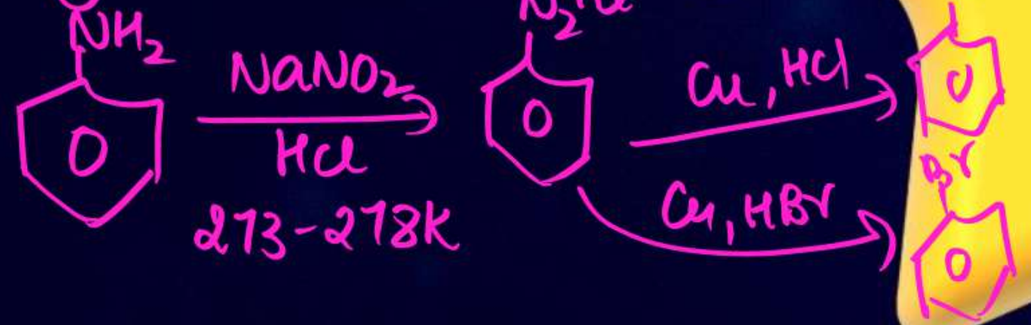


MOP OF

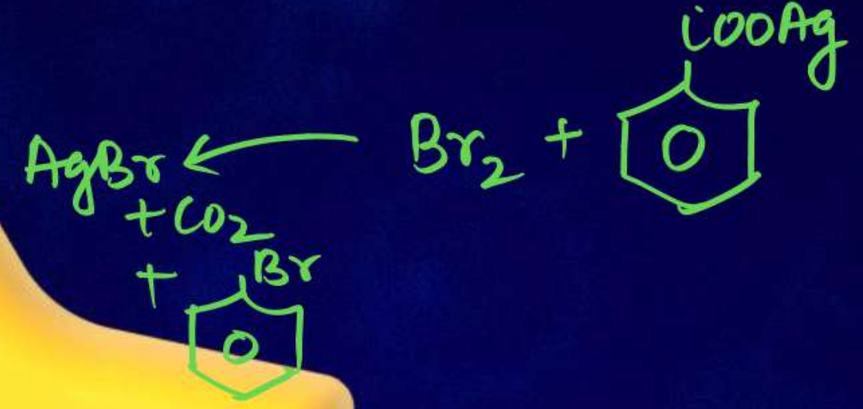
1. Sandmayer Rx



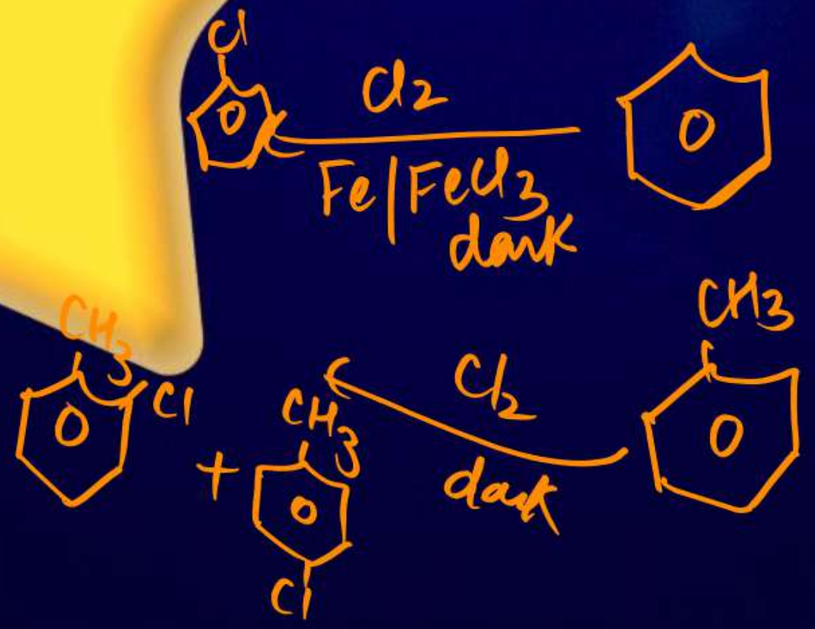
2. Gattermann Rx



3. Hunsdiecker



4. Direct Halogenation



PHYSICAL PROPERTIES OF HALOALKANES

1. BOILING POINT

$$\boxed{\text{Bpt} \propto \text{Molecular Mass}}$$

$\propto$ vanderwaal forces (Reason)

Q. Which has high Bpt

CH_3CH_3 (a) $<$ $CH_3CH_2CH_2CH_3$ (b)

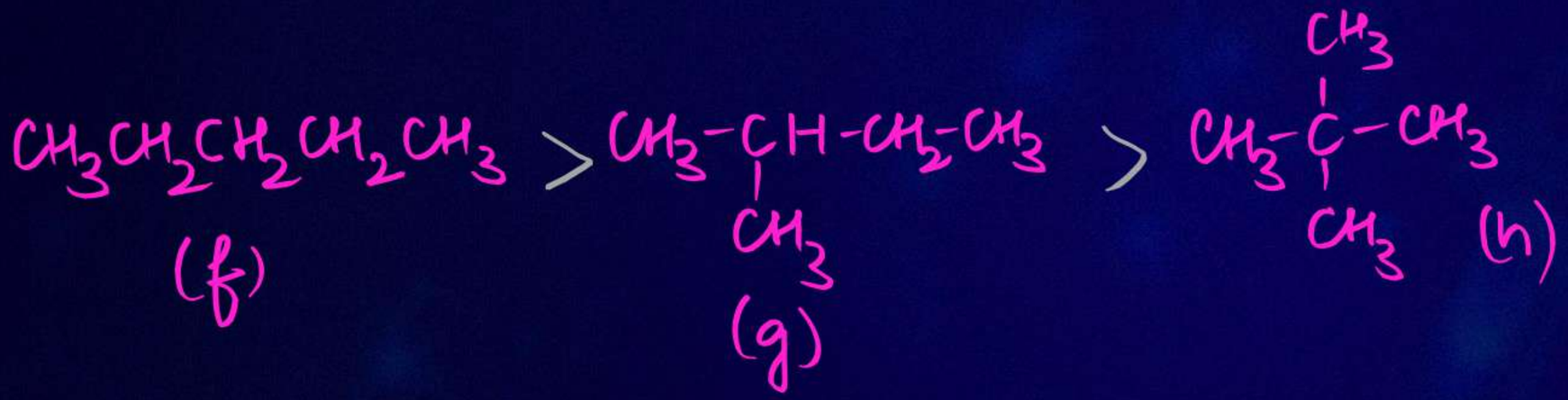
Q. Which has high Bpt

$CH_3CH_2CH_2CH_2-Cl$ (c) $CH_3CH_2CH_2CH_2CH_2-Cl$ (d) $CH_3CH_2CH_2-Cl$ (e)

(d) > (c) > (e)

$$\text{Bpt} \propto \frac{1}{\text{Branching}}$$

Que.



2. PHYSICAL STATE

g
l
s

*Lower Molecule (Haloalkane) are gases except $CH_3I \rightarrow (l)$

Higher Molecule till $C_{18} = (l), (s)$

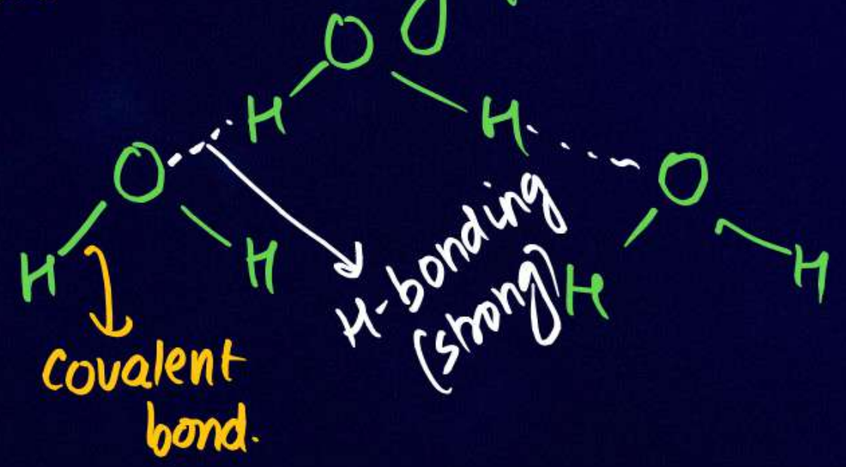
4. Volatile Halogen compounds (VP)

have sweet smell.

5. All are colourless except Br, I - they develop colour in sunlight

3. Solubility (घुलनता) / Mix होना

Haloalkanes being polar in Nature do not dissolve in H_2O. (very slightly soluble) (almost no)



R-X do not have this much energy to break H-bonds. Hence it is very slightly (not dissolve) in H_2O.

FTAFT REVISION

HOMEWORK

Read physical property of Haloalkane from NCERT

+

MOP

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-7**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. PHYSICAL PROPERTIES OF HALOARENES
2. CHEMICAL PROPERTIES OF HALOALKANES

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

NCERT HIGHLIGHT

1.

Alkyl halides are colourless when pure. However, bromides and iodides develop colour when exposed to light. Many volatile halogen compounds have sweet smell.

Exert VP

NCERT HIGHLIGHT

2. **Melting and boiling points**

CH_3Cl CH_3Br CH_3CH_2Cl

Methyl chloride, methyl bromide, ethyl chloride and some chlorofluoromethanes are gases at room temperature. Higher members are liquids or solids. As we have already learnt, molecules of organic halogen compounds are generally polar. Due to greater polarity as well as higher molecular mass as compared to the parent hydrocarbon, the intermolecular forces of attraction (dipole-dipole and van der Waals) are stronger in the halogen derivatives. That is why the boiling points of chlorides, bromides and iodides are considerably higher than those of the hydrocarbons of comparable molecular mass.

EN difference

CH_3CH_3 CH_3CH_2Cl

The attractions get stronger as the molecules get bigger in size and have more electrons. The pattern of variation of boiling points of different halides is depicted in Fig. 6.1. For the same alkyl group, the boiling points of alkyl halides decrease in the order: RI> RBr> RCl> RF. This is because with the increase in size and mass of halogen atom, the magnitude of van der Waal forces increases.

NCERT HIGHLIGHT

The boiling points of isomeric haloalkanes decrease with increase in branching. For example, 2-bromo-2-methylpropane has the lowest boiling point among the three isomers.

	$CH_3CH_2CH_2CH_2Br$	$CH_3CH_2CH(Br)CH_3$	$(CH_3)_3CBr$
b.p./K	375	364	346

4 3 2 1

C_4H_9Br C_4H_9Br C_4H_9Br

NCERT HIGHLIGHT

Density

Many

Bromo, iodo and polychloro derivatives of hydrocarbons are heavier than water. The density increases with increase in number of carbon atoms, halogen atoms and atomic mass of the halogen atoms (Table 6.3).

$d = \frac{m}{V}$ $m \uparrow d \uparrow$

$d \propto$ Molecular Mass

$\propto$ no of C atom

$\propto$ no of X atom

NCERT HIGHLIGHT

Solubility

The haloalkanes are very slightly soluble in water. In order to dissolve haloalkane in water, energy is required to overcome the attractions between the haloalkane molecules and break the hydrogen bonds between water molecules. Less energy is released when new attractions are set up between the haloalkane and the water molecules as these are not as strong as the original hydrogen bonds in water. As a result, the solubility of haloalkanes in water is low. However, haloalkanes tend to dissolve in organic solvents because the new intermolecular attractions between haloalkanes and solvent molecules have much the same strength as the ones being broken in the separate haloalkane and solvent molecules.

QUESTION

Intext Question

6.6 Arrange each set of compounds in order of increasing boiling points.

(i) Bromomethane, Bromoform, Chloromethane, Dibromomethane.

(ii) 1-Chloropropane, Isopropyl chloride, 1-Chlorobutane.

(i) Bromomethane : CH_3Br (A)

Bromoform : $CHBr_3$ (B)

Chloromethane : CH_3Cl (C)

Dibromomethane : CH_2Br_2 (D)

$B_{pt} \propto MM$

$C < A < D < B$

F

Cl

Br

I

size ↑

QUESTION

May Come (Observation) → 1 Q will come from Bpt topic (any chp)

↳ Past PyQ.

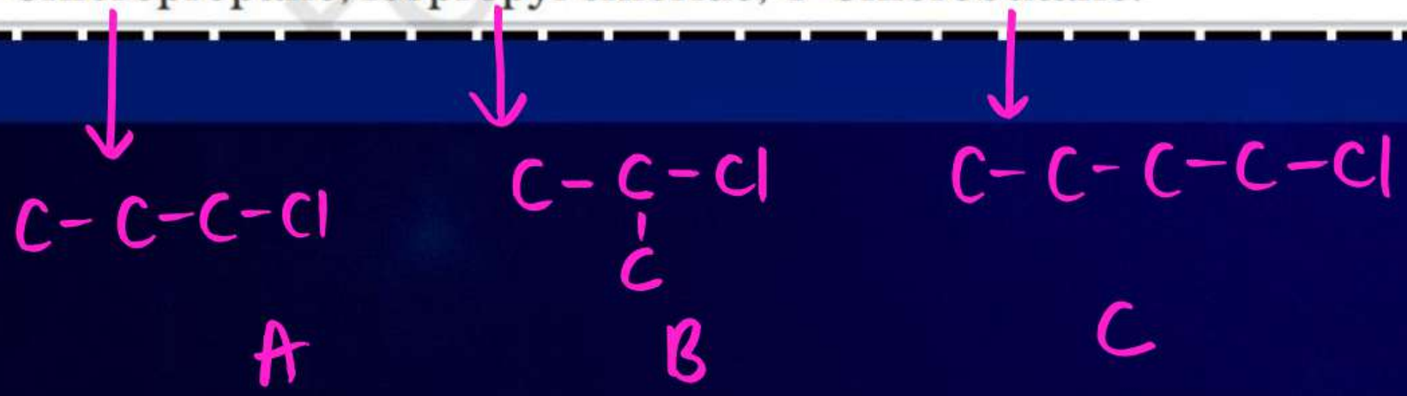
Intext Question

6.6 Arrange each set of compounds in order of increasing boiling points.

(i) Bromomethane, Bromoform, Chloromethane, Dibromomethane.

(ii) 1-Chloropropane, Isopropyl chloride, 1-Chlorobutane.

(ii)



A B C

$B < A < C$

$$\left.\begin{array}{l} \text{Bpt} \propto \text{MM} \\ \propto \dfrac{1}{\text{Branching}} \end{array}\right\}$$

RCOOH > R-OH > RCHO or RCOR

∨

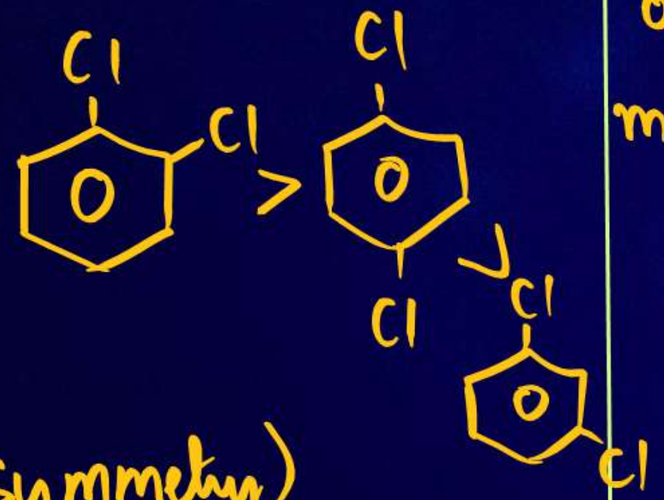
R-R

PHYSICAL PROPERTIES OF HALOARENES

1. Boiling point

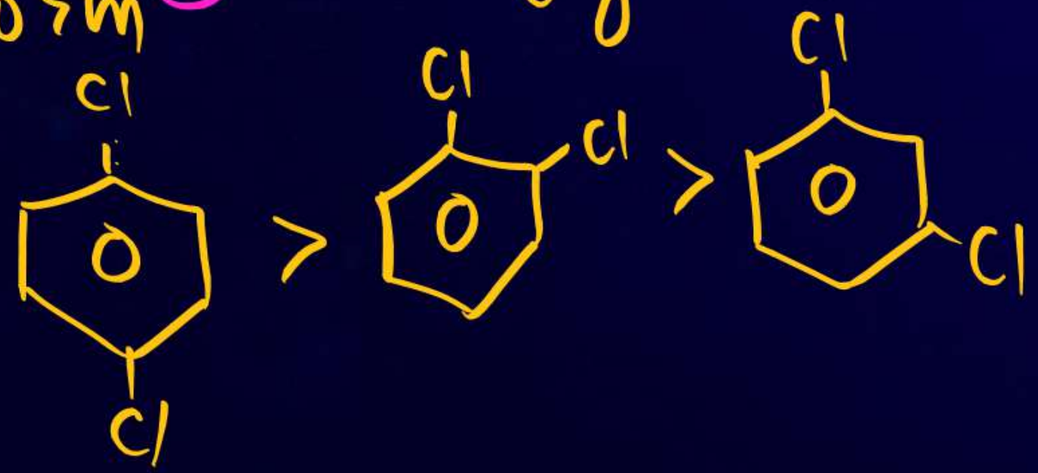
o > p > m

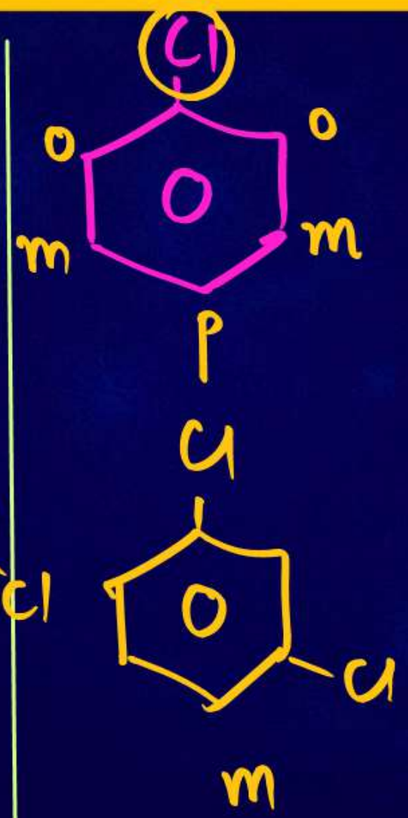
vanderwaal Forces

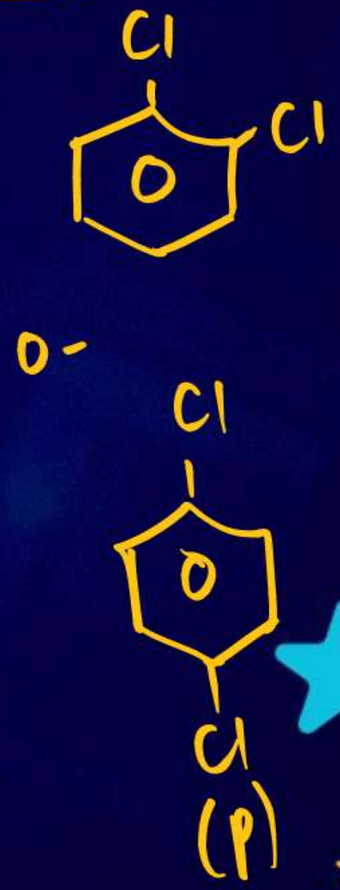


2. Melting point (symmetry)

p > o > m



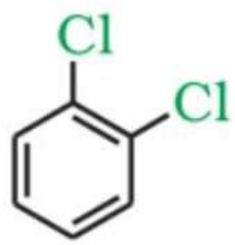
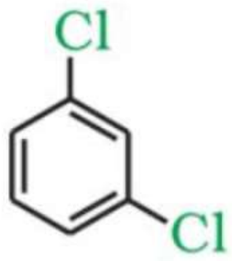




NCERT HIGHLIGHT

2 halogen

Boiling points of isomeric dihalobenzenes are very nearly the same. However, the *para*-isomers are high melting as compared to their *ortho*- and *meta*-isomers. It is due to symmetry of *para*-isomers that fits in crystal lattice better as compared to *ortho*- and *meta*-isomers.

			
b.p / K	453	446	448
m.p/K	256	249	323

CHEMICAL PROPERTIES OF HALOALKANES

1. NUCLEOPHILIC SUBSTITUTION REACTION
2. ELIMINATION REACTION
3. REACTION WITH METALS

BIMOLECULAR NUCLEOPHILIC SUBSTITUTION RX

CHEMICAL PROPERTIES OF HALOALKANES

1. NUCLEOPHILIC SUBSTITUTION REACTION

NUCLEUS LOVING

neutron + proton

+ve

$Nu^{\ominus}$

Replace

Substrate + Attacking Reagent $\xrightarrow{\text{solvent}}$ [Transition state (B. form + B. Break) or Intermediate [C^+, C^-, $C^{\cdot}$]] $\rightarrow$ Product

$$\overset{+}{R}-\overset{-}{X} + Nu^- \xrightarrow{\text{solvent}} R-Nu + X^-$$

TYPES OF NUCLEOPHILIC REACTION

SN_2

Bimolecular Nucleophilic Substitution Rx.

SN_1

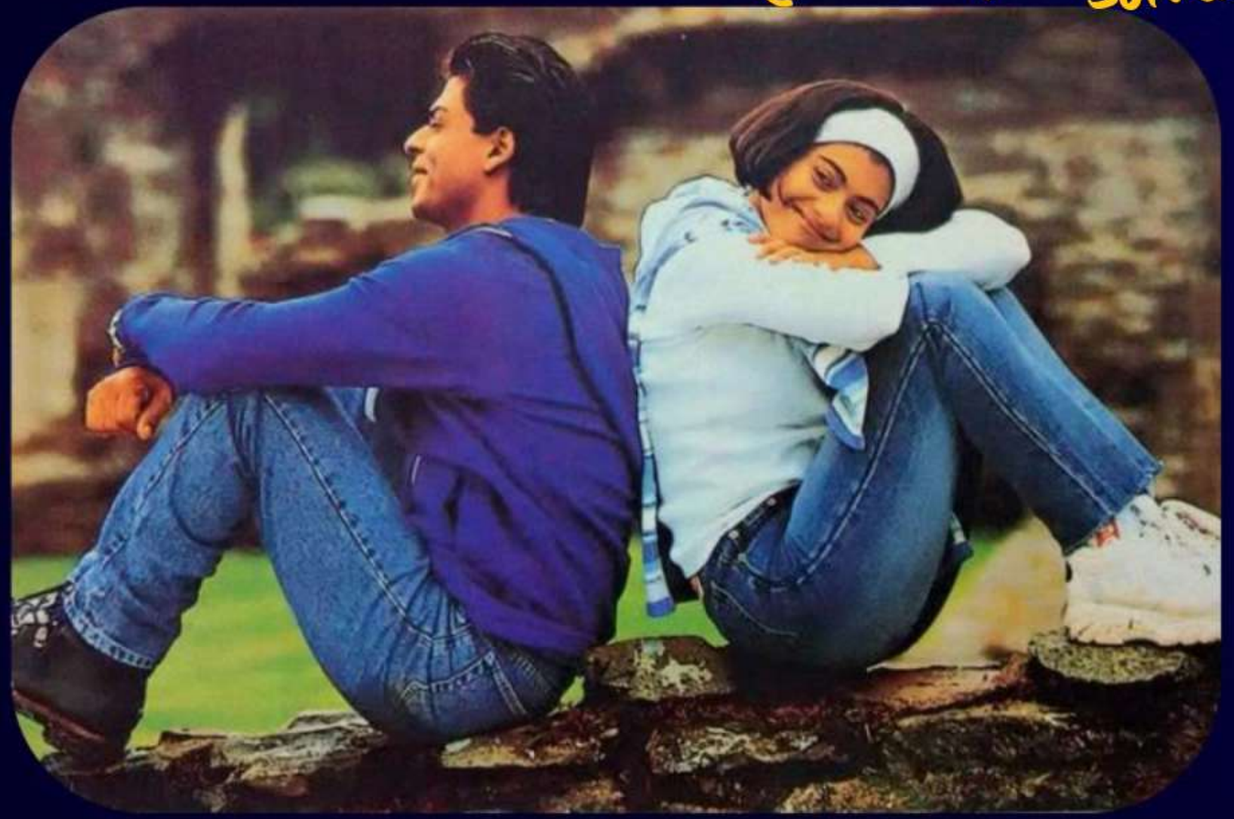
Unimolecular Nucleophilic Substitution Rx.

NCERT HIGHLIGHT

A substitution reaction takes place and halogen atom, called leaving group departs as halide ion. Since the substitution reaction is initiated by a nucleophile, it is called nucleophilic substitution reaction

BIMOLECULAR NUCLEOPHILIC SUBSTITUTION RX

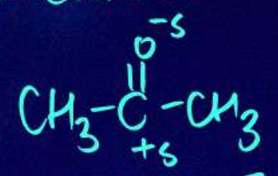
$$\overset{+\delta}{R}-\overset{-\delta}{X} \xrightarrow[\text{(polar aprotic solvent)}]{+Nu^{-}\ \text{solvent}} Nu-R + X^{\ominus}$$

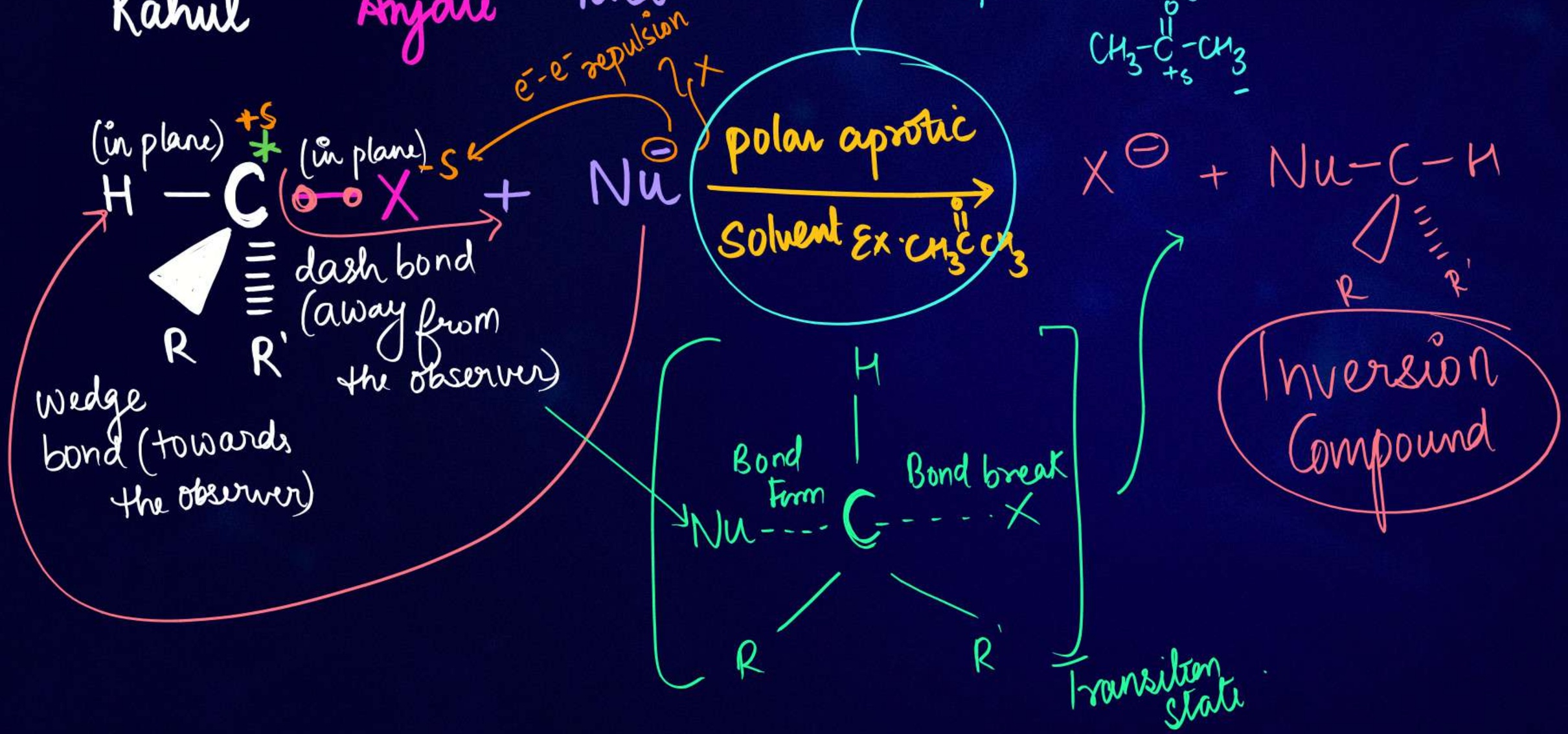


Rahul Anjali Tina

polar = poles = +, −

aprotic = cannot donate H^+





BIMOLECULAR NUCLEOPHILIC SUBSTITUTION RX

Nu- — - - - R — - - - X

Transition State ✓

b.form b.break

Nu- - - - - R- — X

✓ 3 pm-class – Test (15 min) = 15 Q. } MOP, Physical property

↓

MCQ.

✓ Chemical property.

SHOURYA MAM
JOIN MY OFFICIAL TELEGRAM CHANNEL
@CHEMISTRYBY
SHOURYAMAM
Physics Wallah

FTAFT REVISION

HOMEWORK

1. Revise Notes
2. Complete Notes

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-8**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. CHEMICAL PROPERTIES OF HALOALKANES

part 2

(SN_1 & SN_2)

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

QUESTION

METHODS OF PREPARATION

1.

In the conversion of ROH → RX, what is decreasing order of reactivity of hydrogen halide acid?

$$R\text{-}OH \xrightarrow{HX} R\text{-}X + H_2O$$

HX

HF
^
HCl
^
HBr
^
HI

(A) HCl > HBr > HI > HF

(B) HI > HBr > HCl > HF

(C) HF > HCl > HBr > HI

(D) HF > HBr > HCl > HI

QUESTION

2

CUET 2022

PHYSICAL PROPERTY

For a given alkyl group, the densities of the halides follow the order

$d = \frac{m}{v} = MM\uparrow d\uparrow$

(A) RI < RBr < RCl

(B) RI < RCl < RBr

(C) RBr < RI < RCl

(D) RCl < RBr < RI

F > Cl > Br > I

size↑ MM↑ d↑

QUESTION

p > o > m

3.

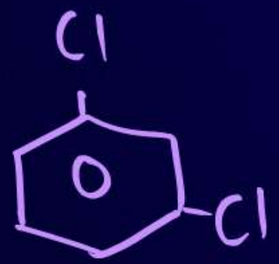
CUET 2022

PHYSICAL PROPERTY

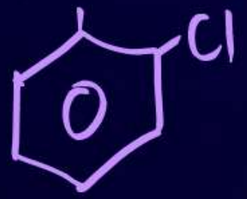
Which among the given compounds will have highest melting point?

(A) Chlorobenzene

(B) m-Dichlorobenzene



(C) o-Dichlorobenzene



(D) p-Dichlorobenzene

QUESTION

F
Cl
Br
I
MM↑

PHYSICAL PROPERTIES

4

Boiling points of the following compounds increases in the order
1-Iodobutane, 1-Bromobutane, 1-chlorobutane, Butane

C-C-C-C-I > C-C-C-C-Br > C-C-C-C-Cl C-C-C-C

(A) Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane

(B) 1-Iodobutane < 1-Bromobutane < 1-chlorobutane < Butane

(C) Butane < 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane

(D) Butane < 1-Chlorobutane < 1-Iodobutane < 1-Bromobutane

QUESTION

PHYSICAL PROPERTIES

5

Alkyl halides are immiscible in water though they are polar because

(A) They react with water to give alcohols

(B) They cannot form hydrogen bond with water

(C) C–X bond cannot be broken easily

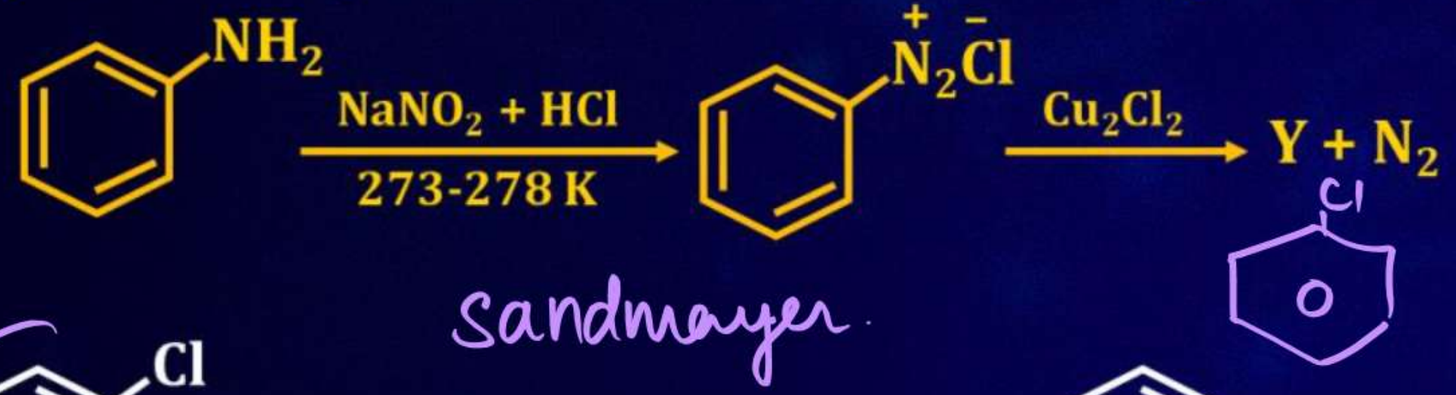
(D) They react with water to give ester

QUESTION

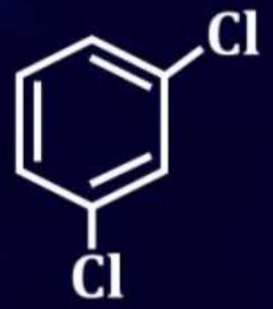
MOP

6

identify the compound 'Y' in the following reaction.



sandmayer.



QUESTION

NCERT EXEMPLAR

MOP

7

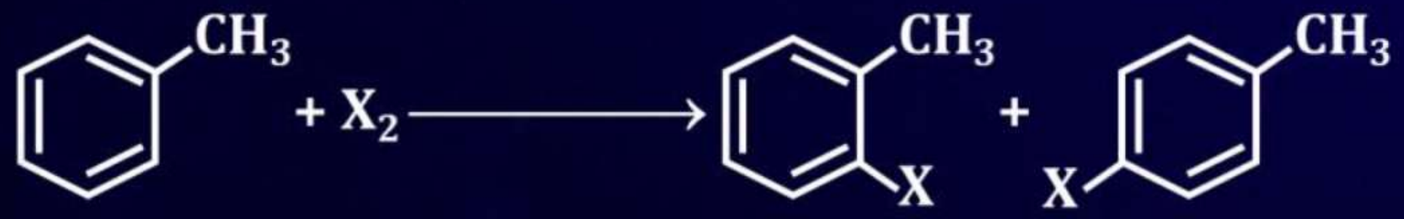
Which of the following is halogen exchange reaction?

Finkelstein Rx

(A) $RX + NaI \longrightarrow RI + NaX$

(B) $C = C + HX \longrightarrow C - C$

(C) $R - OH + HX \longrightarrow R - X + H_2O$

(D) 

QUESTION

NCERT EXEMPLAR

Arrange the following compounds in increasing order of their boiling points

C_4H_9Br C_4H_9Br C_4H_9Br

8

(I) $CH_3-CH(CH_3)-CH_2Br$ (II) $CH_3CH_2CH_2CH_2Br$ (III) $H_3C-C(CH_3)(Br)-CH_3$

III < I < II

(A) II < I < III

(B) I < II < III

(C) III < I < II

(D) III < II < I

QUESTION

Bromination of methane in presence of sunlight is a

9

MOP

(A) nucleophilic substitution

(B) free radical substitution

(C) electrophilic substitution

(D) nucleophilic addition.

QUESTION

What will be the compound R in the following scheme?

10

$$CH_3CH_2CH_2OH \xrightarrow{PCl_5} R$$

R

$CH_3CH_2CH_2Cl$

MOP

Cl — PCl_3 — Cl

R — O — H

R-Cl + $POCl_3$ + HCl

(A) Propyne ≡ ✗

(B) 1-Chloropropane ✓

(C) Propanol OH ✗

(D) Propanone $-\overset{O}{\overset{\|}{C}}-$ ✗

QUESTION

MOP

(11)

1-Butene when treated with HBr gives

$H_3C-H_2C-HC=CH_2 \xrightarrow{HBr^-}$

Markovnikov Rule

$CH_3-CH_2-\underset{Br}{\underset{|}{CH}}-CH_3$ (2°)

(A) Sec-butyl bromide → C-C(Br)-C-C

(B) n-Butyl bromide C-C-C-C-Br

(C) 1-Bromo butane

(D) 3-Butyl bromide C-C-C-C ✗

QUESTION

Assertion & Reason MCQs

Directions: These questions consist of two statements each, printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(1) A✓ R✓ (2) A✓ R✓ (3) A✓ R× (4) A× R✓

(a) Both Assertion and Reason are True and the Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are True but Reason is not a correct explanation of the Assertion.

(c) Assertion is True but the Reason is False.

(d) Assertion is False but Reason is True.

QUESTION

12.

Assertion (A): The boiling points of alkyl halides decrease in the order: RI > RBr > RCl > RF

Reason (R): The boiling points of alkyl chlorides. bromides and iodides are considerably higher than that of the hydrocarbon of comparable molecular mass.

(1) A✓ R✓

(2) A✓ R✓

(3) A✓ R✗

(4) A✗ R✓

12 Que

Galaxy Test

02.

QUESTION

Q13.

Out of ethyl bromide and ethyl chloride which has higher boiling point and why?

[CBSE 2007]

CH_3CH_2Br CH_3CH_2Cl

$C_2H_5Br > C_2H_5Cl$

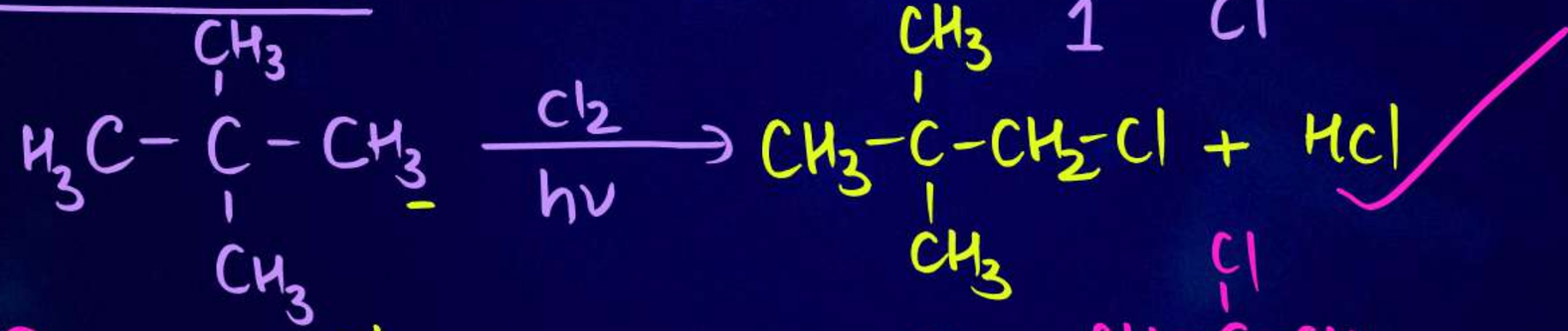
The vander walls forces of attraction are stronger in ethyl bromide than in ethyl chloride, due to bigger size of Br than Cl. Therefore ethyl bromide has higher boiling point than ethyl chloride. (The order of boiling point is RI > RBr > RCl > RF).

QUESTION

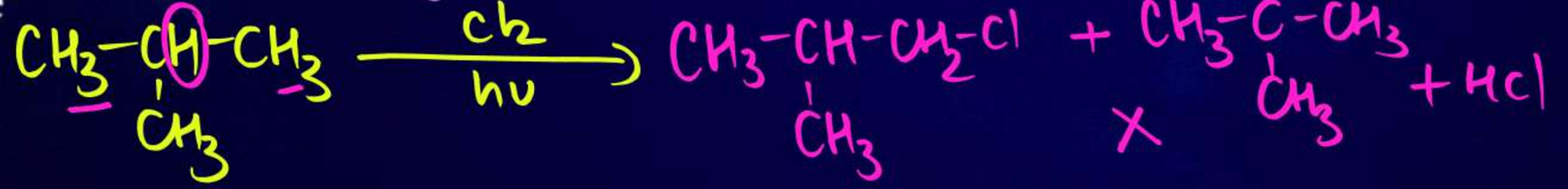
Q14.

Which of the following compounds can yield only one monochlorinated product upon free radical chlorination?

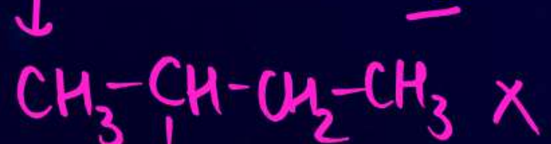
(A) 2, 2-Dimethylpropane



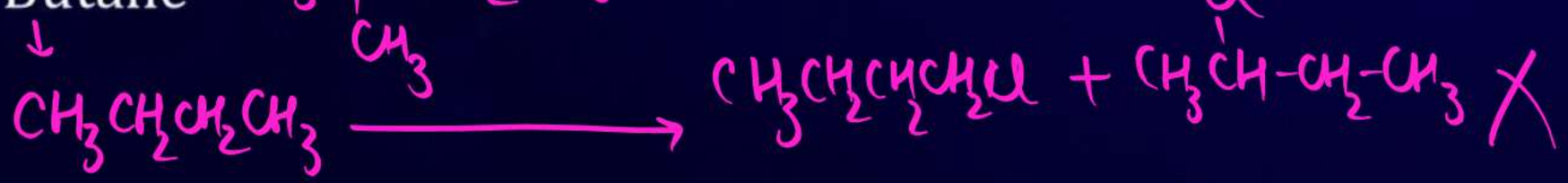
(B) 2-Methylpropane



(C) 2-Methylbutane



(D) n-Butane



Doubts

Q1-14.

1. Bimolecular Nucleophilic substitution Rx.

$$\overset{+s}{R}-\overset{-s}{X} + Nu^- \xrightarrow[\text{aprotic solvent}]{\text{polar}} Nu-R + X^{\ominus}$$

Que. 15.

$$CH_3\overset{+s}{C}H_2\overset{-s}{Cl} + aq.\ \overset{+}{Na}\boxed{\overset{-}{O}H} \longrightarrow OH-CH_2-CH_3 + NaCl$$

Nu^-

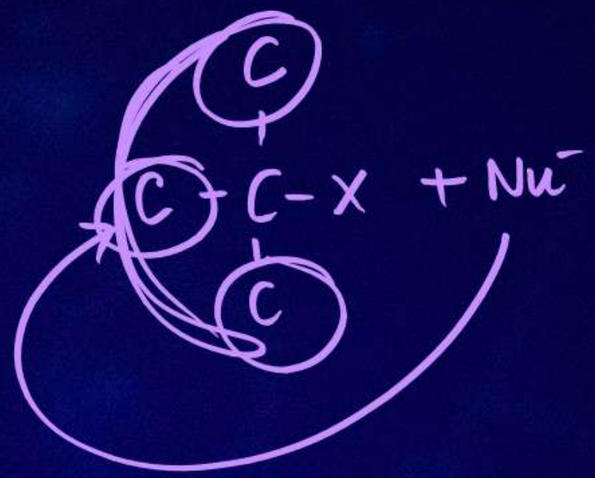
1-chloroethane

ethan-1-ol
or
ethanol

SN_2 Rx

1. It is Bimolecular Nucleophilic Substitution Rx.

   2 Molecules are participating in a Rx. $[Nu^-][R-X]$



2. Rate $\propto [R-X][Nu^-]$

3. It is a single step Rx.

4. Transition state occurs here i.e. Bond formation & bond breakage

5. It occurs in the presence of polar aprotic solvent

6. Order of the Rx $1^\circ > 2^\circ > 3^\circ$

7. Strong Nu^- is Required.

SN1 (Unimolecular Nucleophilic Substitution Rx)

↓

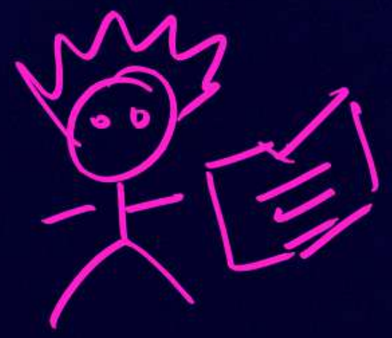
It occurs in two steps :

STEP 1 - Formation of Carbocation

STEP-2- Attack of Nucleophile

Teacher → polar protic solvent

Step-1

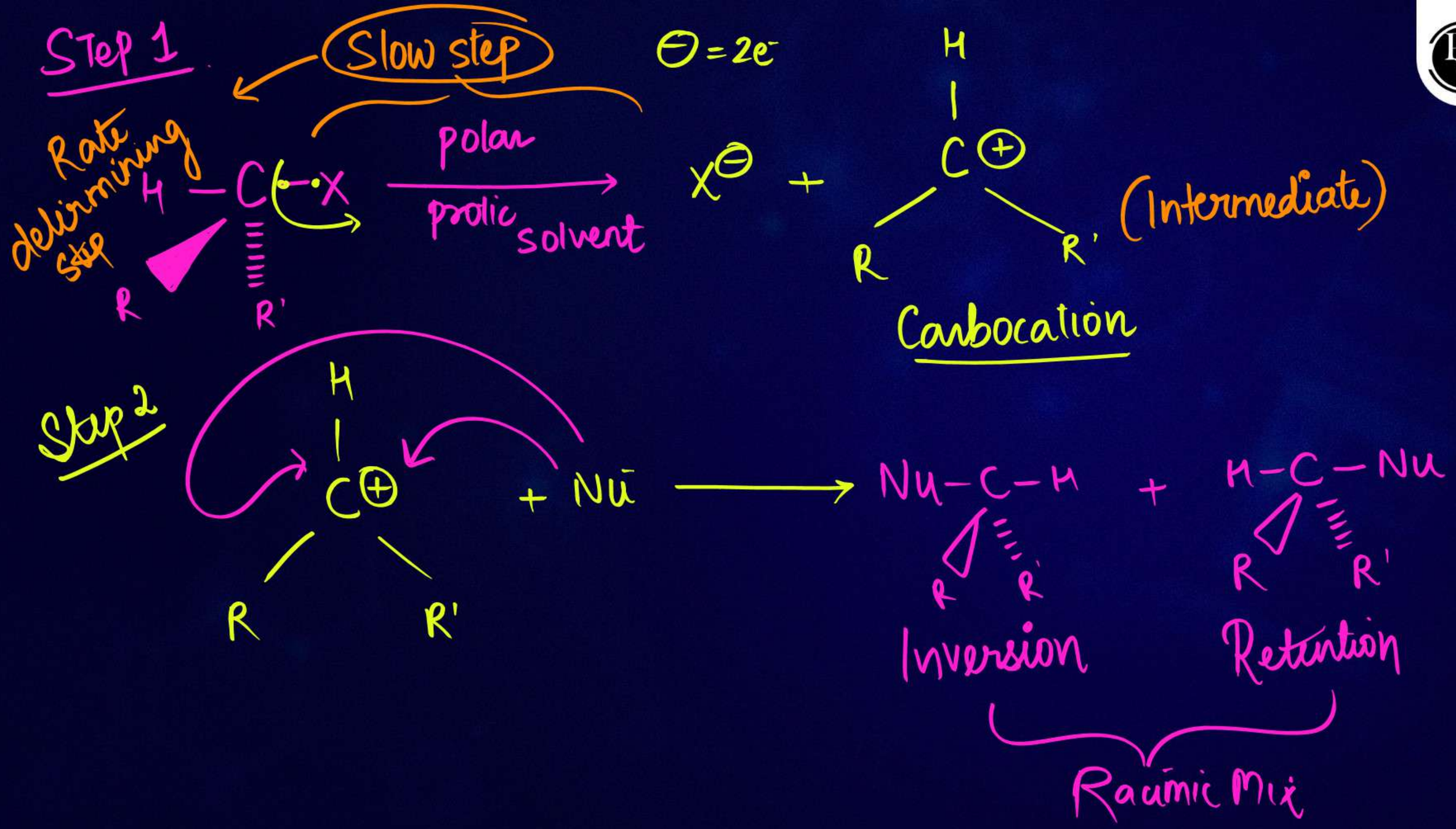


$$R-X \xrightarrow[\text{protic solvent}]{\text{polar}} \underset{\text{Nu}^{\ominus}}{X^{\ominus}} + \underset{\text{Carbocation}}{R^{\oplus}}$$

Step 2

$$R^{\oplus} + Nu^{\ominus} \longrightarrow \text{Inversion} + \text{Retention}$$

$$Nu-R + R-Nu$$


Step 1
Slow step
Rate determining step
polar protic solvent
⊖ = 2e⁻
(Intermediate)
Carbocation
Step 2
Nu⁻
Inversion
Retention
Racemic Mix

SN_1	SN_2
1. It is unimolecular nucleophilic Sub. Rx.	1. Bimolecular
2. It occurs in 2 steps 1) Formation of C^+ 2) Attack of Nu^-	2. one step
3. Polar protic solvent (H_2O) is required.	3. Polar aprotic solvent
4. weak nu^-	4. strong
5. Rate $\propto [RX]$	5. Rate $\propto [RX][Nu^-]$
6. Intermediate ($C^{\oplus}$) is formed.	6. Transition state
7. order of RX $3^\circ > 2^\circ > 1^\circ$	7. $1^\circ > 2^\circ > 3^\circ$
8. Inversion + Retention both are formed	8. Inversion compound is formed.

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HOMEWORK

1) Revise notes

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-9**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. ELIMINATION REACTION & REACTION WITH METALS.
2. CHEMICAL PROPERTIES OF HALOARENES

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

QUESTION

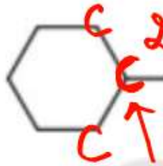
→ SN_2 → 1° > 2° > 3° , SN_1 → 3° > 2° > 1°

Order based que → Paper (past year que)

In the following pairs of halogen compounds, which would undergo S_N2 reaction faster? **Example 6.6**

→ 1° > 2° > 3°

and

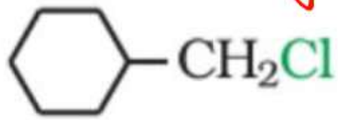


; 2° alkyl halide

1° alkyl halide

and

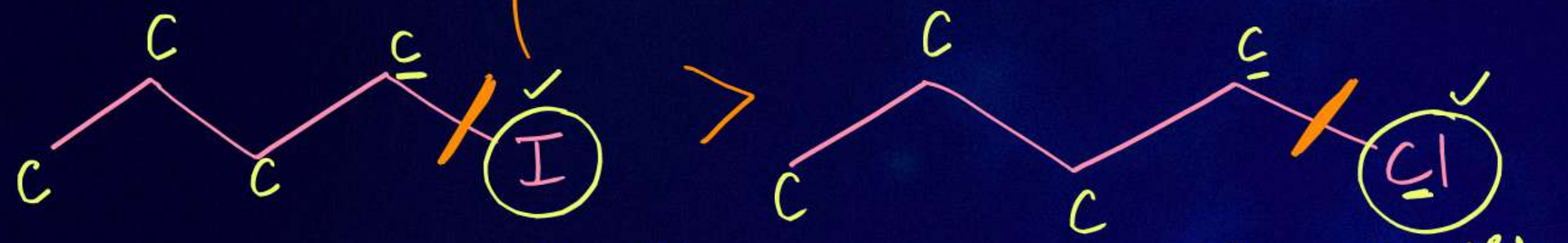
Solution



It is primary halide and therefore undergoes S_N2 reaction faster.

As iodine is a better leaving group because of its large size, it will be released at a faster rate in the presence of incoming nucleophile.

Good Leaving gp



1° alkyl halide

1° alkyl halide

R–F

R–Cl

R–Br

R–I

size ↑

$R-X + Nu^-$

bond length ↑

QUESTION

CUET 2022

SN2

1°

A primary alkyl halide would prefer to undergo

(A) S_N1 reaction

(B) S_N2 reaction

(C) α-elimination

(D) Racemisation

NCERT HIGHLIGHT

$R-X + \bar{N}u \longrightarrow R-Nu + X^-$

R–X +

CN → ambidentate Nu^- → More than one donor site

Reagent (attacking agent)	Nucleophile (Nu^-)	Substitution product R–Nu	Class of main product
NaOH (KOH)	HO^-	ROH	Alcohol
H_2O	H_2O (OH^-)	ROH	Alcohol
NaOR′	$R'O^-$	ROR′	Ether
NaI	I^-	R—I	Alkyl iodide
NH_3	NH_3	RNH_2	Primary amine
$R'NH_2$	$R'NH_2$	RNHR′	Sec. amine
R′R″NH	R′R″NH	RNR′R″	Tert. amine
KCN	$\bar{C}\equiv N:$	RCN	Nitrile (cyanide)
AgCN	Ag—CN:	RNC (isocyanide)	Isonitrile
KNO_2	O=N—O	R—O—N=O (RONO)	Alkyl nitrite
$AgNO_2$	Ag—Ö—N=O	$R—NO_2$	Nitroalkane
R′COOAg	$R'COO^-$	R′COOR	Ester
$LiAlH_4$	H	RH	Hydrocarbon
R'^-M^+	R'^-	RR′	Alkane

KCN → Ionic

AgCN → Covalent

Que.

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NCERT HIGHLIGHT

Mcq | Short | very short

Example 6.5

Haloalkanes react with KCN to form alkyl cyanides as main product while AgCN forms isocyanides as the chief product. Explain.

Solution

KCN is predominantly ionic and provides cyanide ions in solution. Although both carbon and nitrogen atoms are in a position to donate electron pairs, the attack takes place mainly through carbon atom and not through nitrogen atom since C—C bond is more stable than C—N bond. However, AgCN is mainly covalent in nature and nitrogen is free to donate electron pair forming isocyanide as the main product.

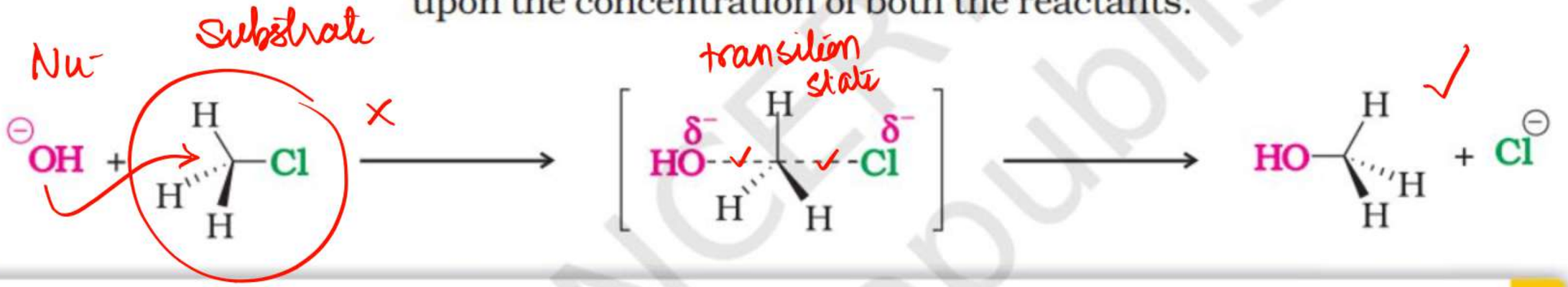
$$\overset{+\delta}{R}-\overset{-\delta}{X} + \overset{+}{K}\underbrace{\overset{-}{CN}}_{Nu^-} \longrightarrow R-CN + KX$$

$$\overset{+\delta}{R}-\overset{-\delta}{X} + \overset{+}{Ag}\underbrace{\overset{-}{CN}}_{Nu^-} \longrightarrow \cancel{R-CN} \quad R-NC + AgX$$

Mechanism: This reaction has been found to proceed by two different mechanims which are described below:

(a) Substitution nucleophilic bimolecular (S_N2)

The reaction between CH_3Cl and hydroxide ion to yield methanol and chloride ion follows a second order kinetics, i.e., the rate depends upon the concentration of both the reactants.



The solid wedge represents the bond coming out of the paper, dashed line going down the paper and a straight line representing bond in the plane of the paper.

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NCERT HIGHLIGHT

nucleophiles. Thus the order of reactivity followed is: SN_2

Primary halide > Secondary halide > Tertiary halide.

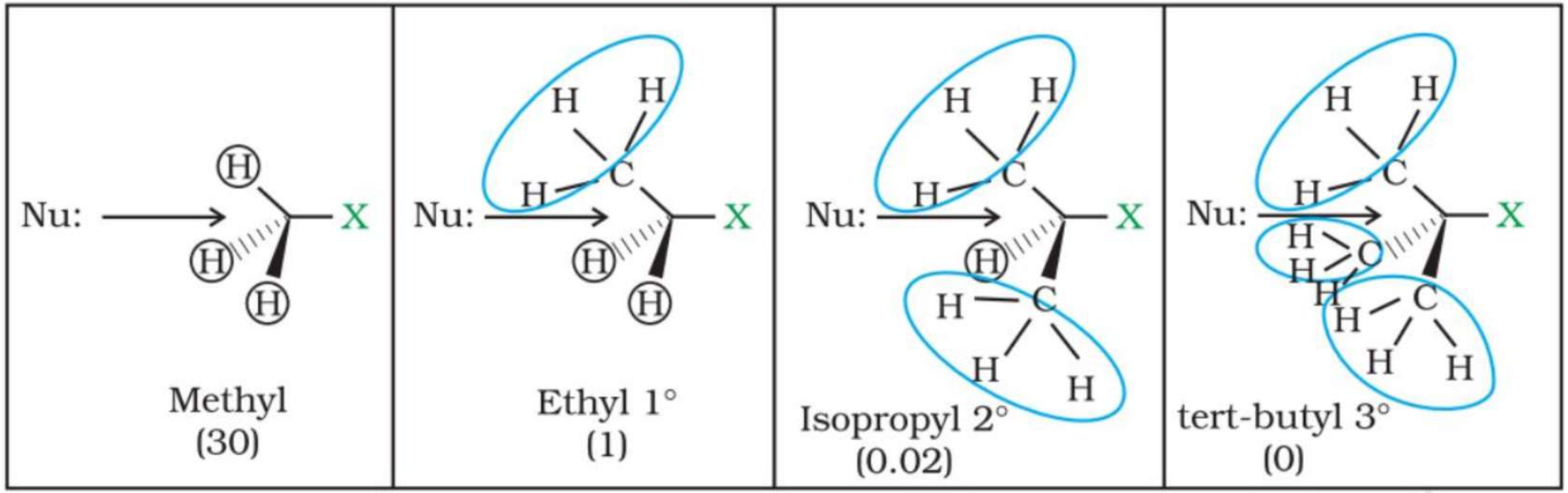


Fig.6.3: Steric effects in S_N2 reaction. The relative rate of S_N2 reaction is given in parenthesis

CHEMICAL PROPERTIES OF HALOALKANES

Observed in Conversion que

(ii) Elimination Rx

↓

β-elimination Rx

Also called dehydrohalogenation reaction

↓

Removal

H → β

X → α

$$\overset{\beta\text{-}C}{CH_3}-\overset{\alpha\text{-}C}{\underset{\underset{Cl}{|}}{CH}}-\overset{\beta\text{-}C}{CH_3} \xrightarrow{\text{alc. KOH}} CH_3-CH=CH_2$$

alkene

α-C $\rightarrow$ X

β-C $\rightarrow$ H

→ It occurs in the presence of alcoholic KOH

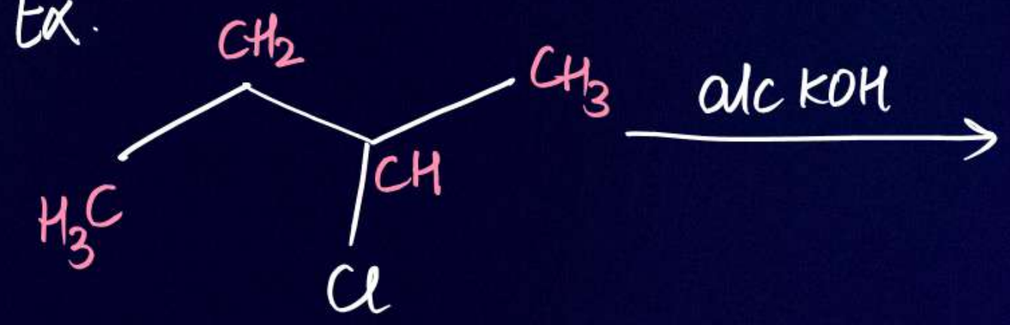
→ Alkene is formed in this Reaction.

→ There is removal of hydrogen & halogen from β-C & α-C respectively. Rx is called dehydrohalogenation Rx.

aq KOH/NaOH → SN_2

alc KOH/NaOH → Elimination Rx

Ex.



$$\overset{4}{CH_3}-\underset{\beta\text{-C}}{\overset{3}{CH_2}}-\underset{\alpha\text{-C}}{\overset{2}{CH}}(Cl)-\underset{\beta\text{-C}}{\overset{1}{CH_3}} \xrightarrow[\beta\text{-elimination}]{\text{alc KOH}}$$

dehydrohalogenation Rx

2-chlorobutane

$$\overset{4}{CH_3}-\overset{3}{\underset{\alpha\text{-C}}{CH_2}}-\overset{2}{CH}=\overset{1}{CH_2} \quad (\alpha\text{-H}=2)$$

but-1-ene (Hoffmann product) (Minor)

$$+\ \overset{4}{CH_3}-\overset{3}{CH}=\overset{2}{CH}-\overset{1}{\underset{\alpha\text{-C}}{CH_3}} \quad (\alpha\text{-H}=6)$$

but-2-ene (Saytzeff product) (Major)

Saytzeff Rule → The compound containing more no of α-H is the Major product, also called saytzeff product and the compound containing less no of α-H is hoffmann product (Minor).

zetseff Rule

CHEMICAL PROPERTIES OF HALOALKANES

(iii) Reaction with Metals

$$R-X + Mg \xrightarrow[\text{ether}]{\text{dry}} \overset{-}{R}-\overset{+}{Mg}X$$

(Grignard Reagent)

Organometallic compound

Highly Reactive

$$\overset{-}{R}-\overset{+}{Mg}X + \underset{(H^+, \bar{O}H)}{H_2O} \longrightarrow R-H + Mg(OH)X$$

(iv) WURTZ RX

$$2\,R-X + 2Na \xrightarrow[\text{ether}]{\text{dry}} 2NaX + R-R$$

Haloalkane — Hydrocarbon

R–X
R–X
2Na

Ex. $2\,CH_3CH_2Cl + 2Na \xrightarrow[\text{ether}]{\text{dry}} 2NaCl + CH_3CH_2CH_2CH_3$

1-chloroethane — butane

$$2\,CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 \xrightarrow[\text{dry ether}]{2Na} 2NaCl + \boxed{\overset{4}{CH_3}-\underset{\underset{CH_3}{|}}{\overset{3}{CH}}-CH_3}\;\boxed{CH_3-\underset{\underset{1}{}}{\underset{\underset{2}{}}{CH}}-CH_3}$$

2-chloropropane

2,3-dimethylbutane

$$CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3 + 2Na \rightarrow CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3$$

Que PYQ

QUESTION

Q1 HW

6.14 Write the structure of the major organic product in each of the following reactions:

(i) $CH_3CH_2CH_2Cl + NaI \xrightarrow[\text{heat}]{\text{acetone}}$

(ii) $(CH_3)_3CBr + KOH \xrightarrow[\text{heat}]{\text{ethanol}}$

(iii) $CH_3CH(Br)CH_2CH_3 + NaOH \xrightarrow{\text{water}}$

(iv) $CH_3CH_2Br + KCN \xrightarrow{\text{aq. ethanol}}$

(v) $C_6H_5ONa + C_2H_5Cl \longrightarrow$

(vi) $CH_3CH_2CH_2OH + SOCl_2 \longrightarrow$

(vii) $CH_3CH_2CH = CH_2 + HBr \xrightarrow{\text{peroxide}}$

(viii) $CH_3CH = C(CH_3)_2 + HBr \longrightarrow$

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QUESTION

Q2 HW

6.16 Arrange the compounds of each set in order of reactivity towards S_N2 displacement:

(i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane

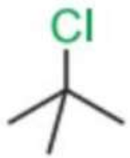
(ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane

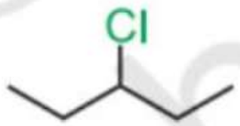
(iii) 1-Bromobutane, 1-Bromo-2,2-dimethylpropane, 1-Bromo-2-methylbutane, 1-Bromo-3-methylbutane.

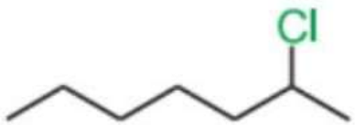
QUESTION

Q3 HW

6.8 In the following pairs of halogen compounds, which compound undergoes faster S_N1 reaction?

(i) 

and 

(ii) 

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FTAFT REVISION

HOMEWORK

1. 12 que to solve
2. Create flowchart of COP of Haloalkanes

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-10**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. CHEMICAL PROPERTIES OF HALOARENES

2. POLYHALOGEN COMPOUNDS

Reactions of Haloarenes

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

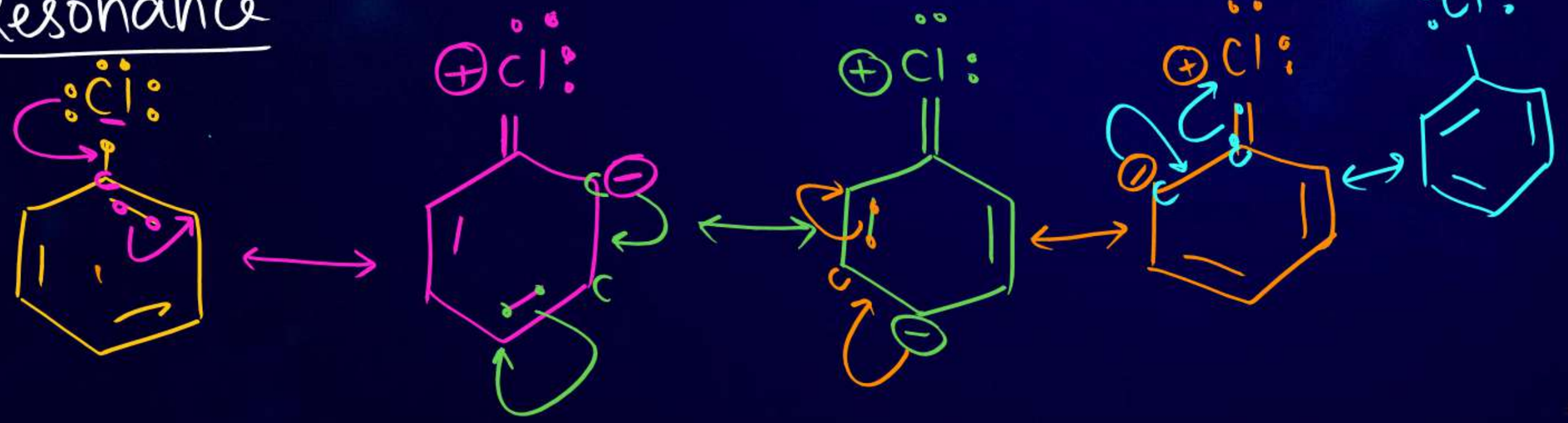
CHEMICAL PROPERTIES OF HALOARENES

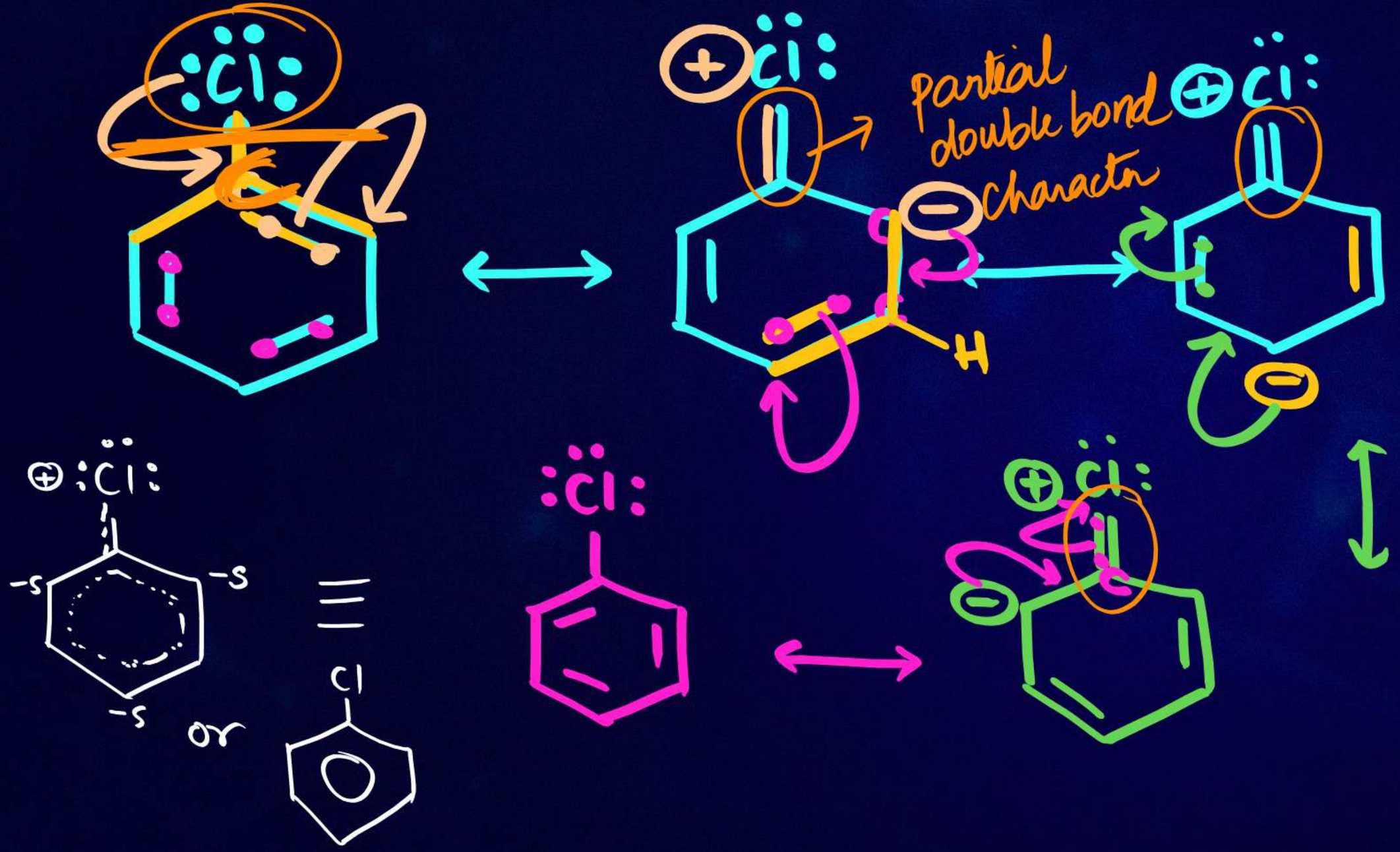
3 Marks

1. NUCLEOPHILIC SUBSTITUTION REACTION

* They are less Reactive towards nucleophilic substitution Reaction. There are the following Reasons-

a) Resonance




partial double bond character
H
or
Cl

$R - X + Nu$

$\hookrightarrow C - X$

C-Cl forms partial double bond which is not easy to break.
Hence Haloarenes are Less Reactive towards SN rx.

(b) Hybridisation

Haloalkane

CH_3-X < Haloarene

sp^3

S% ↓
EN ↓

$3\sigma + 1\,lp$

sp^2

EN ↑↑

It will hold X tightly in comparison to Haloalkane
Hence C-X bond will not break.

% S

$sp > sp^2 > sp^3$

$\frac{100}{2}$ $\frac{100}{3}$ $\frac{100}{4}$

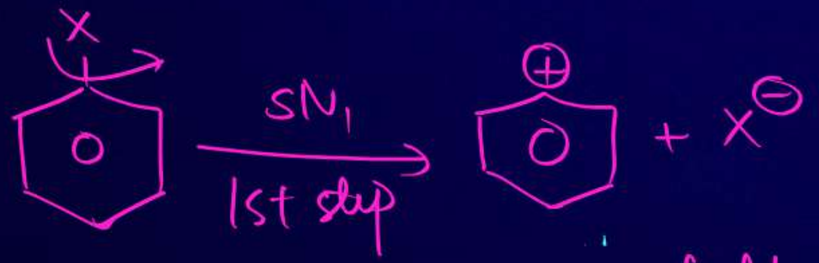
50% 33% 25%

% S ∝ EN

CHEMICAL PROPERTIES OF HALOARENES

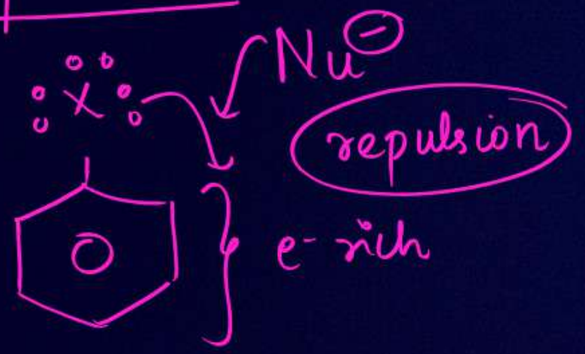
(C) Formation of phenyl cation which is unstable
or
Unstability of phenyl cation

$\boxed{SN_1}$ → In haloalkanes, Carbocation is formed in Rate determining step, which is stable,
but in haloarenes.



in first step, phenyl cation is formed, which is highly unstable.

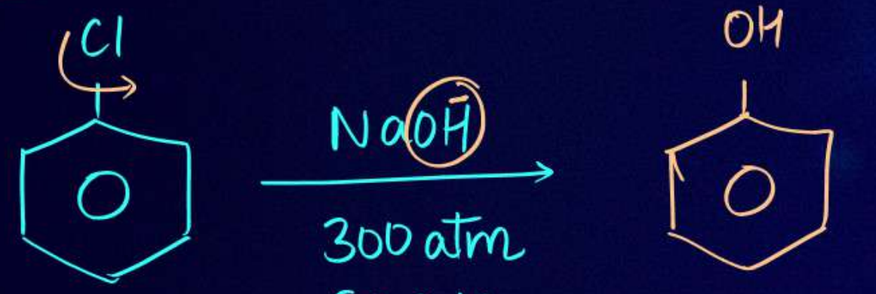
(d) Repulsion



In case of Haloarenes there is e⁻ repulsion b/w Nu^- & Haloarene Hence SN rxn is least Favourable.

Conditions

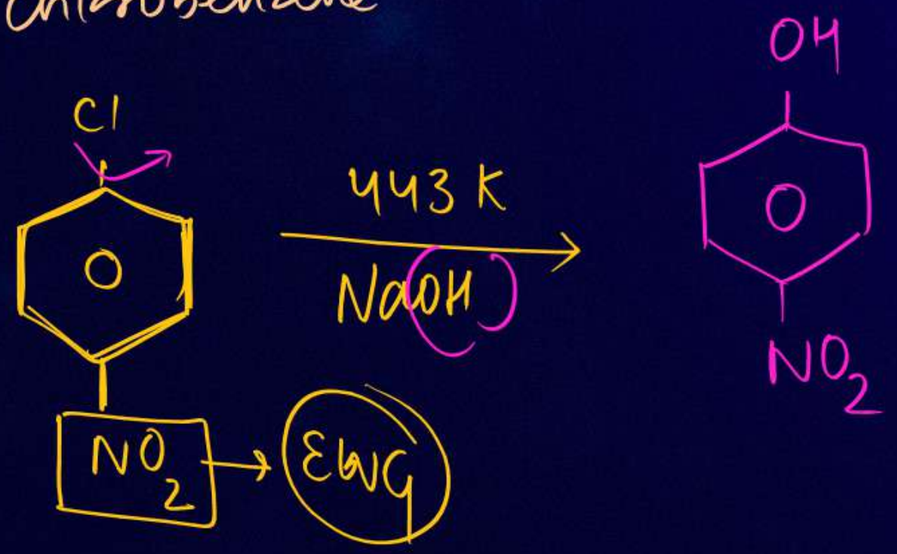
1)



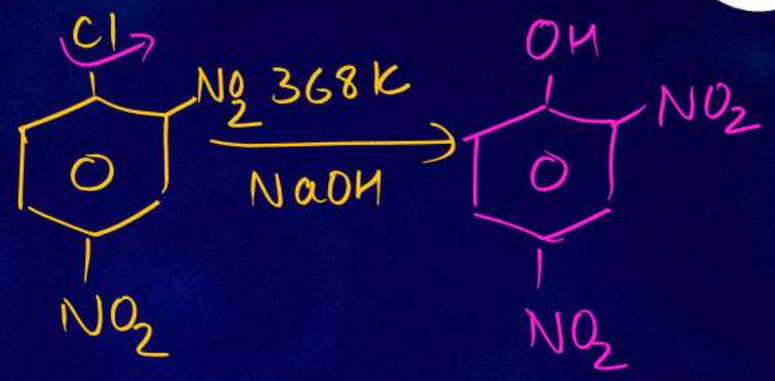
Haloarene
or
1-chlorobenzene

phenol

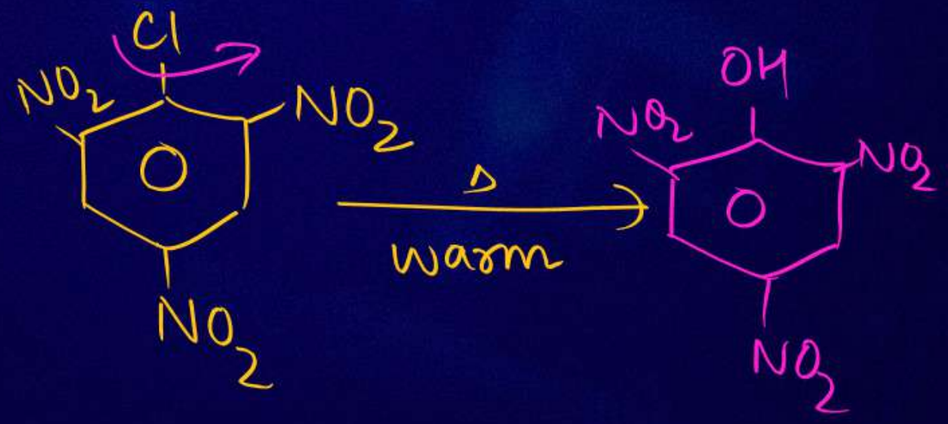
2)

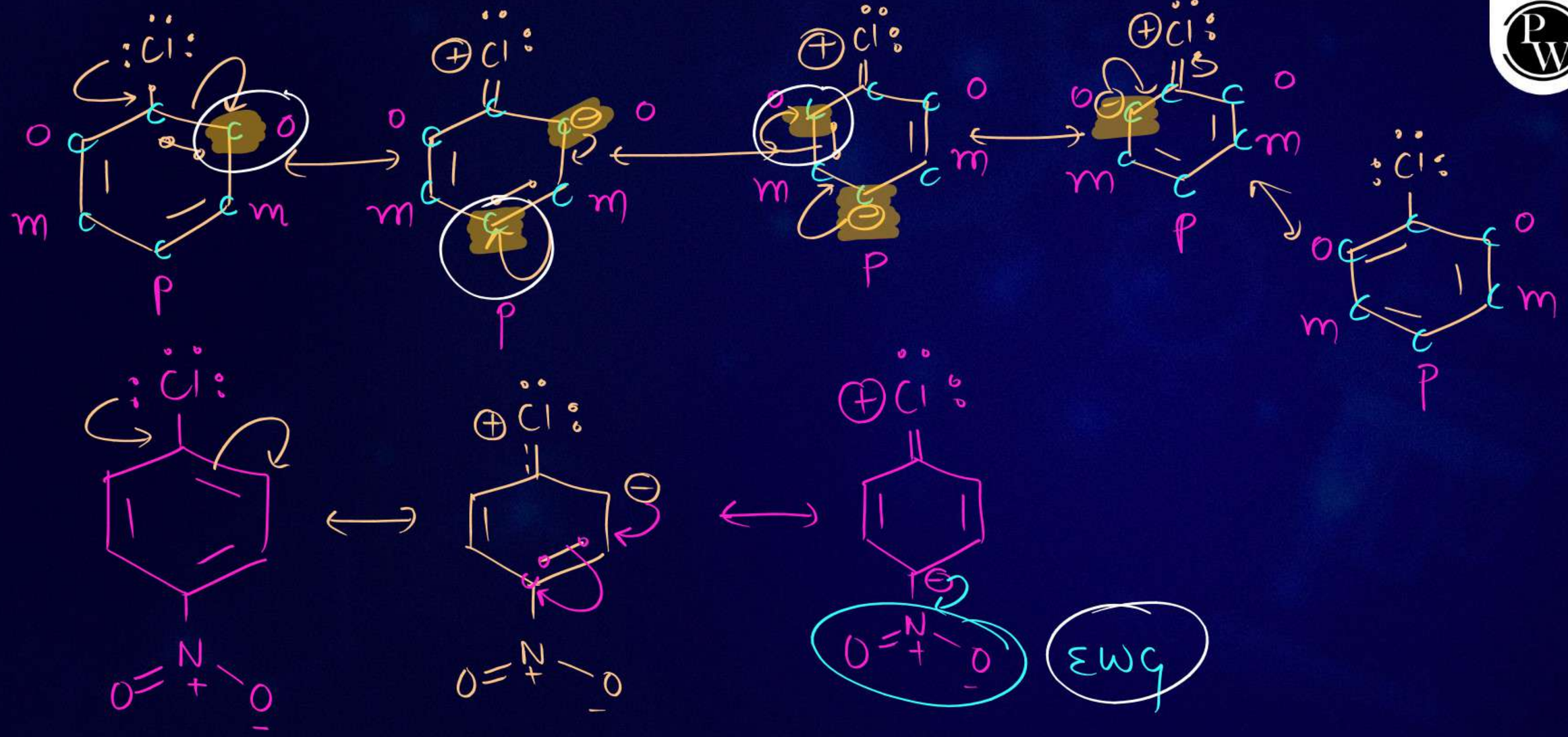


3)



4)




EWG

CHEMICAL PROPERTIES OF HALOARENES

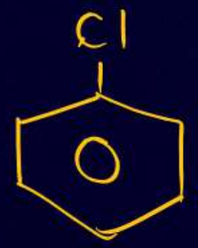
2) Electrophilic substitution Rx

e- loving

$E^{\oplus}$ = Electrophile

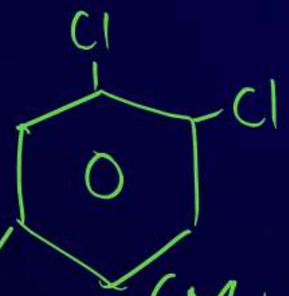
$Cl-Cl \rightarrow Cl^{\ominus} + Cl^{\oplus}$ (Electrophile)

(a) Halogenation



1-chlorobenzene

$\xrightarrow[Cl_2]{\text{anhy } FeCl_3}$

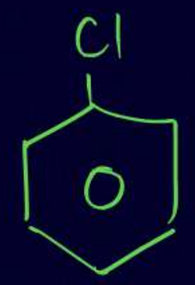


(Minor)
o-dichlorobenzene
1,2-dichlorobenzene

+

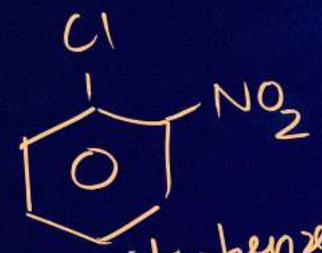
(Major)
p-dichlorobenzene
1,4-dichlorobenzene

2) Nitration



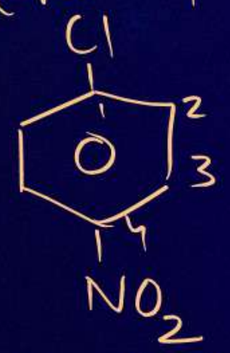
1-chlorobenzene

$$\xrightarrow[H_2SO_4]{HNO_3}$$



1-chloro-2-nitrobenzene (Minor)

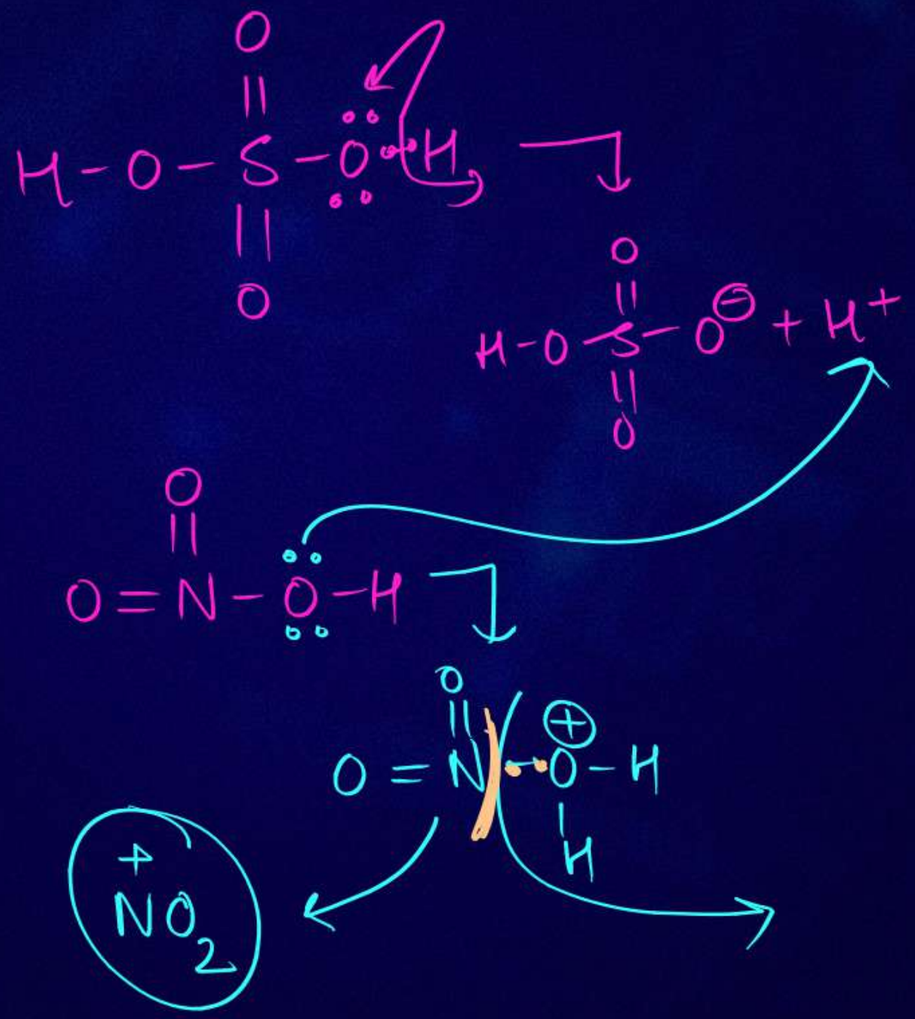
+



1-chloro-4-nitrobenzene (Major)

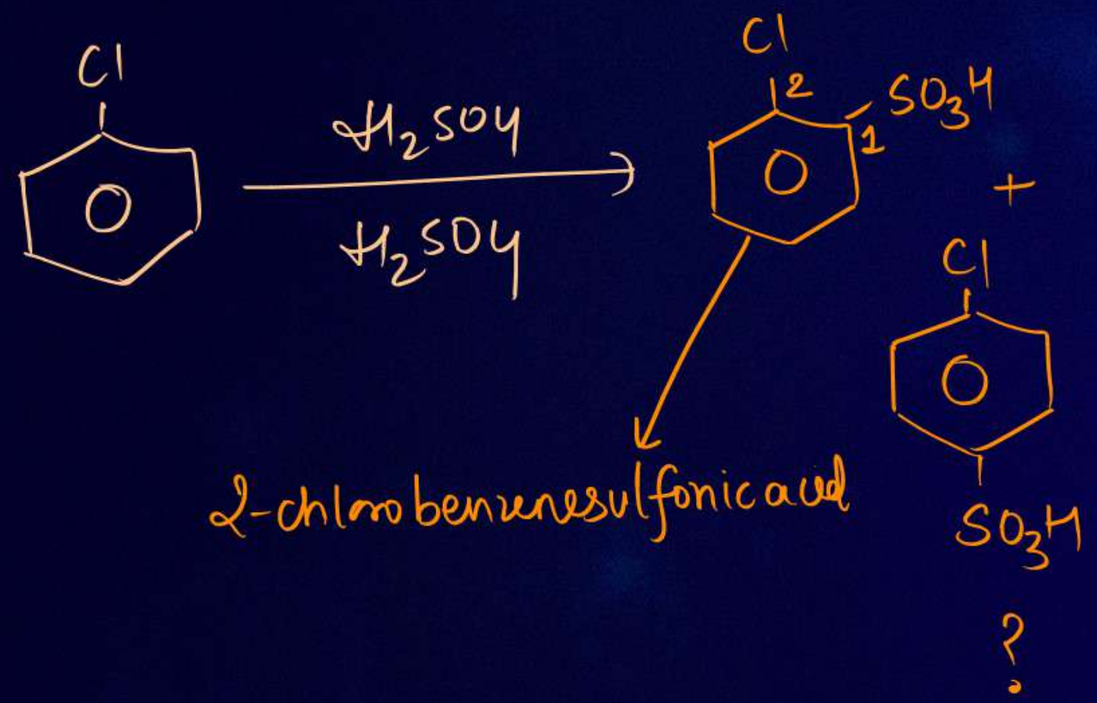
$\overset{+}{N}O_2$

H_2SO_4



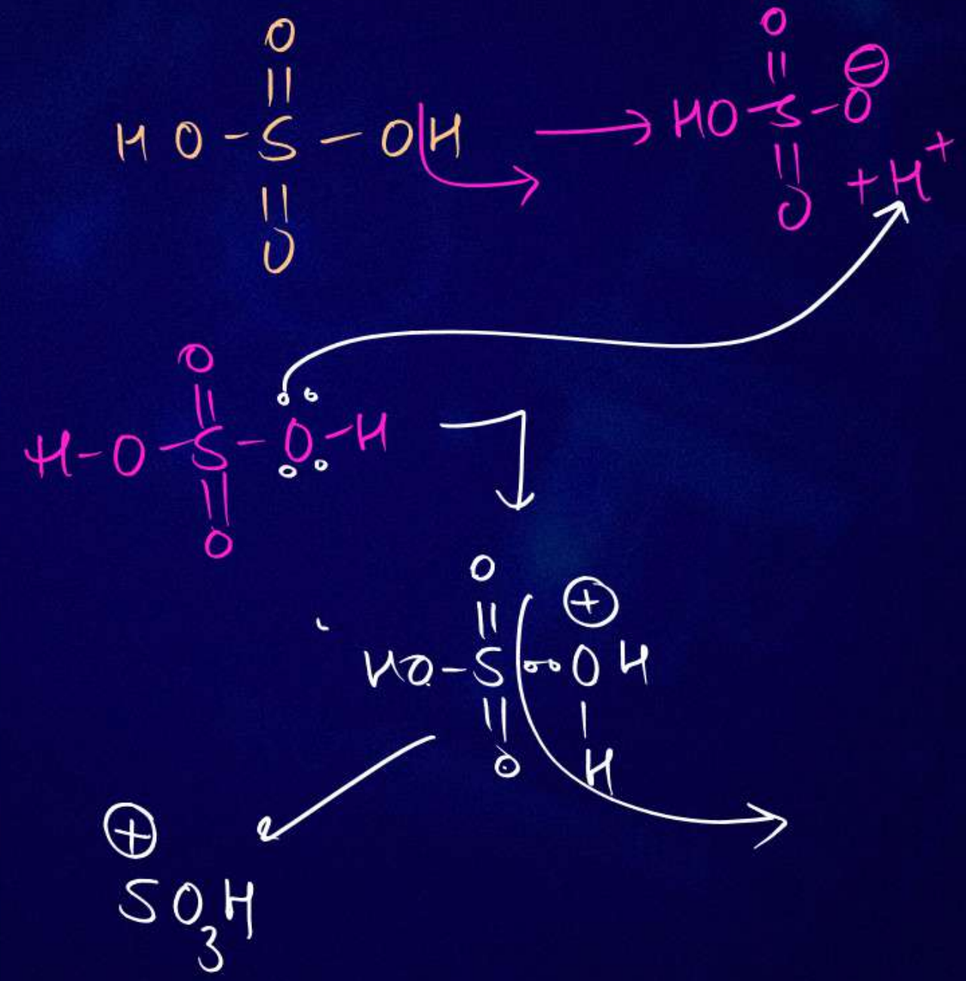
3) Sulphonation

$\overset{+}{S}O_3H$



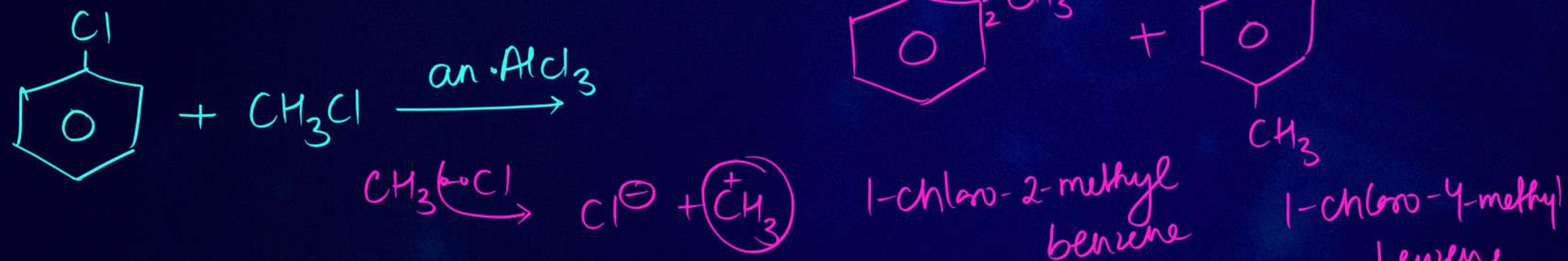
2-chlorobenzenesulfonic acid

H_2SO_4



(4) Friedel Craft Reaction

(a) Friedel craft alkylation

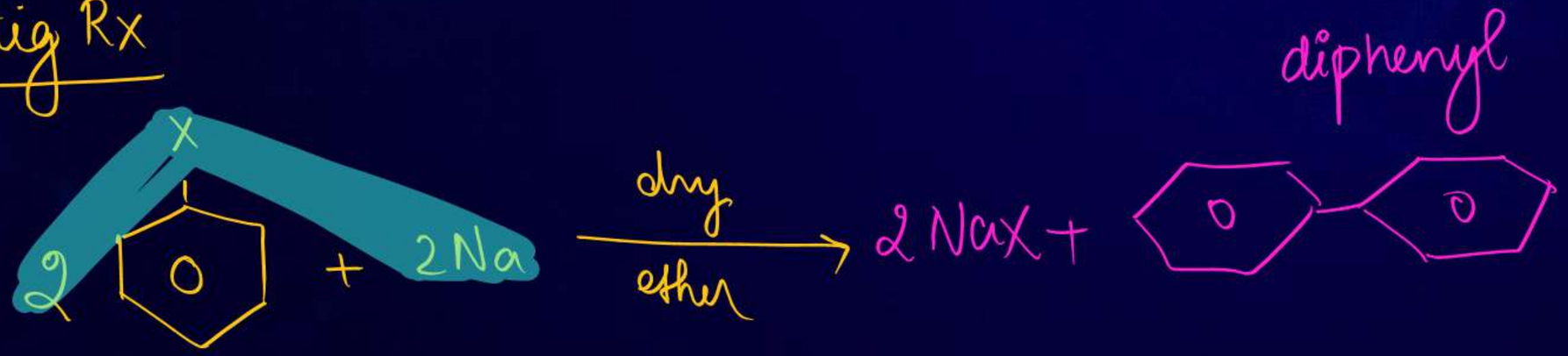


(b) Friedel Craft Acylation ☆

CHEMICAL PROPERTIES OF HALOARENES

3) Wurtz - Fittig Rx

4) Fittig Rx



POLYHALOGEN COMPOUNDS

Polyhalogen Compounds

CH_2Cl_2

Dichloromethane (Methylene chloride)

Carbon compounds containing more than one halogen atom are usually referred to as polyhalogen compounds. Many of these compounds are useful in industry and agriculture. Some polyhalogen compounds are described in this section.

MCQ CUET

Dichloromethane is widely used as a solvent as a paint remover, as a propellant in aerosols, and as a process solvent in the manufacture of drugs. It is also used as a metal cleaning and finishing solvent. Methylene chloride harms the human central nervous system. Exposure to lower levels of methylene chloride in air can lead to slightly impaired hearing and vision. Higher levels of methylene chloride in air cause dizziness, nausea, tingling and numbness in the fingers and toes. In humans, direct skin contact with methylene chloride causes intense burning and mild redness of the skin. Direct contact with the eyes can burn the cornea.

POLYHALOGEN COMPOUNDS

Trichloro-methane (Chloroform)

$CHCl_3$

Chemically, chloroform is employed as a solvent for fats, alkaloids, iodine and other substances. The major use of chloroform today is in the production of the freon refrigerant R-22. It was once used as a general anaesthetic in surgery but has been replaced by less toxic, safer anaesthetics, such as ether. As might be expected from its use as an anaesthetic, inhaling chloroform vapours depresses the central nervous system. Breathing about 900 parts of chloroform per million parts of air (900 parts per million) for a short time can cause dizziness, fatigue, and headache. Chronic chloroform exposure may cause damage to the liver (where chloroform is metabolised to phosgene) and to the kidneys, and some people develop sores when the skin is immersed in chloroform. Chloroform is slowly oxidised by air in the presence of light to an extremely poisonous gas, carbonyl chloride, also known as phosgene. It is therefore stored in closed dark coloured bottles completely filled so that air is kept out.

$$2CHCl_3 + O_2 \xrightarrow{\text{light}} \underset{\text{Phosgene}}{2COCl_2} + 2HCl$$

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POLYHALOGEN COMPOUNDS

Triiodomethane (Iodoform) CHI_3	It was used earlier as an antiseptic but the antiseptic properties are due to the liberation of free iodine and not due to iodoform itself. Due to its objectionable smell, it has been replaced by other formulations containing iodine.
Tetrachloromethane (Carbon tetrachloride) CCl_4	It is produced in large quantities for use in the manufacture of refrigerants and propellants for aerosol cans. It is also used as feedstock in the synthesis of chlorofluorocarbons and other chemicals, pharmaceutical manufacturing, and general solvent use. Until the mid 1960s, it was also widely used as a cleaning fluid, both in industry, as a degreasing agent, and in the home, as a spot remover and as fire extinguisher. There is some evidence that exposure to carbon tetrachloride causes liver cancer in humans. The most common effects are dizziness, light headedness, nausea and vomiting, which can cause permanent damage to nerve cells. In severe cases, these effects can lead rapidly to stupor, coma, unconsciousness or death. Exposure to CCl_4 can make the heart beat irregularly or stop. The chemical may irritate the eyes on contact. When carbon tetrachloride is released into the air, it rises to the atmosphere and depletes the ozone layer. Depletion of the

FTAFT REVISION

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HOMEWORK

1) Revise
2) Complete

PARISHRAM

2026

HALOALKANES & HALOARENES

CHEMISTRY **LECTURE-11**

BY – SHOURYA GROVER MA'AM

TOPICS TO BE COVERED

1. POLYHALOGEN COMPOUNDS PART 2
2. NCERT READING & OPTICAL ISOMERISM
3. CONVERSION & PYQ'S

MY SHIMMERING STARS

#SHOURYA'SGALAXY

START

POLYHALOGEN COMPOUNDS

ozone layer is believed to increase human exposure to ultraviolet rays, leading to increased skin cancer, eye diseases and disorders, and possible disruption of the immune system.

Freons

The chlorofluorocarbon compounds of methane and ethane are collectively known as freons. They are extremely stable, unreactive, non-toxic, non-corrosive and easily liquefiable gases. Freon 12 (CCl_2F_2) is one of the most common freons in industrial use. It is manufactured from tetrachloromethane by **Swarts reaction.** These are usually produced for aerosol propellants, refrigeration and air conditioning purposes. By 1974, total freon production in the world was about 2 billion pounds annually. Most freon, even that used in refrigeration, eventually makes its way into the atmosphere where it diffuses unchanged into the stratosphere. In stratosphere, freon is able to initiate radical chain reactions that can upset the natural ozone balance.

l to g

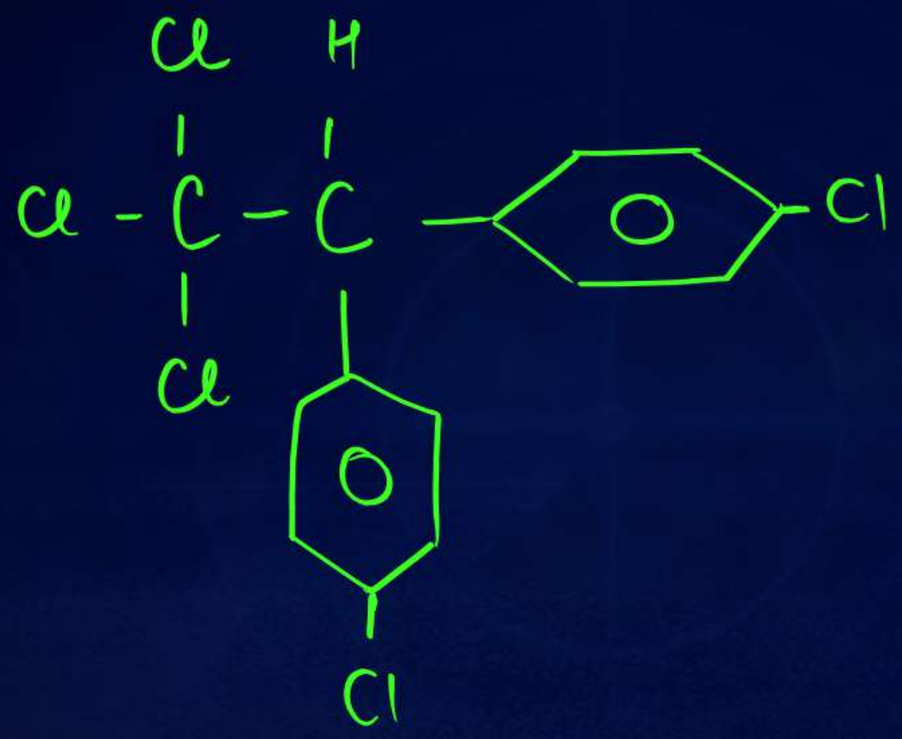
CCl_4

POLYHALOGEN COMPOUNDS

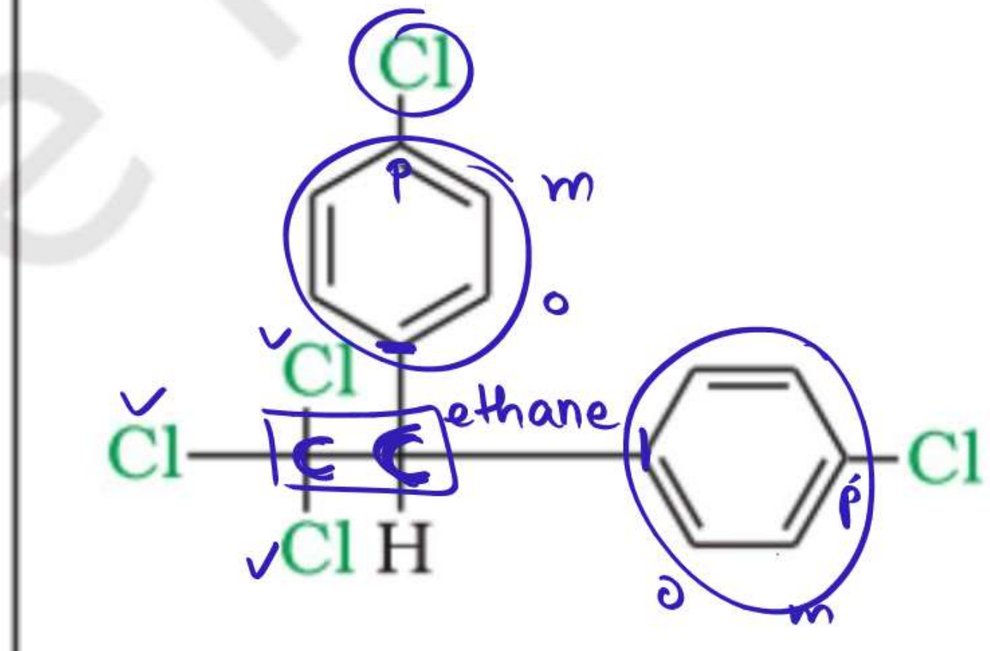
p,p'-Dichlorodiphenyltrichloroethane (DDT)

Structure ☆
Name ☆

DDT, the first chlorinated organic insecticides, was originally prepared in 1873, but it was not until 1939 that Paul Muller of Geigy Pharmaceuticals in Switzerland discovered the effectiveness of DDT as an insecticide. Paul Muller was awarded the Nobel Prize in Medicine and Physiology in 1948 for this discovery. The use of DDT increased enormously on a worldwide basis after World War II, primarily because of its effectiveness against the mosquito that spreads malaria and lice that carry typhus. However, problems related to extensive use of DDT began to appear in the late 1940s. Many species of insects developed resistance to DDT, and it was also discovered to have a high toxicity towards fish. The chemical stability of DDT and its fat solubility compounded the problem. DDT is not metabolised very rapidly by animals; instead, it is deposited and stored in the fatty tissues. If ingestion continues at a steady rate, DDT builds up within the animal over time. The use of DDT was banned in the United States in 1973, although it is still in use in some other parts of the world.


Cl
H
Cl - C - C
Cl
Cl
Cl

POLYHALOGEN COMPOUNDS



DDT

OPTICAL ISOMERISM (NCERT READING)

OPTICAL ISOMERISM (NCERT READING)

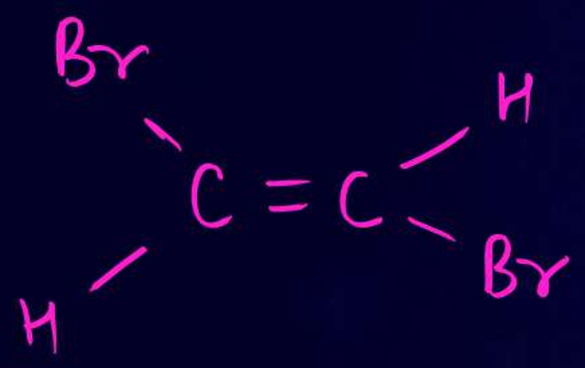
ISOMERISM

same parts

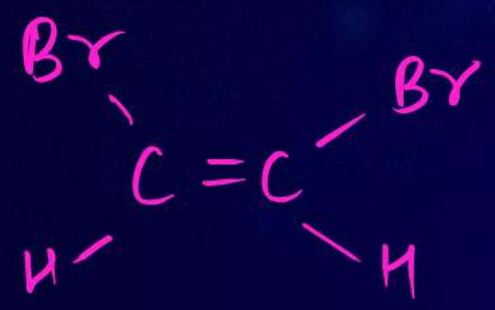
When two compounds have same Molecular Formula but difference in any of one property

- STRUCTURAL (same Molecular Formula difference in Structure)
- STEREOISOMERISM → same Molecular Formula but diff in Spatial arrangement of atoms.
  - ✓ OPTICAL
  - GEOMETRICAL

OPTICAL ISOMERISM (NCERT READING)



trans



cis

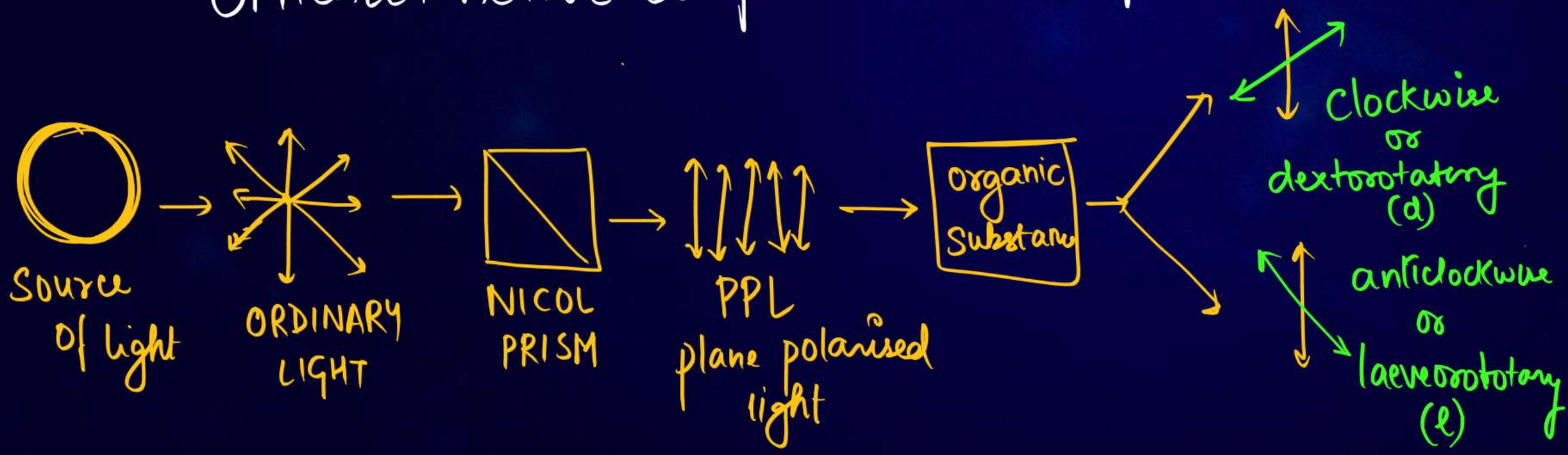
Stereoisomers

OPTICAL ISOMERISM (NCERT READING)

OPTICAL ISOMERISM

↓

OPTICALLY ACTIVE compounds exhibit optical isomerism.



OPTICAL ISOMERISM (NCERT READING)

(c) ***Stereochemical aspects of nucleophilic substitution reactions***
In order to understand the stereochemical aspects of substitution reactions, we need to learn some basic stereochemical principles and notations (**optical activity, chirality, retention, inversion, racemisation**, etc.).

PPL

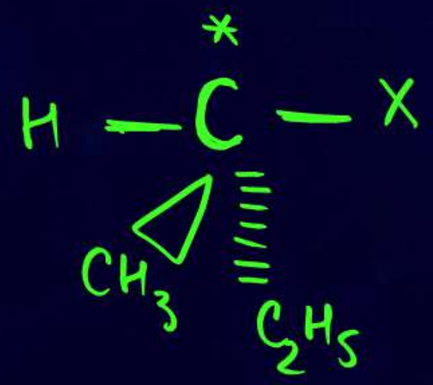
(i) *Optical activity*: Plane of plane polarised light produced by passing ordinary light through Nicol prism is rotated when it is passed through the solutions of certain compounds. Such compounds are called **optically active** compounds. The angle by which the plane polarised light is rotated is measured by an instrument called polarimeter. If the compound rotates the plane of plane polarised light to the right, i.e., clockwise direction, it is called *dextrorotatory* (Greek for right rotating) or the *d*-form and is indicated by placing a positive (+) sign before the degree of rotation. If the light is rotated towards left (anticlockwise direction), the compound is said to be laevo-rotatory or the *l*-form and a negative (–) sign is placed before the degree of rotation. Such (+) and (–) isomers of a compound are called **optical isomers** and the phenomenon is termed as **optical isomerism**.

OPTICAL ISOMERISM (NCERT READING)

Conditions For Optical Activity –

1) presence of atleast one chiral centre.

Chiral Carbon :- A carbon on which 4 different groups are attached.



2) If a compound contains more than 1 chiral carbon

can be

optical Active

optical inactive

We will see symmetry elements

POS

COS

Plane of Symmetry

Centre of Symmetry

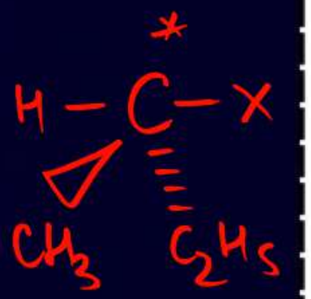
If both are absent → OA

If any one of them is present → OIA

OPTICAL ISOMERISM (NCERT READING)

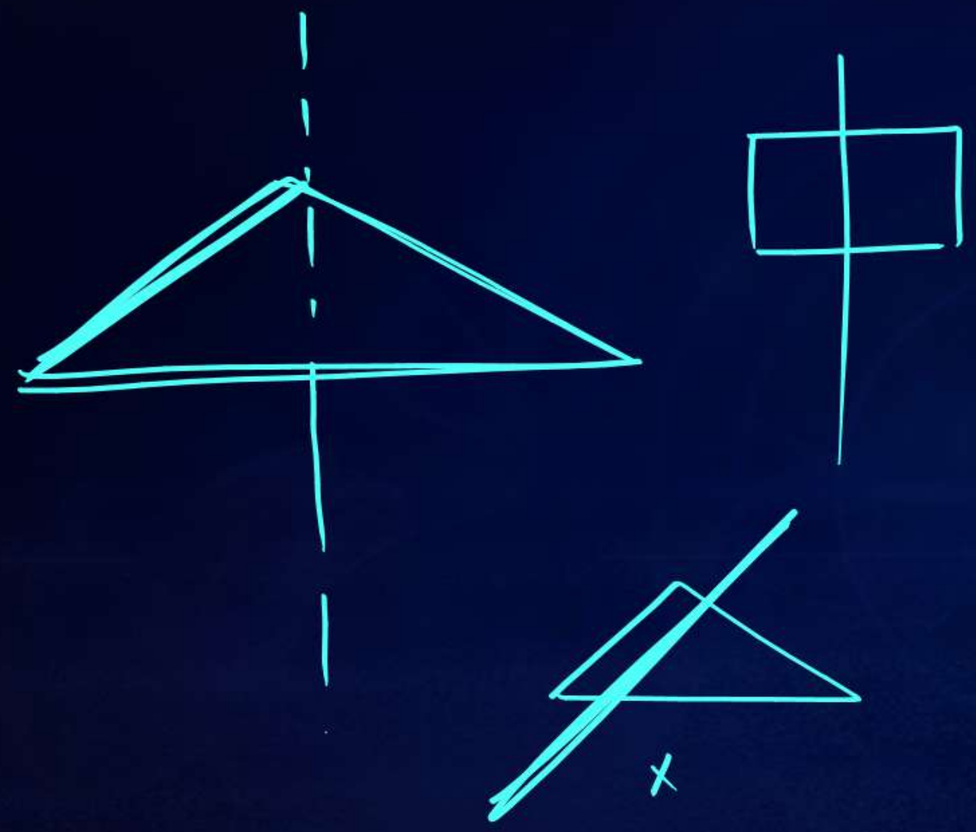
(ii) *Molecular asymmetry, chirality and enantiomers*: The observation of Louis Pasteur (1848) that crystals of certain compounds exist in the form of mirror images laid the foundation of modern stereochemistry. He demonstrated that aqueous solutions of both types of crystals showed optical rotation, equal in magnitude (for solution of equal concentration) but opposite in direction. He believed that this difference in optical activity was associated with the three dimensional arrangements of atoms in the molecules (**configurations**) of

OPTICAL ISOMERISM (NCERT READING)

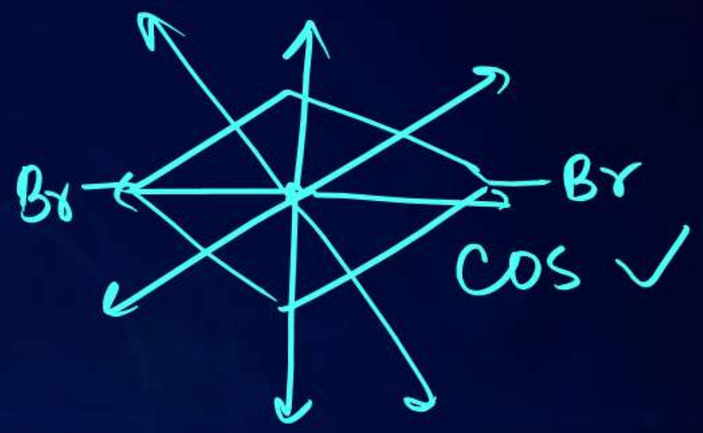


two types of crystals. Dutch scientist, *J. Van't Hoff* and French scientist, *C. Le Bel* in the same year (1874), independently argued that the spatial arrangement of four groups (valencies) around a central carbon is tetrahedral and if all the substituents attached to that carbon are different, the mirror image of the molecule is not superimposed (overlapped) on the molecule; such a carbon is called **asymmetric carbon** or **stereocentre**. The resulting molecule would lack symmetry and is referred to as asymmetric molecule. The asymmetry of the molecule along with non superimposability of mirror images is responsible for the optical activity in such organic compounds.

POS



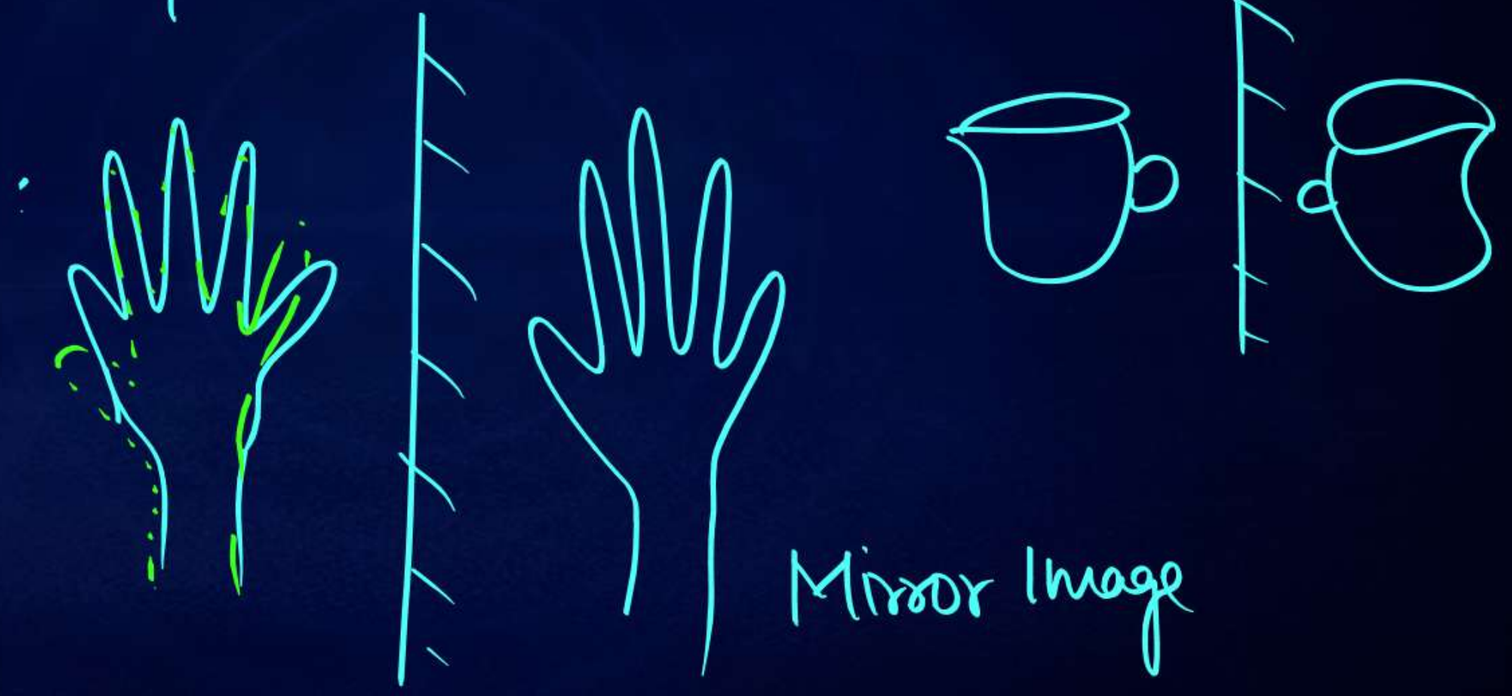
COS



Enantiomers

↓

optical active compounds which non superimposable Mirror Images.



OPTICAL ISOMERISM (NCERT READING)

The symmetry and asymmetry are also observed in many day to day objects: a sphere, a cube, a cone, are all identical to their mirror images and can be superimposed. However, many objects are non superimposable on their mirror images. For example, your left and right hand look similar but if you put your left hand on your right hand by moving them in the same plane, they do not coincide. The objects which are non-superimposable on their mirror image (like a pair of hands) are said to be **chiral** and this property is known as **chirality**. Chiral molecules are optically active, while the objects, which are, superimposable on their mirror images are called **achiral**. These molecules are optically inactive.

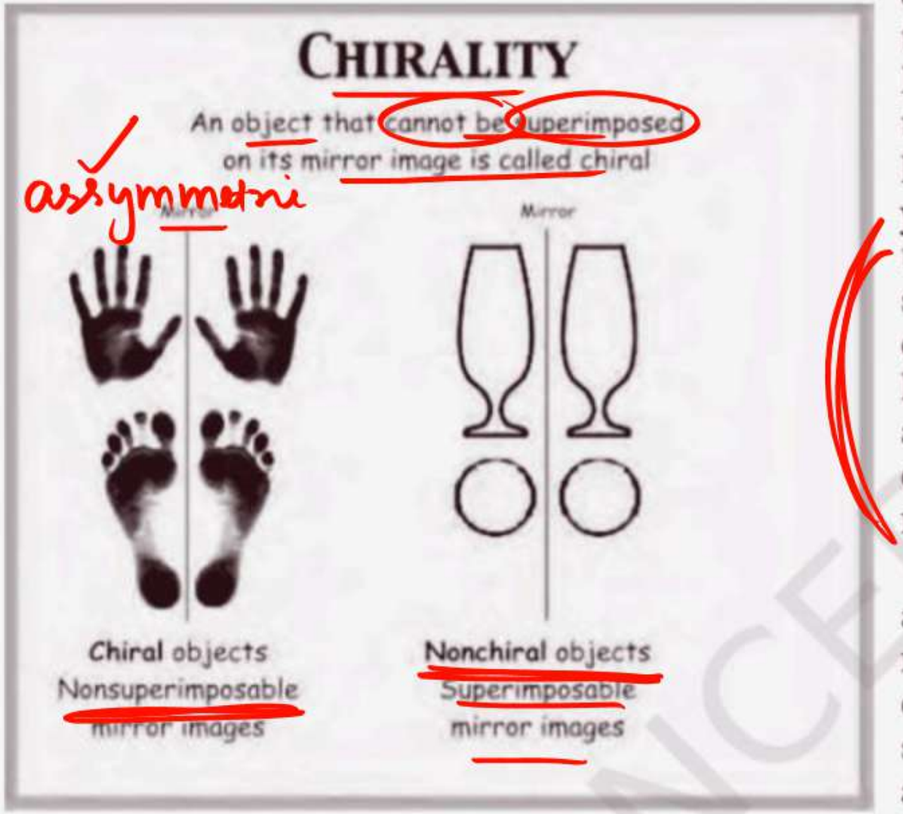


Fig 6.4: Some common examples of chiral and achiral objects

The above test of molecular chirality can be applied to organic molecules by constructing models and its mirror images or by drawing three dimensional structures and attempting to superimpose them in our minds. There are other aids, however, that can assist us in recognising chiral molecules. One such aid is the presence of a single asymmetric carbon atom. Let us consider two simple molecules propan-2-ol (Fig.6.5) and butan-2-ol (Fig.6.6) and their mirror images.

OPTICAL ISOMERISM (NCERT READING)

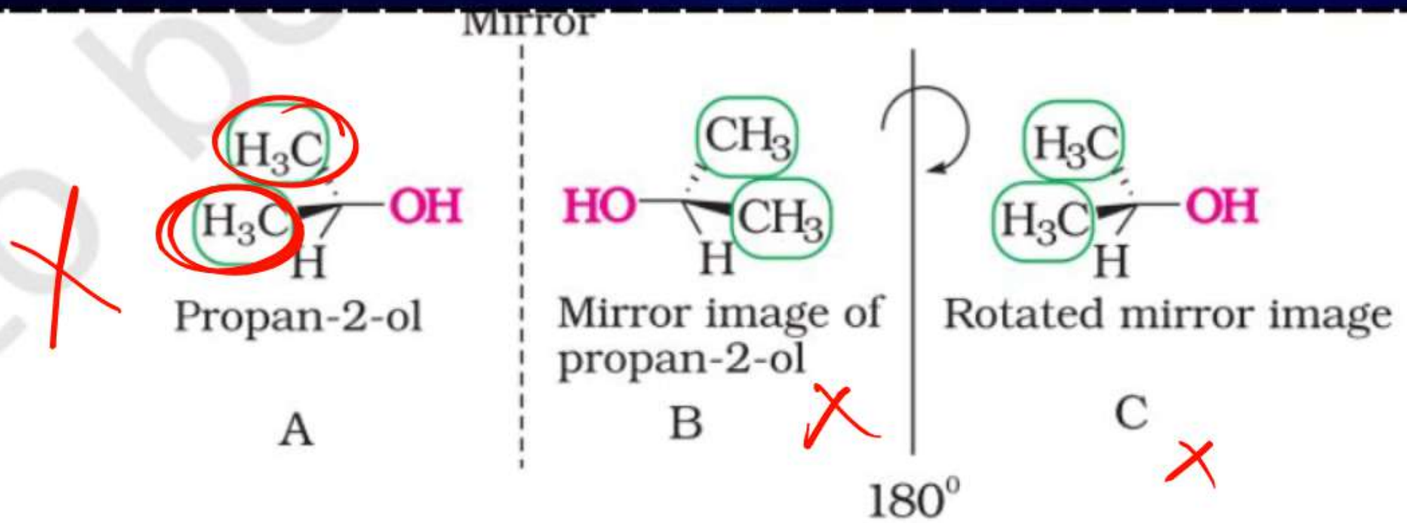


Fig 6.5: *B is mirror image of A; B is rotated by 180° and C is obtained; C is superimposable on A.*

As you can see very clearly, propan-2-ol (A) does not contain an asymmetric carbon, as all the four groups attached to the tetrahedral carbon are not different. We rotate the mirror image (B) of the molecule by 180° (structure C) and try to overlap the structure (C) with the structure (A), these structures completely overlap. Thus propan-2-ol is an **achiral** molecule.

OPTICAL ISOMERISM (NCERT READING)

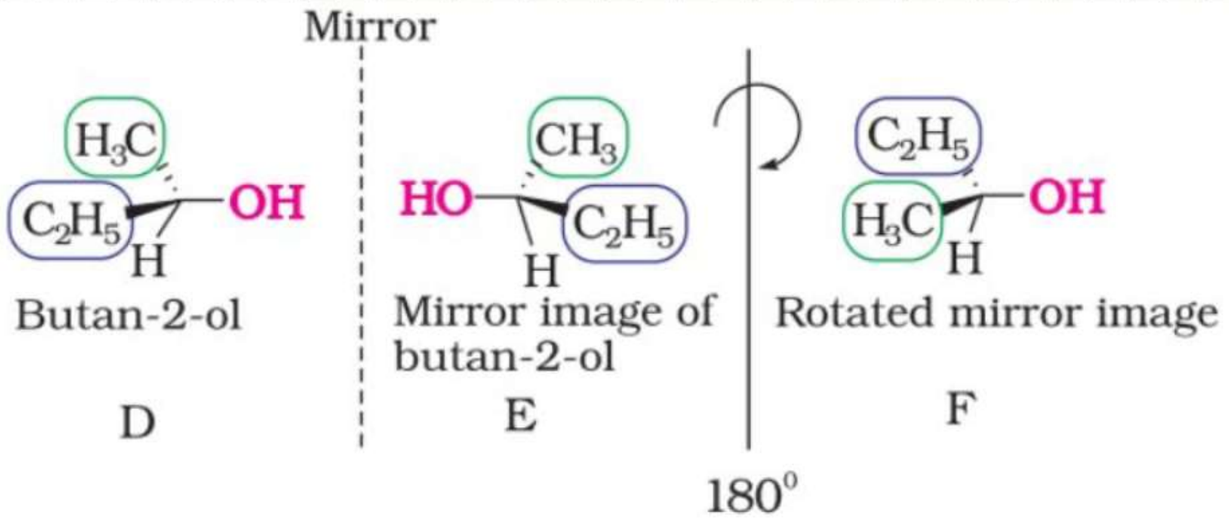


Fig 6.6: E is mirror image of D; E is rotated by 180° to get F and F is non superimposable on its mirror image D.

Butan-2-ol has four different groups attached to the tetrahedral carbon and as expected is **chiral**. Some common examples of chiral molecules such as 2-chlorobutane, 2, 3-dihyroxypropanal, ($OHC–CHOH–CH_2OH$), bromochloro-iodomethane (BrClCHI), 2-bromopropanoic acid ($H_3C–CHBr–COOH$), etc.

OPTICAL ISOMERISM (NCERT READING)

nolecule
or image

The stereoisomers related to each other as non-superimposable mirror images are called **enantiomers** (Fig. 6.7). A and B in Fig. 6.5 and D and E in Fig. 6.6 are enantiomers.

Enantiomers possess identical physical properties namely, melting point, boiling point, refractive index, etc. They only differ with respect to the rotation of plane polarised light. If one of the enantiomer is *dextro rotatory*, the other will be *laevo rotatory*.

However, the sign of optical rotation is not necessarily related to the absolute (actual) configuration of the molecule.

A mixture containing two enantiomers in equal proportions will have zero optical rotation, as the rotation due to one isomer will be cancelled by the rotation due to the other isomer. Such a mixture is known as **racemic mixture** or **racemic modification**. A racemic mixture is represented by prefixing *dl* or (±) before the name, for example (±) butan-2-ol. The process of conversion of enantiomer into a racemic mixture is known as **racemisation.**

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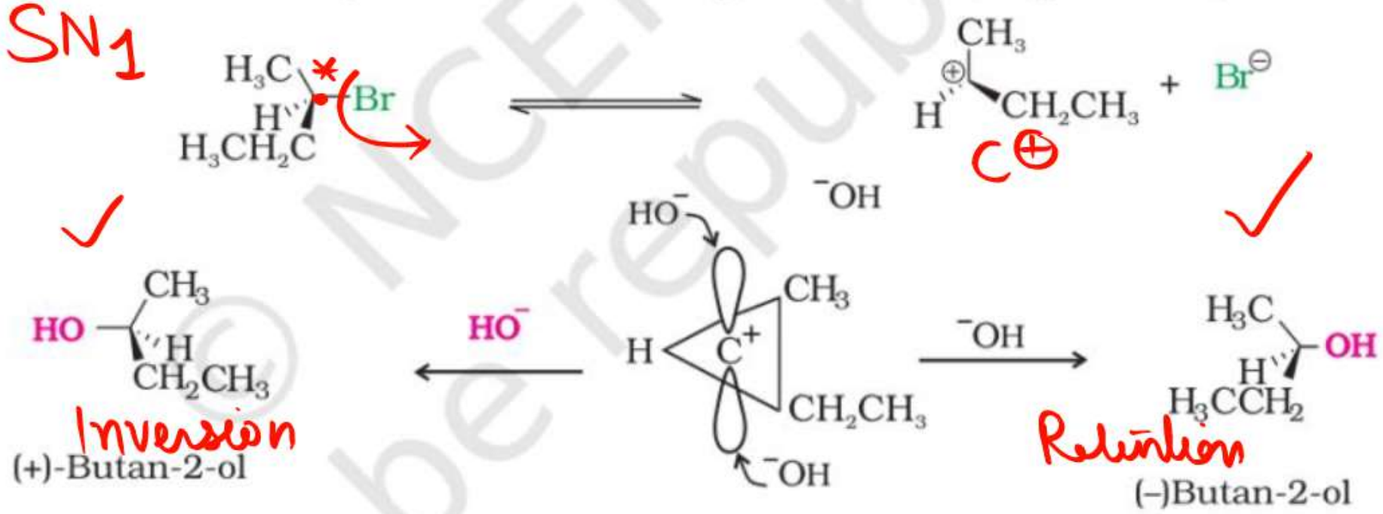
OPTICAL ISOMERISM (NCERT READING)

In case of optically active alkyl halides, S_N1 reactions are accompanied by racemisation. Can you think of the reason why it happens? Actually the carbocation formed in the slow step being sp^2 hybridised is planar (achiral). The attack of the nucleophile may be accomplished from either side of the plane of carbocation resulting in a mixture of products, one having the same configuration (the –OH



attaching on the same position as halide ion) and the other having opposite configuration (the –OH attaching on the side opposite to halide ion). This may be illustrated by hydrolysis of optically active 2-bromobutane, which results in the formation of (±)-butan-2-ol.

and

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CONVERSIONS

QUESTIONS

1) Chloroethane to butane

$$CH_3-CH_2-Cl \xrightarrow[\text{dry ether}]{+2Na} CH_3CH_2CH_2CH_3 + 2NaCl$$

CH_3CH_2Cl

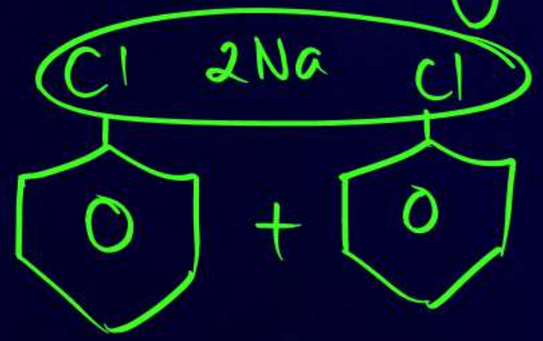
CH_3CH_2Cl

$2Na$

QUESTIONS

2) Chlorobenzene to diphenyl

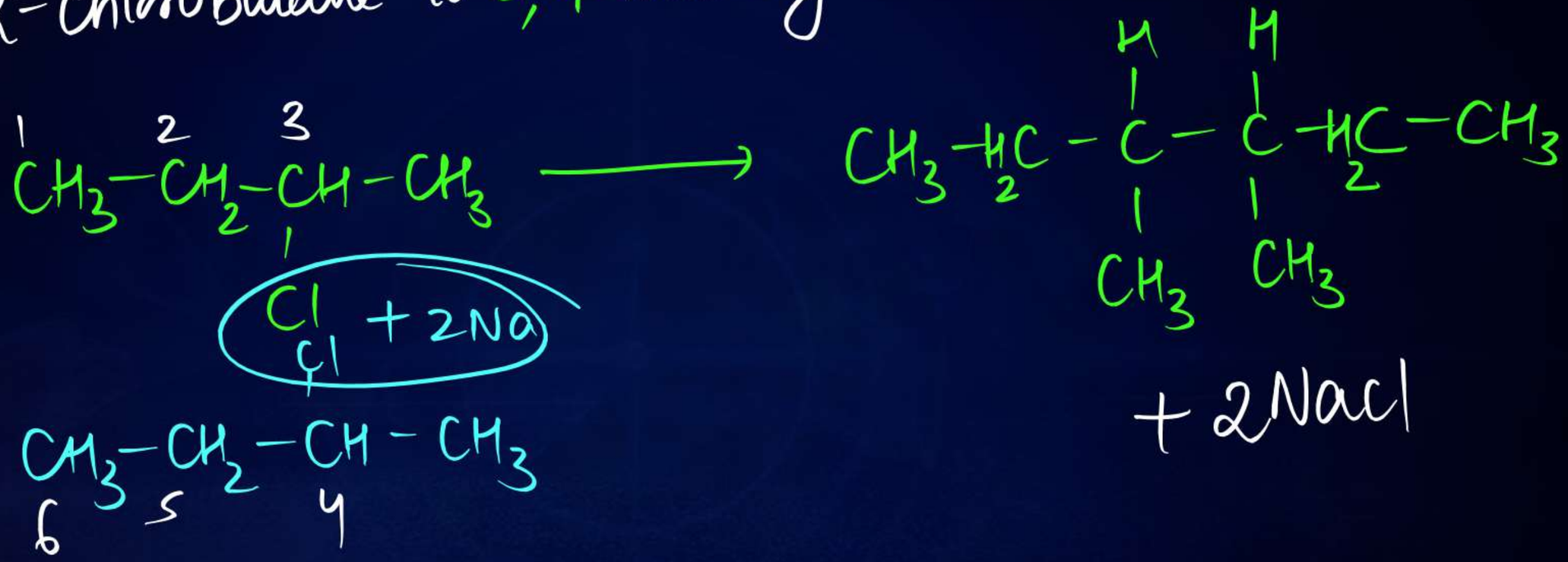
Fittig Rx



3) 1-chlorobutane $\longrightarrow$ n-octane

$$CH_3CH_2CH_2CH_2-Cl \xrightarrow[\text{dry ether}]{\text{Wurtz Rx} + 2Na} CH_3CH_2CH_2CH_2CH_2CH_2CH_3 + 2NaCl$$

4) 2-chlorobutane to 3,4-dimethylhexane

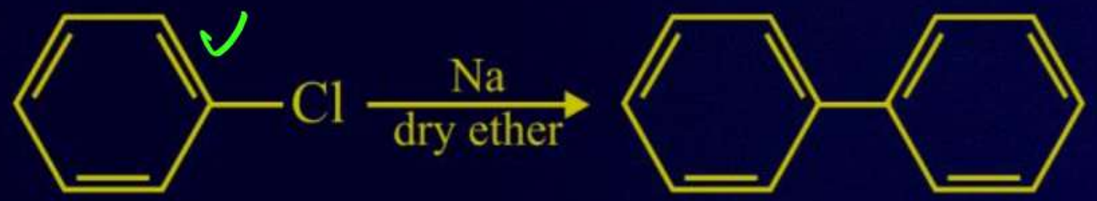


PYQ'S

QUESTIONS

Consider the following reaction:

[CUET 2023]



Name of the reaction is:

(A) Balz-Schiemann reaction

(B) Wurtz reaction

(C) Wurtz-Fitting reaction

(D) Fitting reaction

QUESTIONS

Which of the following compound is chiral in nature?

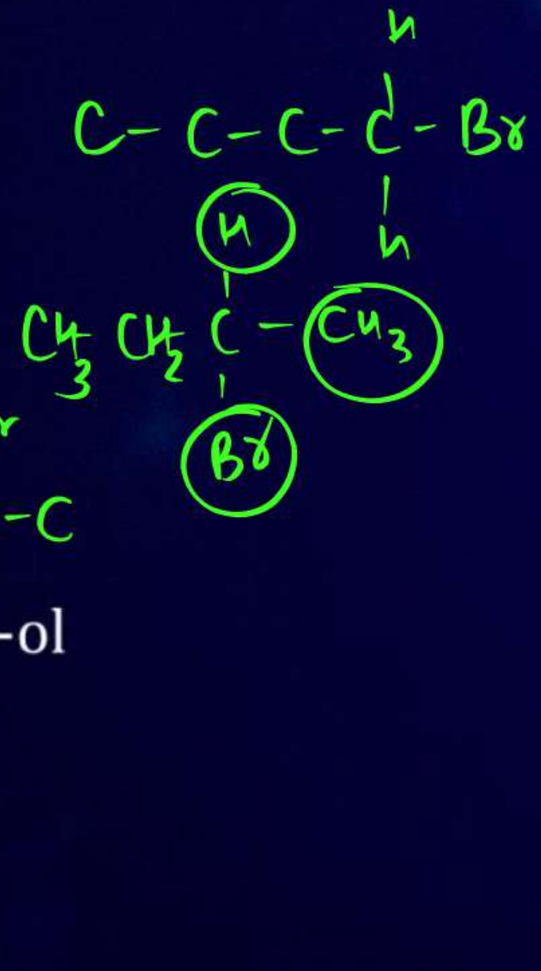
[NTA CUET 2022]

(A) 1-Bromobutane

(B) 2-Bromobutane

(C) 2-Bromopropane

(D) 2-Bromopropan-2-ol



QUESTIONS

POLYHALOGEN COMPOUNDS

Which of the following organic halogen compound is used as refrigerant in refrigerators and air conditioners?

(A) BHC

(B) CCl_3

(C) Freon

(D) $CHCl_3$

QUESTIONS

POLYHALOGEN COMPOUNDS

Which compound from the following is used for metal cleaning and finishing?

(A) $CHCl_3$

(B) CHI_3

(C) CH_2Cl_2

(D) C_6H_6Br

QUESTIONS

Write the following:

(i) Allylic halogenation

(ii) Markovnikov's rule **(iii) Kharasch effect**

(iv) Swarts reaction **(v) Finkelstein reaction** **(vi) Hundsdiecker reaction**

(vii) Sandmeyer reaction **(viii) Preparation of Iodobenzene**

(ix) Balz-Schiemann reaction Next chap

(x) Gattermann reaction

Next chp

QUESTIONS

(i) Allylic halogenation:

Reaction in which halogenation occurs at the allylic position of alkene are called allylic halogenation reaction. It occurs in alkene other then ethane.

Example:

$$\underset{\text{Propene}}{CH_3-CH=CH_2}+Cl_2\rightarrow \underset{\text{3-Chloroprop-1-ene}}{Cl-CH_2-CH=CH_2}+HCl$$

(ii) Markovnikov's rule: The addition of unsymmetrical reagents like HX, H_2O etc. to unsymmetrical alkenes occurs in such a way that the negative part of addition molecule does to that carbon atom of the double bond which carries lesser number of hydrogen atoms. Example:

$$CH_3CH=CH_2+\overset{\delta+}{H}\,\overset{\delta-}{I}\rightarrow \underset{(\text{minor})}{CH_3CH_2CH_2I}+\underset{(\text{major})}{CH_3CHICH_3}$$

QUESTIONS

antimarkovnikov

(iii) Kharasch effect:

In presence of peroxide like benzyl perixode (C6H5CO–O–O–COC_6H_5), the addition of HBr to unsymmetrical alkenes takes place opposite to Markovnikov's rule. This is known as Peroxide effect or Kharasch effect.

Example:

$$\underset{\text{Propene}}{CH_3CH=CH_2} + HBr \xrightarrow{(C_6H_5COO)_2} \underset{\text{1-Bromopropane}}{CH_3CH_2-CH_2Br}$$

(iv) Swarts reaction:

Synthesis of alkylk fluoride (fluoroalkane) by heating an alkyl chloride/bromide in the presence of metallic fluoride like AgF, Hg_2F_2 or SbF_3 is called Swarts reaction.

$$H_3C-Br + AgF \rightarrow H_3C-F + AgBr$$

(v) Finkelstein reaction

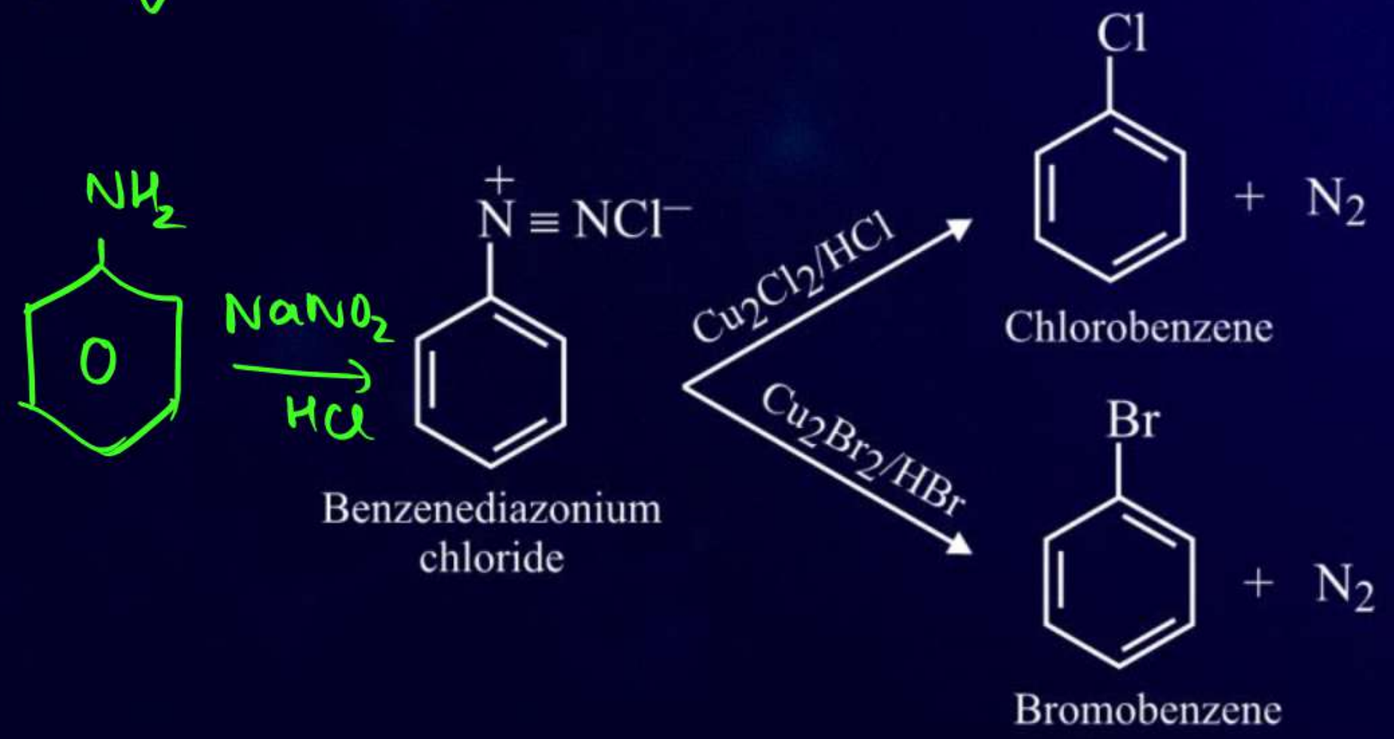
Preparation of alkyl iodide by the reaction of alkyl chlorides/bromides with NaI in dry acetone is known as finkelstein reaction.

$$R-Cl + NaI \rightarrow R-I + NaCl$$

(vi) Hundsdiecker reaction:

$$\underset{\text{Silver propanoate}}{CH_3CH_2COOAg} + Br_2 \xrightarrow{CCl_4,\ \text{Reflux}} \underset{\text{Bromoethane}}{CH_3CH_2-Br} + CO_2 + AgBr$$

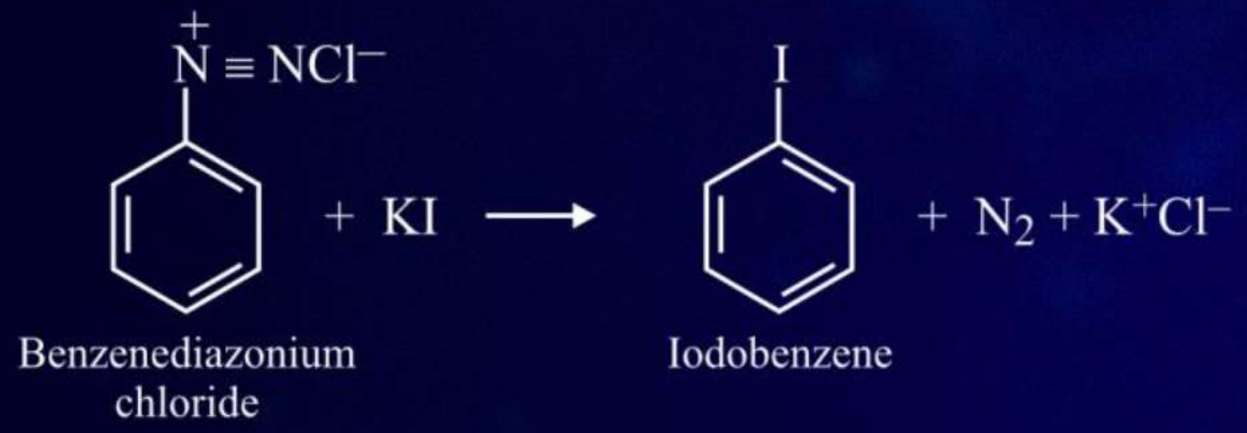
(vii) Sandmeyer reaction



QUESTIONS

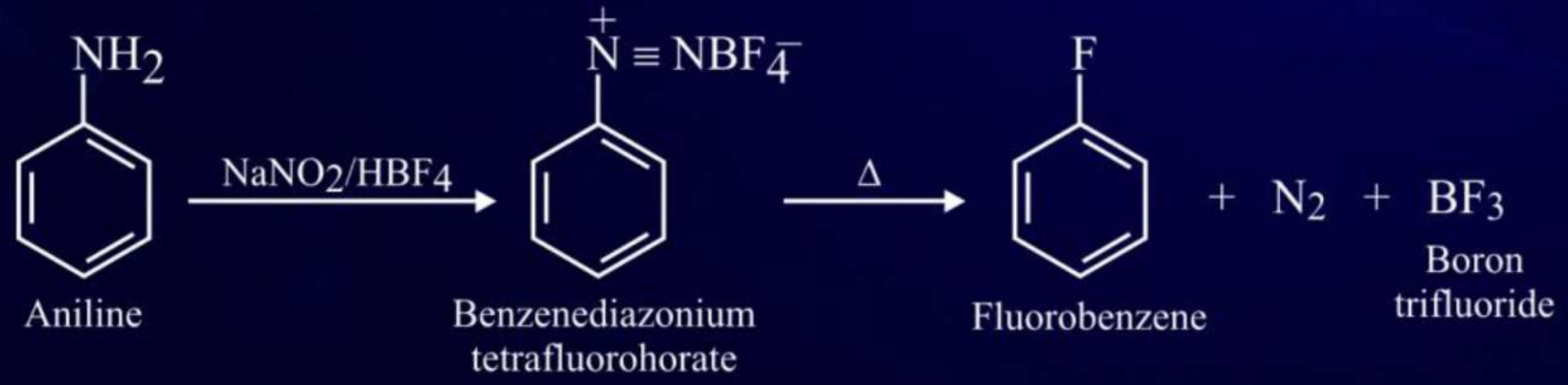
(viii) Preparation of Iodobenzene

next

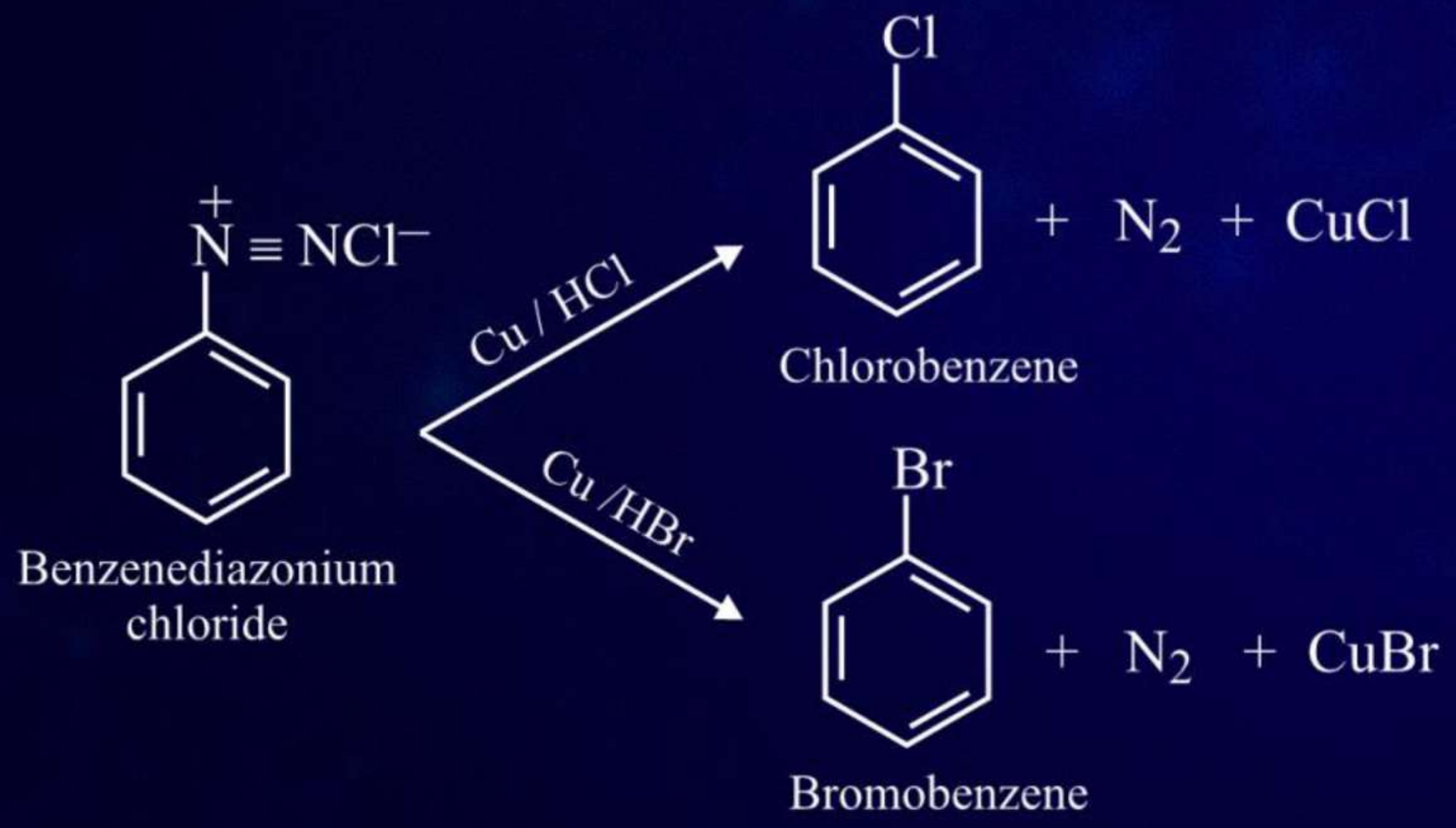


(ix) Balz-schiemann reaction:

(Preparation of fluorobenzene)



(x) Gattermann reaction:



QUESTIONS

What is a racemic mixture? Give one example. **[CBSE 2011, 13]**

Inversion | Retention

OA + nonsuperimposable

Mirror Image

A 50 : 50 mixture of two enantiomers of any optically active compound is called a racemic mixture. It is optically inactive. Since rotation caused by the molecules of one enantiomer exactly cancelled by equal and opposite rotation caused by the same molecules of the other enantiomers. For example an equimolar mixture of (+) –2-bromobutane and (–)-2-bromobutane.

RM

QUESTIONS

R-Cl + aq. KOH ⟶ R-OH

The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohols but in presence of alcoholic KOH, alkenes are the major products. Explain why?

R-Cl + alc KOH

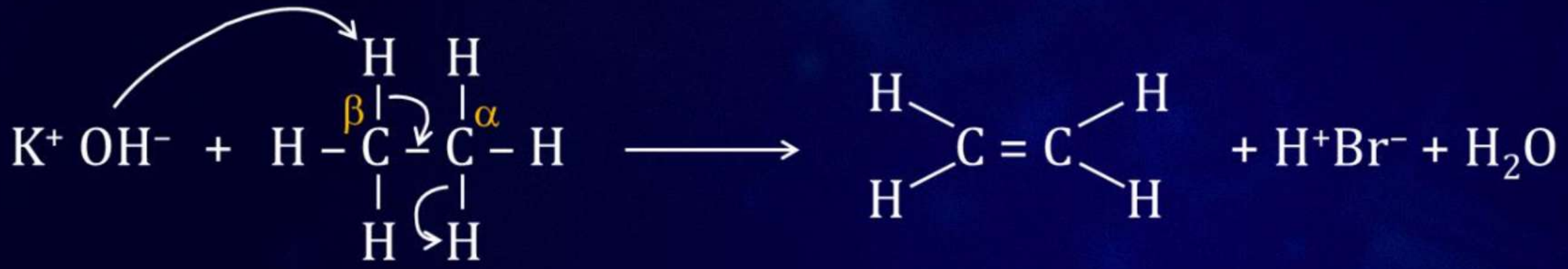
Or

What is dehydrohalogenation reaction? Write its chemical reaction.

In aqueous solution, KOH is almost complete ionised to give OH^- ions which being a strong nucleophile bring about a substitution reaction on alkyl halide to form alcohol and in aqueous solution OH^- are less basic.

But an alcoholic solution of KOH contains alkoxide RO^- ions which being a much stronger base than OH^- ions therefore eliminates a molecule of HX from an alkyl halide to form alkenes. In these reactions, the hydrogen atom is lost from the β-carbon, therefore these reactions are classified as β-elimination reactions.

QUESTIONS



QUESTIONS

What happen when

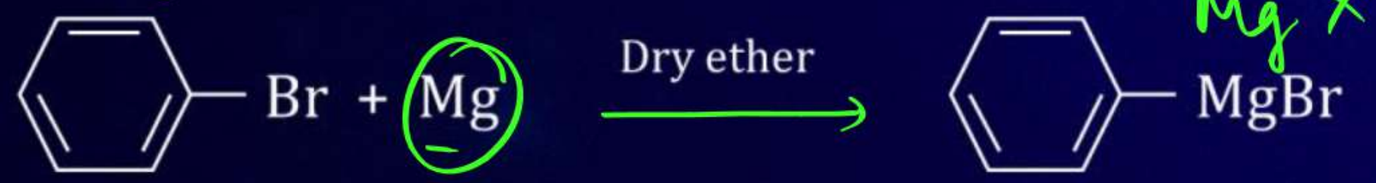
(i) Bromobenzene is treated with Mg in the presence of dry ether.

(ii) Methyl bromide is treated with sodium in presence of dry ether

2 CH_3Br

R-X

(i)



Bromobenzene

Phenylmagnesium bromide
(Organometallic compound : Grignard reagent)

(ii) Wurtz reaction

$$2\,CH_3 - Br + 2Na + Br - CH_3 \xrightarrow{\text{Dry ether}} CH_3 - CH_3 + 2NaBr$$

Methyl Bromide

Ethane

QUESTIONS

Why haloarenes are less reactive than haloalkanes?

Or

Why haloarenes are less reactive than haloalkanes towards nucleophilic substitution reactions?

4 Reasons

SHOURYA MAM
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@CHEMISTRYBY
SHOURYAMAM
Physics Wallah

HOMEWORK

1) DPP solve
2) Revise
3) Complete notes

GIFT - solve all DPP's