Alkanes

- ✓Introduction
- ✓Physical Properties
- ✓Isomerism
- ✓Structure

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Alkanes

Hydrocarbons – C + H

1. Saturated HC → Alkanes
2. Unsaturated HC → Alkenes & Alkyne
3. Aromatic HC / Arenes

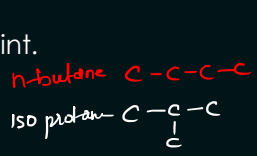
Alkanes

Physical Properties

- 1st 4 hydrocarbon (methane, ethane, Propane and butane are gases, next 13 members are (C5 to C 17) are colorless liquids and rest are wax in nature.
- They are non-polar nature and dissolved in nonpolar solvents (CCl4, Benzene, etc)
- Specific gravity and melting point is increased with molecular weight
- Branching decreases the boiling point.

Table of Boiling Points of Linear Alkanes:

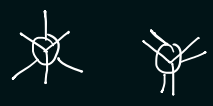
Name of Alkane	How many carbons ?	Chem Formula	Boiling Point in °C	State at (20°C)	Melting Point in °C
Methane	1	CH_4	-162	gas	-183
Ethane	2	C_2H_6	-89	gas	-172
Propane	3	C_3H_8	-42	gas	-188
***n*-Butane**	4	C_4H_{10}	0	gas	-138
***n*-Pentane**	5	C_5H_{12}	36	liquid	-130
***n*-Hexane**	6	C_6H_{14}	69	liquid	-95
***n*-Heptane**	7	C_7H_{16}	98	liquid	-91
***n*-Octane**	8	C_8H_{18}	126	liquid	-57
***n*-Nonane**	9	C_9H_{20}	151	liquid	-54
***n*-Decane**	10	$C_{10}H_{22}$	174	liquid	-30



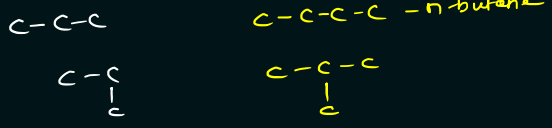
Alkanes

Isomers of Alkanes

- Structural Isomerism- Chain and Functional Isomers
- Confirmational isomerism
- https://youtu.be/3WHrLJD33Ds?si=CNIWxVUjyKqFI5BX



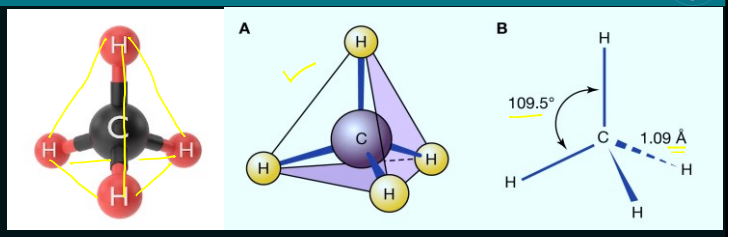
Name	Number of Possible Isomers
methane	—
ethane	—
propane	—
butane	2
pentane	3
hexane	5
heptane	9
octane	18
nonane	35
decane	75

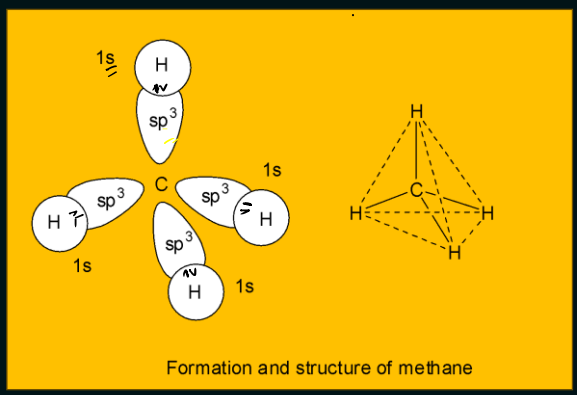


Alkanes

Structure

- Methane- Tetrahedral (SP^3 Hybridized)





Alkanes

Methods of Preparations

1. Hydrogenation of Unsaturated Hydrocarbons
2. Reduction of Alkyl Halide
3. Wurtz Reaction

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Alkanes

- Alkanes- Simplest, saturated hydrocarbons, made of carbons and hydrogens only with C-C and C-H covalent bond.
- Saturated Hydrocarbons are also referred as **Paraffins** (parum- away; little and affinis- Little affinity)- Less reactives
- General formula: C_nH_{2n+2} (n = 1, 2, 3,....)
- Homologous Series

Name	Molecular Formula (C_nH_{2n+2})	Condensed Structural Formula
methane	CH_4	CH_4
ethane	C_2H_6	CH_3CH_3
propane	C_3H_8	$CH_3CH_2CH_3$
butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$
pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$
hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$
heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

Reactivity – alkynes > Alkenes > Alkanes

$C\equiv C$ (2π bond, 1σ) $C=C$ (1π, 1σ) $C-C$ (1σ)

n = 1 CH_4

n = 2 $2\times2+2$ C_2H_6 ethane

Alkanes Methods of Preparations

1. From Unsaturated Hydrocarbons (Alkene and Alkynes)- Hydrogenation Reaction

#Catalytic Hydrogenation/Reduction

#**Sanderson & Sabatier Reaction** ★ GPPAT

Syn Addition Reaction Occurs

Methane Can't be Prepared ★GPPAT NEET

#Catelyst: Ni/Pt/Pd

Ⓐ $R-CH=CH_2 + H_2 \xrightarrow[\Delta\ 200-300^\circ C]{Ni} R-CH_2-CH_3$ Alkane

Alkene

Pt/Pd – Room temp

Ⓑ $R-C\equiv CH + 2H_2 \xrightarrow[\Delta]{Ni} R-CH_2-CH_3$ Alkane

$R-C\equiv CH \xrightarrow[Ni/\Delta]{H_2} R-CH=CH_2 \xrightarrow[Ni/\Delta]{H_2} R-CH_2-CH_3$ alkane

alkyne (1) alkene (2)

↳ Rate limiting/determining step

Δ 200-300°C

Room temp

Syn

Anti

GPPAT NEET NET ★ Rate of React" → B > A

$C\equiv C-H$ alkyne

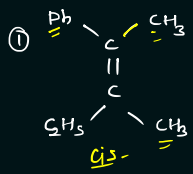
$C=C$ alkene

Alkanes Methods of Preparations

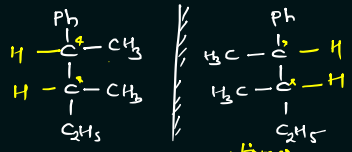
1. From Unsaturated Hydrocarbons (Alkene and Alkynes)- Hydrogenation Reaction

↳ Unsymmetrical Alkenes → always give a pair of optical active isomers (Enantiomers in Rac. mix.)

Ph- Phenyl

① 

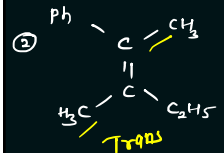
H_2, Ni/Pt/Pd →



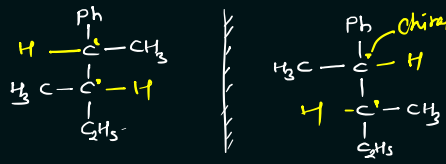
pair of enantiomers

Racemic mixture

↳ 2 optical isomers 2- product

② 

H_2, Ni/Δ →



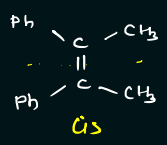
Enantiomers

Racemic mixture

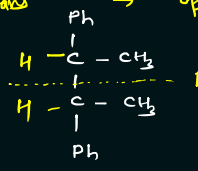
Alkanes Methods of Preparations

1. From Unsaturated Hydrocarbons (Alkene and Alkynes)- Hydrogenation Reaction

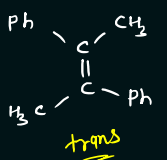
↳ Symmetrical Alkenes → Cis type give – op. inactive compound - Meso compound
trans → optically active enantiomer



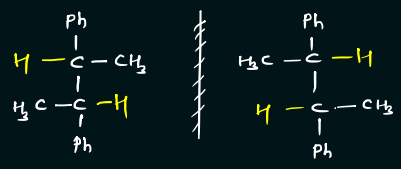
H_2, Ni/Δ →



Meso compound – optically inactive



H_2, Ni/Δ →



optical active

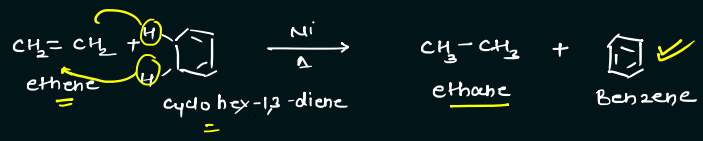
Enantiomers

Racemic mixture

Alkanes Methods of Preparations

1. From Unsaturated Hydrocarbons (Alkene and Alkynes)- Hydrogenation Reaction

↳ Transfer Hydrogenation → Driving force → Aromaticity



↳ Selective Hydrogenation

$CH_3-\overset{5}{C}H=\overset{4}{C}H-\overset{3}{C}H_2-\overset{2}{C}H=\overset{1}{C}H_2$ + 1 mole H_2 → Ni/Δ

(A) $CH_3-CH_2-CH_2-CH_2-CH=CH_2$ — 2 α-H

OR

(B) $\overset{3}{C}H_3-CH=CH-\overset{2}{C}H_2-CH_2-CH_3$ — 5 α-H

Alkanes Methods of Preparations

2. Reduction of Alkyl Halide

↳ Methane can be prepared

$$RX \xrightarrow[H_2]{\text{Reduction}} RH + HX$$

Catalyst →

① Zn + dil HCl
= Zn + CH_3COOH
Zn/Cu in ethanol

* limitation
↳ R-F can not be used

① CH_3-Cl (methyl chloride / Chloro-methane) $\xrightarrow{Zn + dil\ HCl}$ CH_4 + HCl (Methane)

Mechanism → $Zn \rightarrow Zn^{2+} + 2e^-$

$CH_3-Cl \rightarrow CH_3^{\oplus} + Cl^{\ominus}$

$CH_3^{\oplus} + 2e^{\ominus} \rightarrow CH_3^{\ominus} \xrightarrow{H^+} CH_4$

② C_2H_5-Br (ethyl bromide) $\xrightarrow[Zn + dil\ HCl]{2[H^+]}$ C_2H_6 + HBr (Ethane)

Alkanes Methods of Preparations

2. Reduction of Alkyl Halide

(II) $Li^+[AlH_4]^-$

↳ 1° & 2° Alkyl halide (1° $R-X$, 2° R_2CH-X) → alkane

↳ 3° Alkyl halide R_3C-X → Alkene by elimination dehydrohalogenation

↳ CH_3-CH_2-Cl (1°) $\xrightarrow{Li[AlH_4]}$ CH_3-CH_3 ethane

↳ $CH_3-\underset{Cl}{CH}-CH_3$ (2°) → $CH_3-\underset{H}{CH}-CH_3$ propane

2-chloro propane

↳ $CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl$ (3°) $\xrightarrow[-HCl]{\text{dehydrohalogenation}}$ $CH_3-\overset{CH_2}{\overset{\|}{C}}-CH_3$ + HCl

2-methy prop-1-ene

Alkanes Methods of Preparations

2. Reduction of Alkyl Halide

(III) $Na^+[BH_4]^-$ → 1° & 2° alkyl halide → No Reaction ✗

3° alkyl halide → Alkane

(IV) $Ph_3Sn^+H^-$ → 1°, 2°, 3° alkyl halide → Alkane

(V) HI/Red P ⇒ "Good Reducing Agent" = used Alkyl iodide

C_2H_5I ethyl iodide $\xrightarrow{HI}$ C_2H_6 ethane + I_2

$I_2 \xrightarrow{P} PI_3$

Alkanes Methods of Preparations

3. Wurtz Reaction # Imp - alkyl halide ∴ 2 molecule

$$R\text{-}X + 2Na + X\text{-}R \xrightarrow{\text{dry ether (Solvent)}} R\text{-}R + 2NaX$$

alkane

① $CH_3\text{-}Br + 2Na + CH_3\text{-}Br \longrightarrow CH_3\text{-}CH_3 + 2NaBr$

ethane

② $2C_2H_5Cl + 2Na \longrightarrow C_2H_5\text{-}C_2H_5 + 2NaCl$

ethyl chloride — butane — C_4H_{10}

✓ #From Alkyl halide. - 2 mole

Increase the no. of C-Chain.

Used in Ascent of Chain.

Even no C-chain is mainly prepared.

Na metal with Dry ether is used in this reaction.

Alkanes Methods of Preparations

3. Wurtz Reaction - Reaction Mechanism

(A) Free Radical Mechanism ✓

$2Na \longrightarrow 2Na^+ + 2e^-$

$2R\text{-}X \longrightarrow 2R^+ + 2X^-$

$2R^+ + 2e^- \longrightarrow 2R^\bullet$ - alkyl Free Radical

$R^\bullet + R^\bullet \longrightarrow R\text{-}R$

$2Na^+ + 2X^- \longrightarrow 2NaX$

(B) Anion Mechanism

$2Na \longrightarrow 2Na^+ + 2e^-$

$R\text{-}X \longrightarrow R^\oplus + X^\ominus$

$R^\oplus + 2e^\ominus \longrightarrow R^\ominus$

$R^\ominus + R\text{-}X \longrightarrow R\text{-}R$ Nucleophilic Substitution Reaction

$R^+ X^-$

Alkanes Methods of Preparations

3. Wurtz Reaction

Q.1

C_2H_5Cl $\xrightarrow{Na(dry\ ether)}$ $C_2H_5^{\bullet}$ ethyl Radical

$C_2H_5^{\bullet}$ $C_2H_5^{\bullet}$ → $C_2H_5-C_2H_5$ ① butane (major)

$C_2H_5^{-}$ $C_2H_5^{+}$ → Disproportionation Reaction :- Oxidation & Reduction in same molecules

C_2H_4 ethene ② C_2H_6 ethane ③

Alkanes Methods of Preparations

3. Wurtz Reaction

Q.2 :- Why Odd-chain are not prepared by this method – very low yield

CH_3Cl methyl chloride
C_2H_5Cl ethyl chloride
$\xrightarrow{Na\ in\ dry\ ether}$
$CH_3^{\bullet}$ methyl Radical
$C_2H_5^{\bullet}$ ethyl Radical

$CH_3^{\bullet}$ $C_2H_5^{\bullet}$ → $CH_3-C_2H_5$ ① propane (yield odd)

$CH_3^{\bullet}$ $CH_3^{\bullet}$ → CH_3-CH_3 ② ethane

$C_2H_5^{\bullet}$ $C_2H_5^{\bullet}$ → $C_2H_5-C_2H_5$ ③ butane (major)

C_2H_4 ethene ④
C_2H_6 ethane ③ ⑤

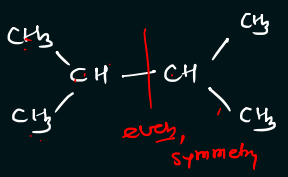
Alkanes Methods of Preparations

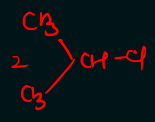
3. Wurtz Reaction

high yield :- even
symmetry

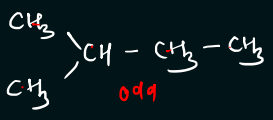
Q.3 - Tick the high yield alkanes that are prepared by Wurtz Reaction

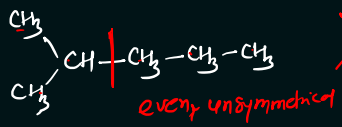
(A) $CH_3-CH_2-CH_2-CH_3$ — even, symmetrical ✓

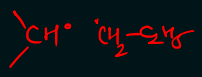
(B)  — even, symmetry ✓



(C) $CH_3-CH_2-CH_2-CH_2-CH_3$ — odd ✗

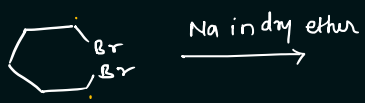
(D)  — odd ✗

(E)  — even, unsymmetrical ✗



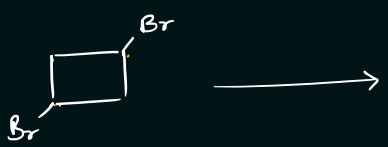
Alkanes Methods of Preparations

3. Wurtz Reaction – Intramolecular Wurtz Reaction



1,5-dibromo pentane

Cyclo pentane

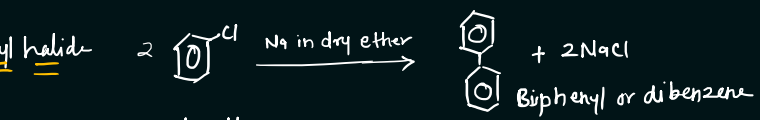


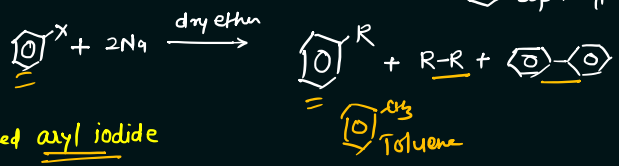
Bicyclo [1.1.0] butane

Alkanes Methods of Preparations

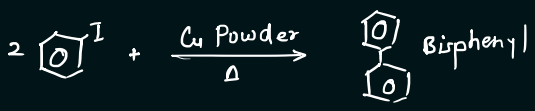
Similar Reaction to Wurtz Reaction

(A) Frankland Reaction $2RX + Zn \xrightarrow{\text{dry ether}} R-R + ZnCl_2$

(B) Fittig Reaction – from Aryl halide 

(C) Wurtz-Fittig Reactn – 

(D) Ullman Synthesis – only used aryl iodide

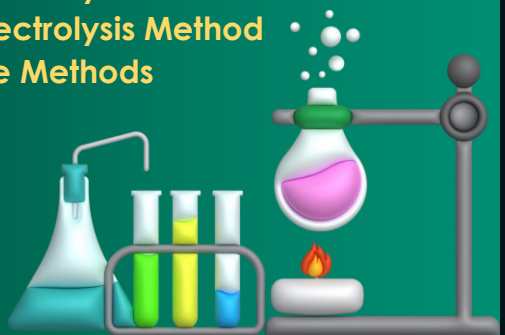


Alkanes

Methods of Preparations

Decarboxylation Methods

4. Kolbe's Electrolysis Method
5. Soda-Lime Methods



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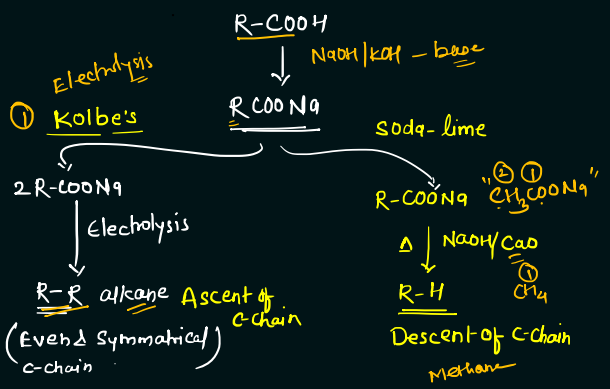
Alkanes Methods of Preparations

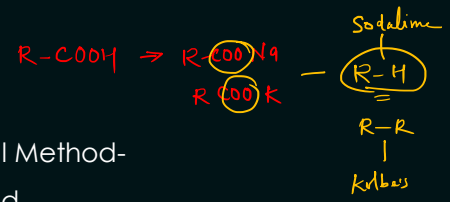
Decarboxylation Reaction of Carboxylic Acids

Removal of CO_2 – decarboxylation

4. Kolbe's Electrolysis Synthesis - Electrical Method-

5. Soda-Lime Methods- Chemical Method

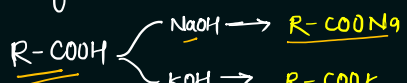


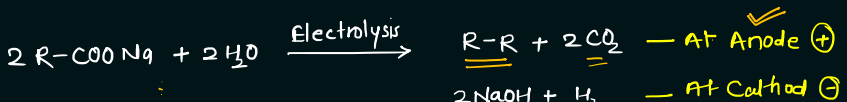


Alkanes Methods of Preparations

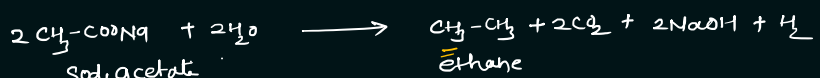
4. Kolbe's Synthesis

↳ Use strong conc. of Na or K salt of carboxylic acid in aqeous medium





Suitable for preparatn of Even & Symmetry c-chain Alkanes



Alkanes Methods of Preparations

4. Kolbe's Synthesis → Reaction Mechanism

$2CH_3COONa \longrightarrow 2CH_3COO^- + 2Na^+$

$2H_2O \longrightarrow 2H^+ + 2OH^-$

Anode ⊕ (Oxidn ↓ loss of e^-)

$2CH_3-COO^{\cdot} \longrightarrow 2e^- + CH_3-COO^{\cdot}$

$2\,CH_3-\underset{\underset{O}{\|}}{C}-O^{\cdot} \longrightarrow 2CH_3^{\cdot} + 2\,C(=O)=O$

$CH_3^{\cdot} + CH_3^{\cdot} \longrightarrow CH_3-CH_3$ ethane

Cathode ⊖ (Redn ↓ gain e^-)

$2H^+ + 2e^- \longrightarrow 2H \longrightarrow H_2$

$2Na^+ + 2OH^- \longrightarrow 2NaOH$

#Use to prepare even/symmetrical C-Chain alkanes.

Increase the no. of C-Chain (Ascent of Chain)

#↑pH →↑Reaction

by this method, alkene, alkyne and cycloalkane, and cycloaklene can also be prepared. Arenes

Alkanes Methods of Preparations

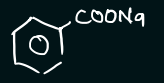
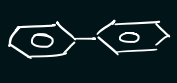
4. Kolbe's Synthesis

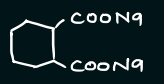
Not Prefer for odd no. of C-chain

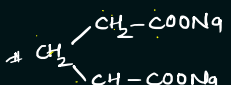
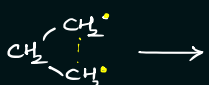
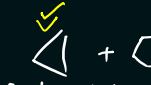
↳ $CH_3COONa + C_2H_5COONa \xrightarrow[\text{Electrolysis}]{H_2O} CH_3^{\cdot}, C_2H_5^{\cdot} \longrightarrow$

1) $CH_3-C_2H_5$ propane
2) CH_3-CH_3 ethane
3) $C_2H_5-C_2H_5$ Butane

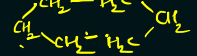
} Yeild ↓, Odd-C-chain → ✗

2  $\xrightarrow[\text{Electrolysis}]{H_2O}$  Bisphenyl

 →  →  cyclo hexene +  Bicyclo [4.4.0] decane

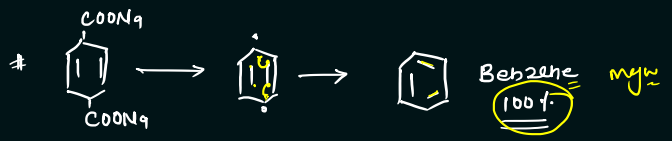
 →  →  +  cyclohexane

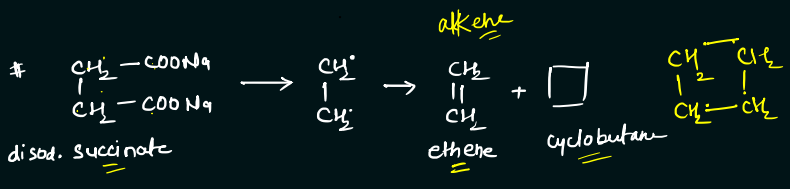
Cyclo propane major

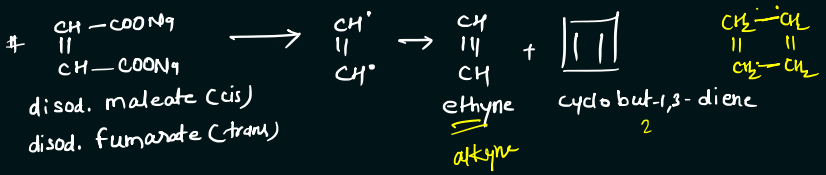


Alkanes Methods of Preparations

4. Kolbe's Synthesis



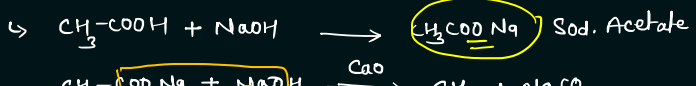


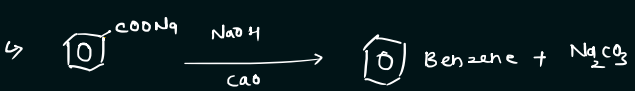


Alkanes Methods of Preparations

5. Soda Lime Methods

- Use of Soda → Na & Lime - CaO
- Reaction occurs in Basic aqueous medium
- Descent of C-chain - length
- Methane can be prepared by this method





Alkanes Methods of Preparations

5. Soda Lime Methods – Reaction Mechanism

$R-COONa + NaOH \xrightarrow[\text{basic}]{CaO} Na_2CO_3 + R-H$

$R-COONa \xrightarrow{\text{basic}} R-COO^- + Na^+$ (acetate / carboxylation)

$R-\overset{O}{\overset{\|}{C}}-O^- \longrightarrow R^- + \overset{O}{\overset{\|}{C}}=O$

R^- = Carbocation

Rate Determining Step

Stability = $1^\circ > 2^\circ > 3^\circ$ – due to +I effect

$R_3C^- > R_2CH^- > RCH_2^-$

Reactivity for decarboxylation

$R^- \xrightarrow{H^+OH^-} R-H$

$NaOH + OH^- + Na^+ + CO_2 \rightarrow Na_2CO_3 + H_2O$

R_3C^- → e⁻ density ↑ unstable

Alkanes Methods of Preparations

5. Soda Lime Methods

$-\overset{|}{C}{}^-$ → ↑ electron density at C⁻ ion → ↑ unstability and try to avoid formation

Q. Rate of Decarboxylation

(a) $CH_2-COONa$ (b) $CH_2-COONa$, O_2N (−M effect) (c) CH_2COONa, HO (+M)

b > a > c

Q2

(a) COONa (b) COONa (c) COONa

c > b > a

(Resonance stability) (Aromatic stability)

Alkanes

Methods of Preparations

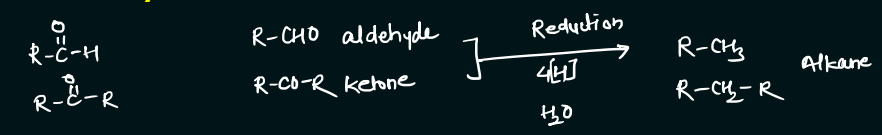
From Aldehyde/Ketone

6. Clemenson Reduction
7. Wolf-Kishner Reduction
8. Red Phosphorus/Iodine

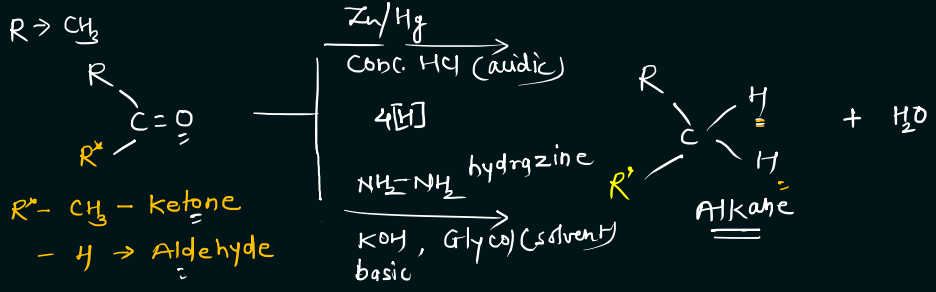
B.Pharm. | POC-I | U 2 | L6

Alkanes Methods of Preparations

From Aldehyde or Ketone- Reduction



✓Clemenson Reduction



Wolf-Kishner Reduction

Alkanes Methods of Preparations

6. Clemenson Reduction →

↳ Zn/Hg Catalyst
↳ Conc. HCl (Acidic medium)

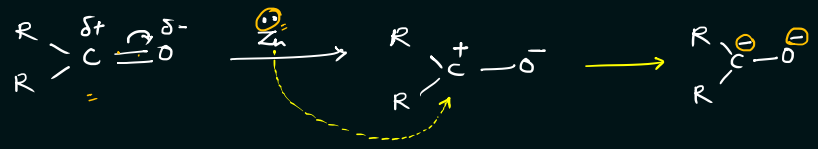
$CH_3-\overset{O}{\overset{\|}{C}}-H + 4[H] \xrightarrow[\text{Conc HCl}]{Zn/Hg} CH_3-CH_3 + H_2O$

Ethanal → Ethane

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + 4[H] \xrightarrow[\text{Conc. HCl}]{Zn/Hg} CH_3-CH_2-CH_3 + H_2O$

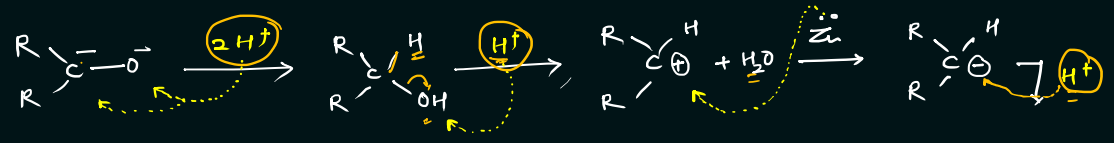
Propanone → Propanone

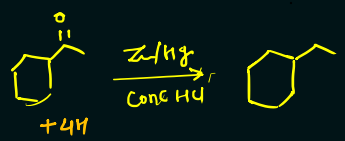
Reaction Mechanism



Alkanes Methods of Preparations

6. Clemenson Reduction



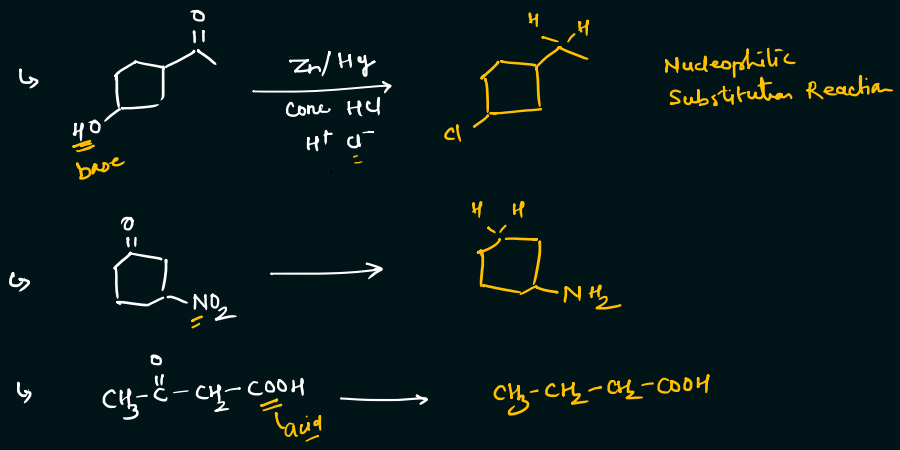
↳ 

Alkane

↳ $CH_3-CH_2-CHO \longrightarrow CH_3-CH_2-CH_3 + H_2O$

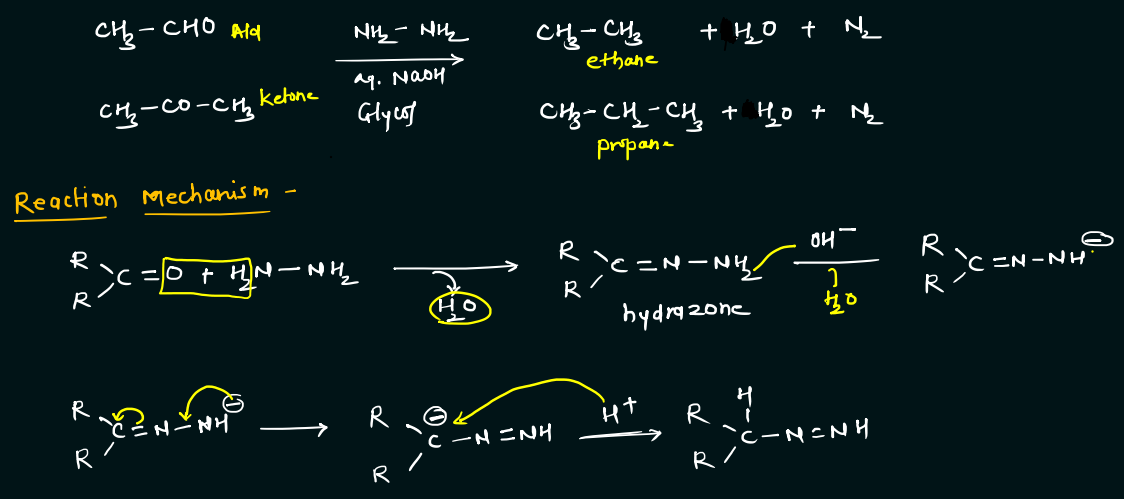
Alkanes Methods of Preparations

6. Clemenson Reduction



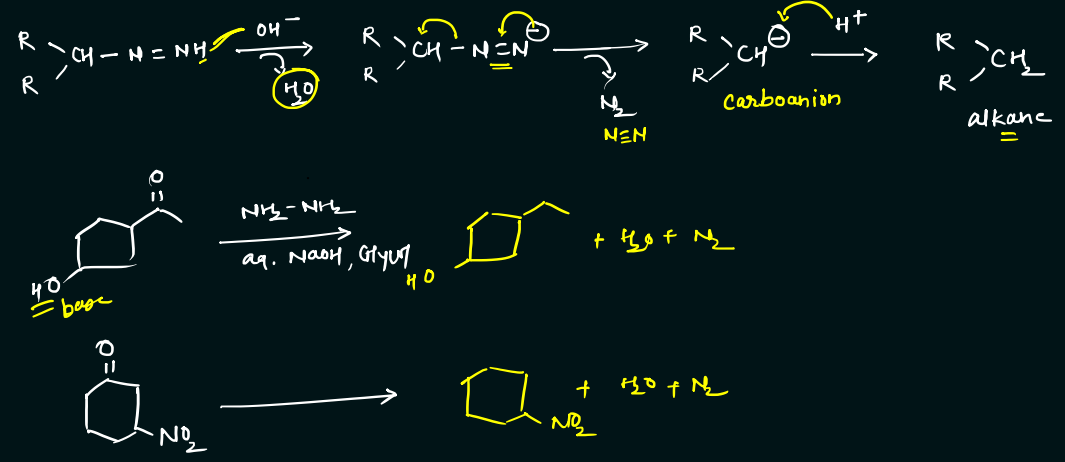
Alkanes Methods of Preparations

7. Wolf-Kishner Reduction



Alkanes Methods of Preparations

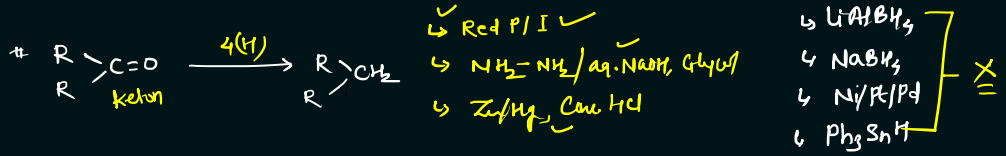
7. Wolf-Kishner Reduction

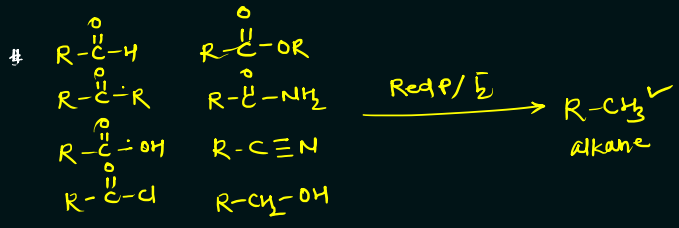


Alkanes Methods of Preparations

8. Red Phosphorus/Iodine → very strong Reducing Agent

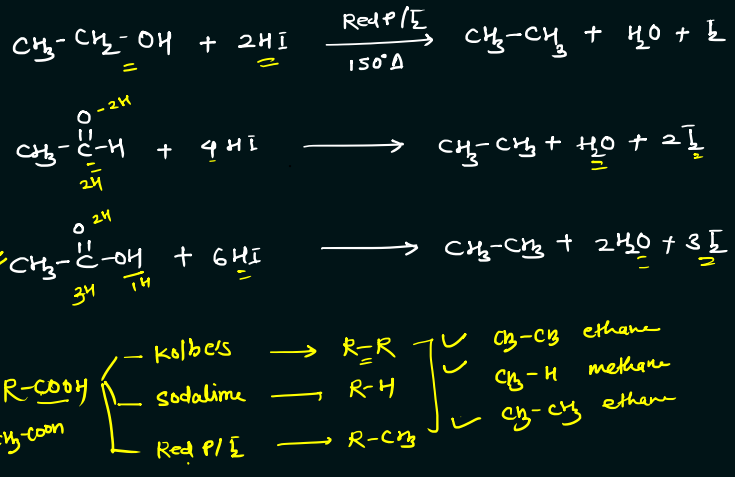
Acid $\xrightarrow{2H}$ Ald/ketone $\xrightarrow{2H}$ Alcohol $\xrightarrow{2H}$ alkane





Alkanes Methods of Preparations

8. Red Phosphorus/Iodine



Alkanes

Methods of Preparations

9. From Grignard's Reagents
10. Corey House Synthesis

B.Pharm. | POC-I | U 2 | L7

Alkanes Methods of Preparations

9. From Grignard's Reagents

$R-Mg-X \xrightarrow{H^+OH^-} R-H + Mg(X)(OH)$ (alkane)

- Organometalic compounds → C–Metal
- Got Nobel prize – in 1912 with others
- you can prepare allmost all org. compounds
- Grignard's Reagents → $CH_3-Mg-Cl$, $C_2H_5-Mg-Br$, $C_6H_5-Mg-Cl$, $(CH_3)_2CH-Mg-Cl$

* Preparation of Grignard Reagents

$R-X \xrightarrow[\text{dry ether}]{Mg} R-Mg-X$ (G.R.)

$R-X \rightarrow R^+ X^- \xrightarrow{Mg} R^+ Cl^- \xrightarrow{Mg^+} R-Mg-X$

→ Covelent bond 50%.

Ionic bond 50%.

Alkanes Methods of Preparations

9. From Grignard's Reagents

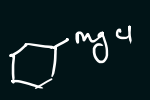
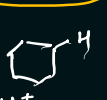
$R-Mg-X \xrightarrow{H^+OH^-} R-H + Mg(X)(OH)$ (Alkane)

\# $R-Mg-X$ (base)

↳ search for active hydrogens H^+

↳ H with F/O/N

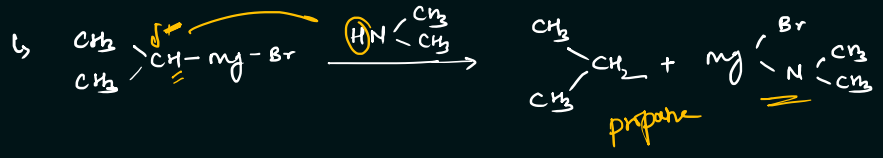
↳ Acidic hydrogen

- $C_2H_5-Br \xrightarrow[\text{dry ether}]{Mg} C_2H_5-Mg-Br \xrightarrow{H^+OH^-} C_2H_6 + Mg(Br)(OH)$
- $CH_3-Cl \xrightarrow[\text{dry ether}]{Mg} CH_3-Mg-Cl \xrightarrow{CH_3-NH_2} CH_4 + Mg(Cl)(NH-CH_3)$
-  $\xrightarrow{CH\equiv CH}$  $+ Mg(Cl)(C\equiv CH)$

* alkyne – acidic H^+

Alkanes Methods of Preparations

9. From Grignard's Reagents



Rate of Reaction — A > B > C

Leaving tendency $I^- > Br^- > Cl^-$

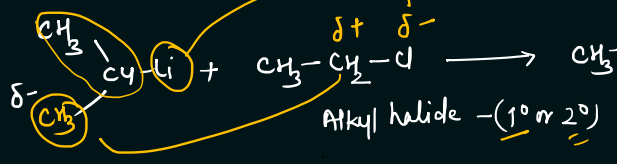
(A) $CH_3-I \xrightarrow[\text{dry ether}]{Mg} CH_3-Mg-I \xrightarrow{HOH} CH_4$

(B) $CH_3-Br \longrightarrow CH_3-Mg-Br \longrightarrow CH_4$

(C) $CH_3-Cl \longrightarrow CH_3-Mg-Cl \longrightarrow CH_4$

Alkanes Methods of Preparations

10. Corey House Synthesis



$CH_3-CH_2-CH_3 + CH_3-Cu + LiCl$

Alkyl halide – (1° or 2°)

Unsymmetrical & odd C-chain alkane can be prepared unlike Kolbe's & Wurtz Reacⁿ

Gilman's Reagent R_2CuLi – dialkyl lithium cuperate

↳ Organometalic compound

Alkanes Methods of Preparations

10. Corey House Synthesis

step 1) $CH_3-Br + 2Li \longrightarrow CH_3-Li + LiBr$

step 2) $2\ CH_3-Li \xrightarrow{CuI}$ Cuprous Iodide $\rightarrow$ $(CH_3)_2Cu-Li$ Dialkyl Lithium Cuperate [Gilman's Reagent] $+ LiI$

step 3) $(CH_3)_2Cu-Li + CH_3-CH_2-Br \longrightarrow CH_3-CH_2-CH_3 + CH_3-Cu + LiBr$

↳ 1° or 2° alkyl halide / Not should be 3° alkyl halide

Nucleophilic Substitution Reaction SN-2 Reactn → 1° > 2° > 3°

SN2 SN1

Alkanes Methods of Preparations

10. Corey House Synthesis

↳ $(CH_3)_2CH-Cu-Li + C_4H_9Cl \longrightarrow C_5H_{12} + CH_3-Cu + LiCl$

butanyl chloride → pentane

↳ prepare $(CH_3)_2CH-CH_2-CH_3$ by Gilman's Reagent

2-methyl butane

$(CH_3)_2CH-Cl \xrightarrow[\text{dry ether}]{2Li} (CH_3)_2CH-Li \xrightarrow{CuI}$ $[(CH_3)_2CH]_2Cu-Li$

2° halide

$[(CH_3)_2CH]_2Cu-Li + CH_3-CH_2-Cl \rightarrow (CH_3)_2CH-CH_2-CH_3$

ethyl chloride

Alkanes Methods of Preparations

10. Corey House Synthesis