ULTIMATE KCET

CRASH COURSE 2026

Chemistry | **Lecture - 02**

General organic chemistry

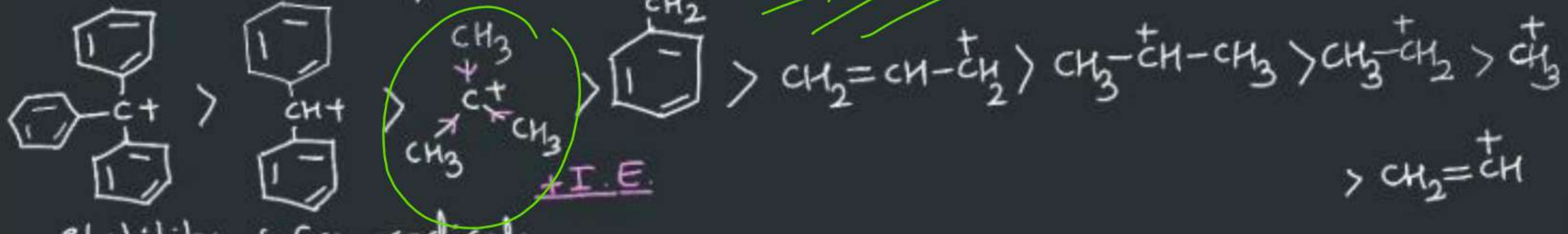
By – Sreeja Ma'am

Topics *to be covered*

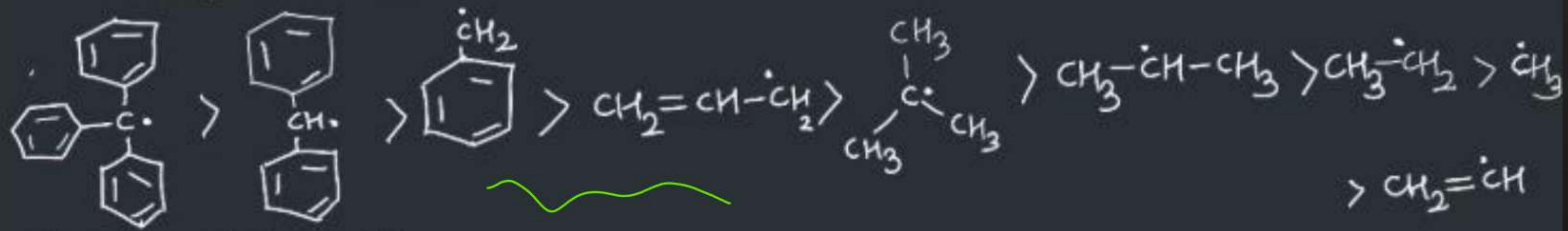
1. Isomerism
2. Electronic effects

Chapter weightage – 2 mark for kcet

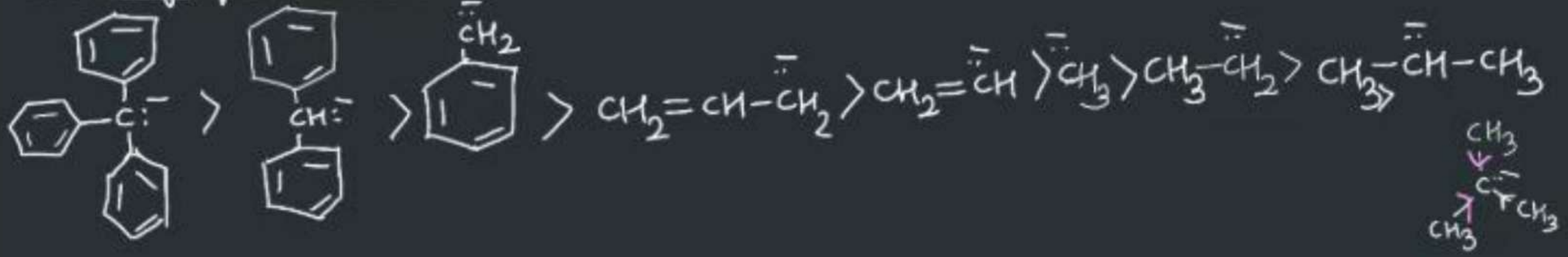
Stability order of Carbocation



Stability of free radical:



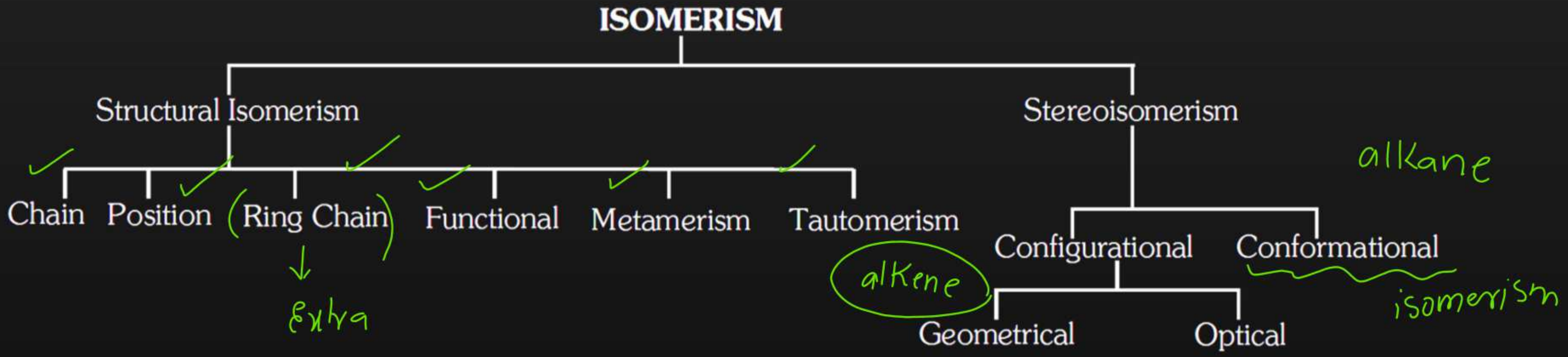
Stability of Carbanion



Isomerism

$\overset{1}{H_3C}-\boxed{\overset{2}{CH_2}-\overset{3}{CH_2}}-\overset{4}{CH_3}$

Two or more than two compounds having the same molecular formula but different physical/chemical or both properties are called isomers and the phenomenon is called isomerism



ISOMERISM

- Structural Isomerism
  - Chain ✓
  - Position ✓
  - (Ring Chain) ✓ ↓ extra
  - Functional ✓
  - Metamerism ✓
  - Tautomerism ✓
- Stereoisomerism
  - Configurational
    - Geometrical
    - Optical
  - Conformational isomerism

alkene

alkane

Isomerism

Same formula diff. structures

- **Isomerism**
  - **Structural Isomerism** ✓
    - Chain isomerism ✓
    - Position isomerism ✓
    - Functional isomerism ✓
    - Metamerism ✓
    - Tautomerism ✓

      (Ring chain isomerism)
  - **Stereoisomerism**
    - Conformational isomerism
    - Configurational isomerism
      - Optical isomerism
      - Geometrical isomerism

Chain Isomerism (C.I.)

The compounds which have same molecular formula, same functional group but different arrangement of carbon chain (Parental or side chain) show chain isomerism.

Alkanes →

CH_4

H_3C-CH_3

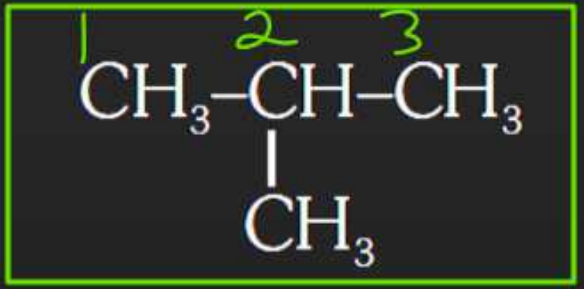
$H_3C-H_2C-CH_3$

No isomerism

$C-C-C-C$

Ex. $\boxed{\overset{4}{C}H_3-\overset{3}{C}H_2-\overset{2}{C}H_2-\overset{1}{C}H_3}$ n-butane

Butane (4C)

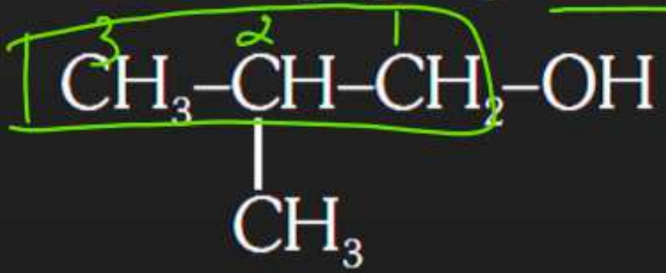

$\overset{1}{C}H_3-\overset{2}{C}H(CH_3)-\overset{3}{C}H_3$

isobutane

2–Methyl propane (3C)

Ex. $\underbrace{\overset{4}{C}H_3-\overset{3}{C}H_2-\overset{2}{C}H_2-\overset{1}{C}H_2}-\textcircled{OH}$

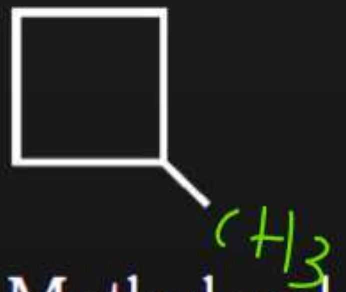
1–Butanol (4C)


$\overset{3}{C}H_3-\overset{2}{C}H(CH_3)-\overset{1}{C}H_2-OH$

2–Methyl–1–propanol (3C)

chain isomers

~~**Ex.**~~



Methylcyclobutane

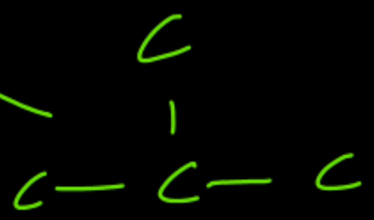
or

Cyclopentane

→ $C-C-C-C$

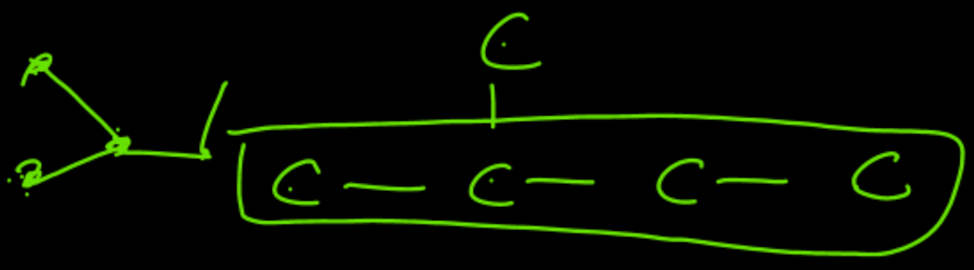
4C

$C-C-C-C$

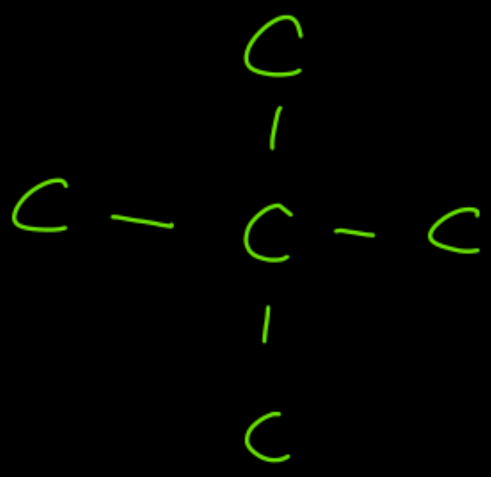


5C

→ $C-C-C-C-C$ → n-pentane



→ isopentane



→ Neopentane

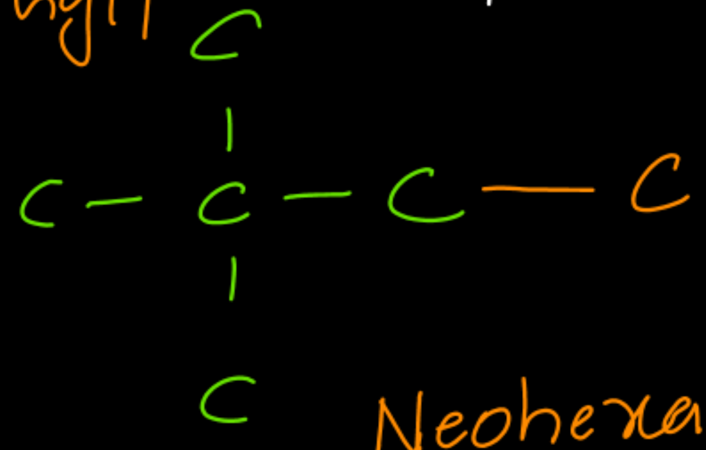
6C

* $C-C-C-C-C-C$ n-hexane

*

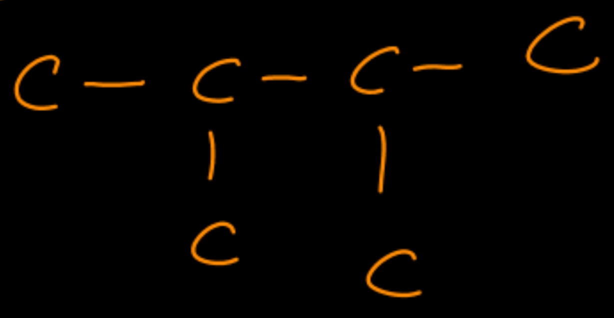
2-Methylpentane isohexane

*



Neohexane.

*



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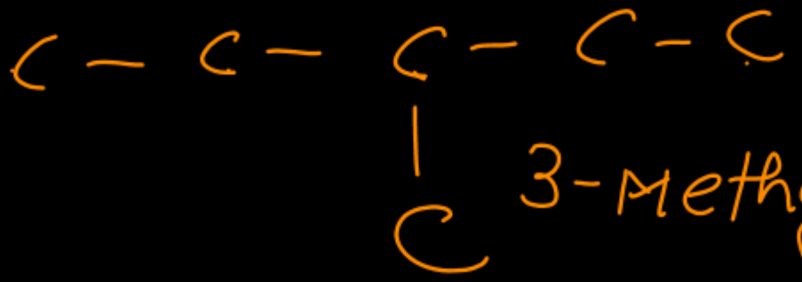


3-Methylpentane

alkane → C_nH_{2n+2} → $\underline{\underline{C_4H_{10}}}$

C_4H_{10} → 2 chain isomers
Butane

C_5H_{12} → 3 chain isomers
pentane

C_6H_{14} → 5 chain isomers
hexane

C_7H_{16} → 9 chain isomers.
heptane

Position Isomerism (P.I.)

The compounds which have same molecular formula, same functional group, same parent carbon chain but different position of functional group or multiple bond or substituents, show position isomerism.

Ex. $CH_2{=}CH{-}CH_2{-}CH_3$

But–1–ene

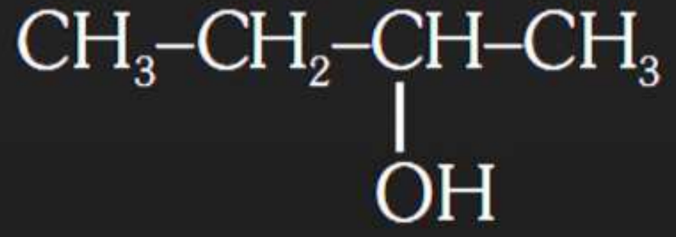
$CH_3{-}CH{=}CH{-}CH_3$

But–2–ene

Ex. $CH_3{-}CH_2{-}CH_2{-}CH_2{-}OH$

$\overset{}{\underset{4}{}}\quad\underset{3}{}$

1–Butanol

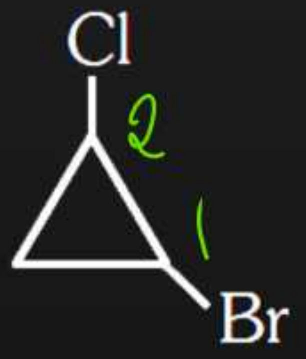


$CH_3{-}CH_2{-}\underset{\underset{OH}{|}}{CH}{-}CH_3$

2–Butanol

lowest set of locant
+ alphabetical order

Ex.

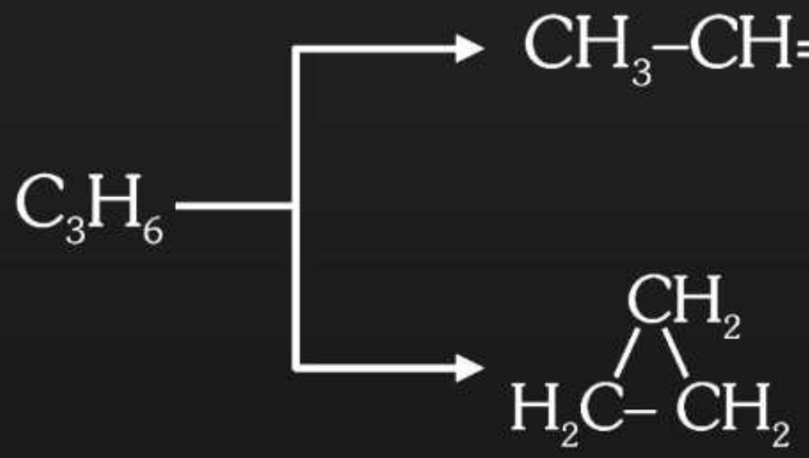


1-Bromo-2-chlorocyclopropane

1-Bromo-1-chlorocyclopropane

Ring chain isomerism (RCI)

Same molecular formula but different mode of linking (open chain & closed chain) of carbon atoms.



C_3H_6 → $CH_3–CH=CH_2$ [open chain]

C_3H_6 → cyclopropane [closed chain or ring]

(alkene)

C_nH_{2n}

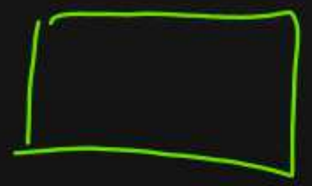
RCI → alkene + alicyclic comp.

alicyclic compounds

alkane or alkene or alkynes (aliphatic) in cyclic form

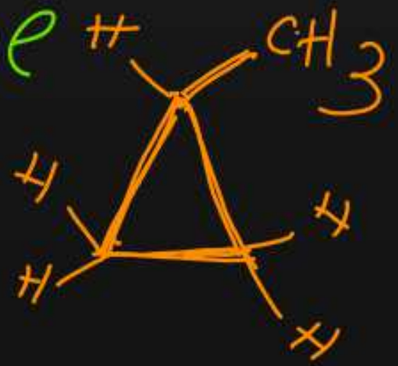
C_4H_8
Butene

C – C – C = C or
butene



cyclobutane

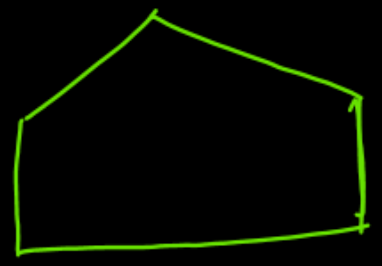
or



C_4H_8

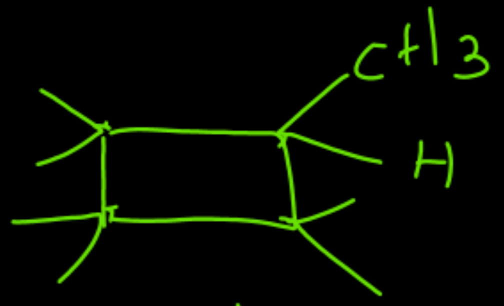
$H_3C-H_2C-H_2C-HC=CH_2 \longrightarrow C_5H_{10}$

Pentene

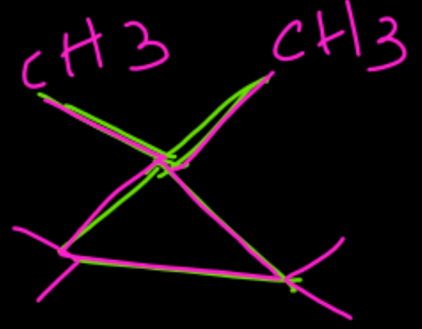


C_5H_{10}

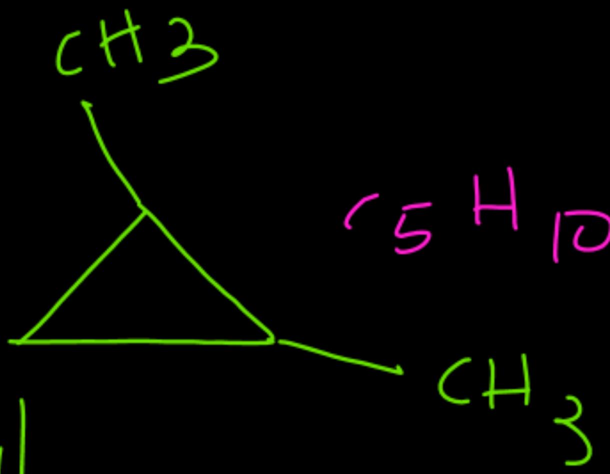
cyclopentane



C_5H_{10}



1,1-dimethyl cyclopropane



C_5H_{10}

$\boxed{C_5H_{10}}$

Functional Isomerism

KCET IMP

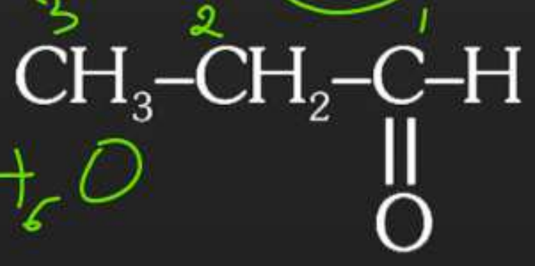
Same molecular formula but different functional groups.

Following compounds show Functional isomerism, as they have same molecular formula and different functional group.

C_2H_6O C_2H_6O → Ether

(i) Alcohol and Ether ⟶ CH_3-CH_2-OH and CH_3-O-CH_3

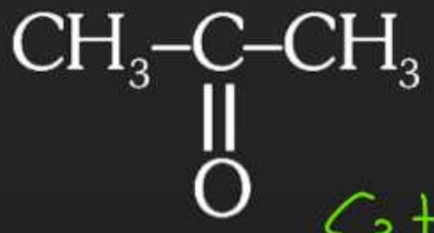
(ii) Aldehydes and Ketones ⟶



$\overset{3}{C}H_3-\overset{2}{C}H_2-\overset{1}{C}(=O)-H$

C_3H_6O

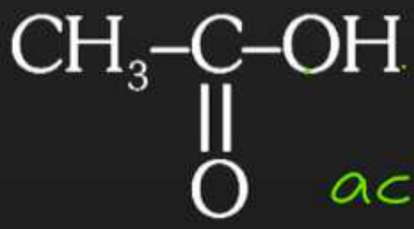
and



$CH_3-C(=O)-CH_3$

C_3H_6O

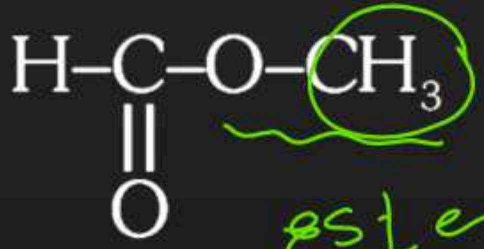
(iii) Acids and Ester ⟶



$CH_3-C(=O)-OH$

acid.

and



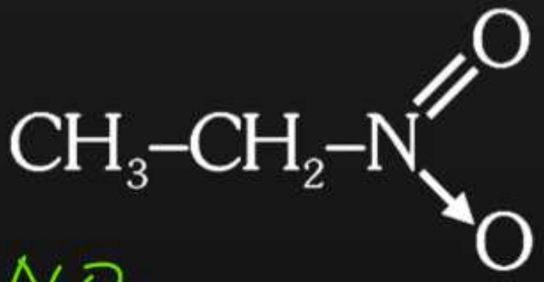
$H-C(=O)-O-CH_3$

ester

(iv) Cyanide and Isocyanide ⟶ $CH_3-CH_2-CH_2-CN$ and $CH_3-CH_2-CH_2-NC$

Ambident nucleouphile

(v) Nitro and Nitrite ⟶



$CH_3-CH_2-N(=O)\rightarrow O$

and $CH_3-CH_2-O-N=O$

NO_2

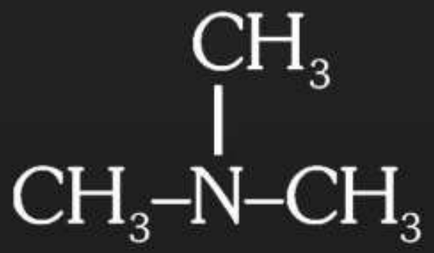
NO_2

ONO

(vi) 1°, 2°, 3° Amines

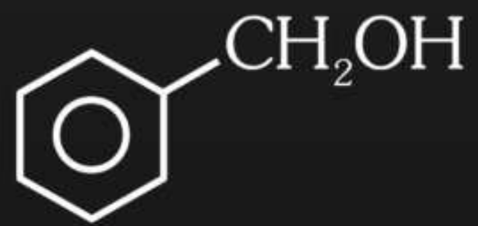
(i) $CH_3 - CH_2 - CH_2 - NH_2$

(ii) $CH_3 - NH - CH_2 - CH_3$

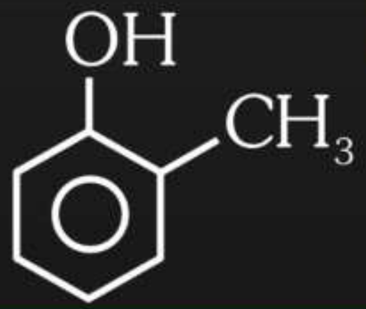
(iii) 

$CH_3-N(CH_3)-CH_3$

(vii) Alcoholic and Phenolic compounds :



and



KCET

(viii) Alkyl halides do not show Functional isomerism.

[redacted]

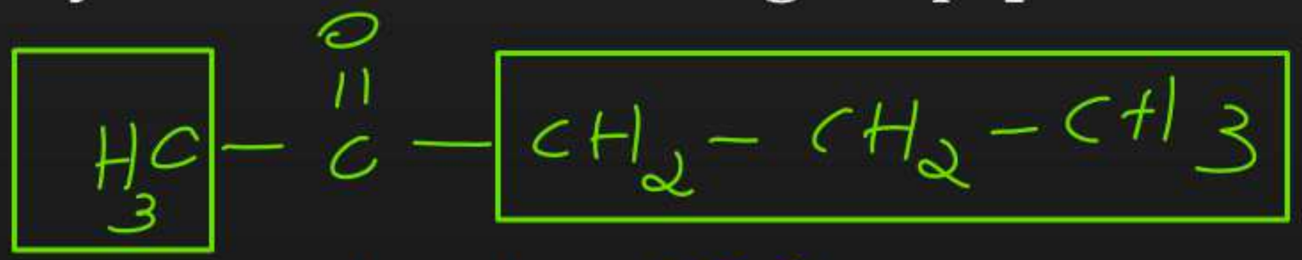
Metamerism

$H_3C-O-CH_2-CH_2-CH_3$

$H_3C-CH_2-O-CH_2-CH_3$

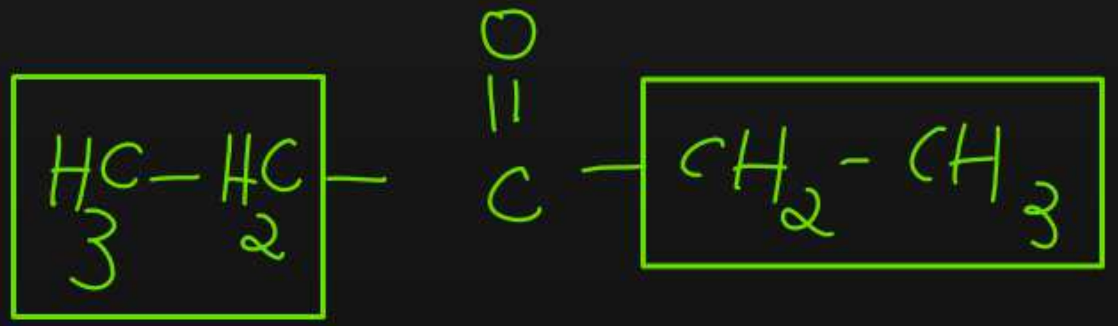
Same molecular formula, same polyvalent Functional group but different alkyl groups attached to polyvalent Functional group.

Polyvalent Functional group [Which have more than one valency] are :

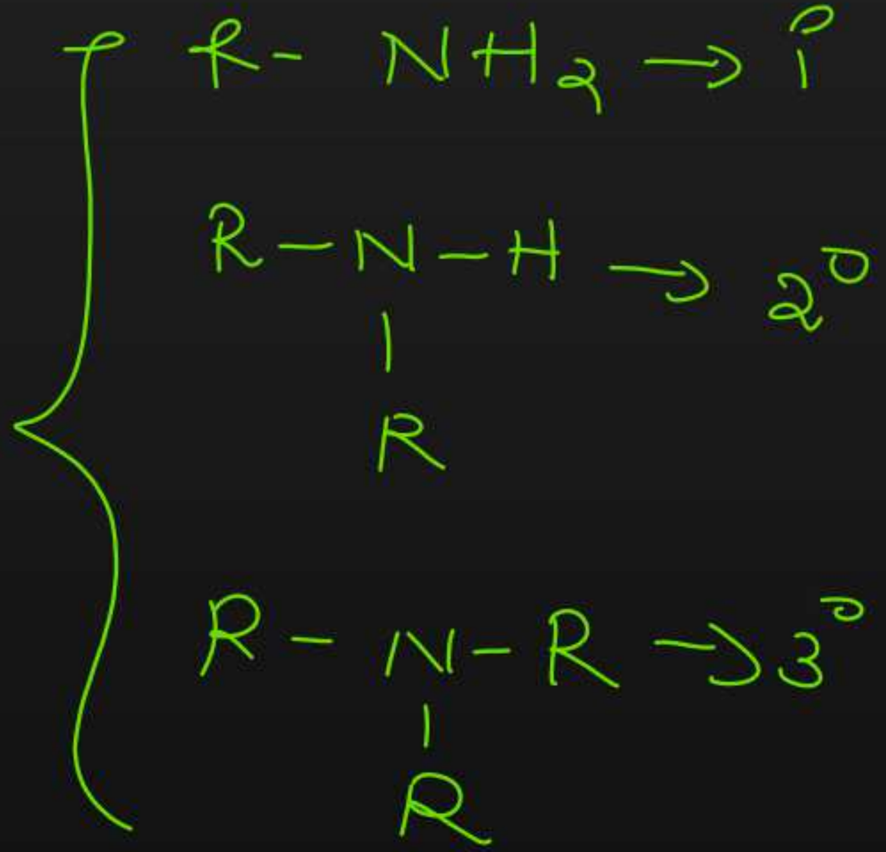


$\boxed{H_3C}-\overset{\overset{O}{\|}}{C}-\boxed{CH_2-CH_2-CH_3}$

2-pentanone.



$\boxed{H_3C-H_2C}-\overset{\overset{O}{\|}}{C}-\boxed{CH_2-CH_3}$

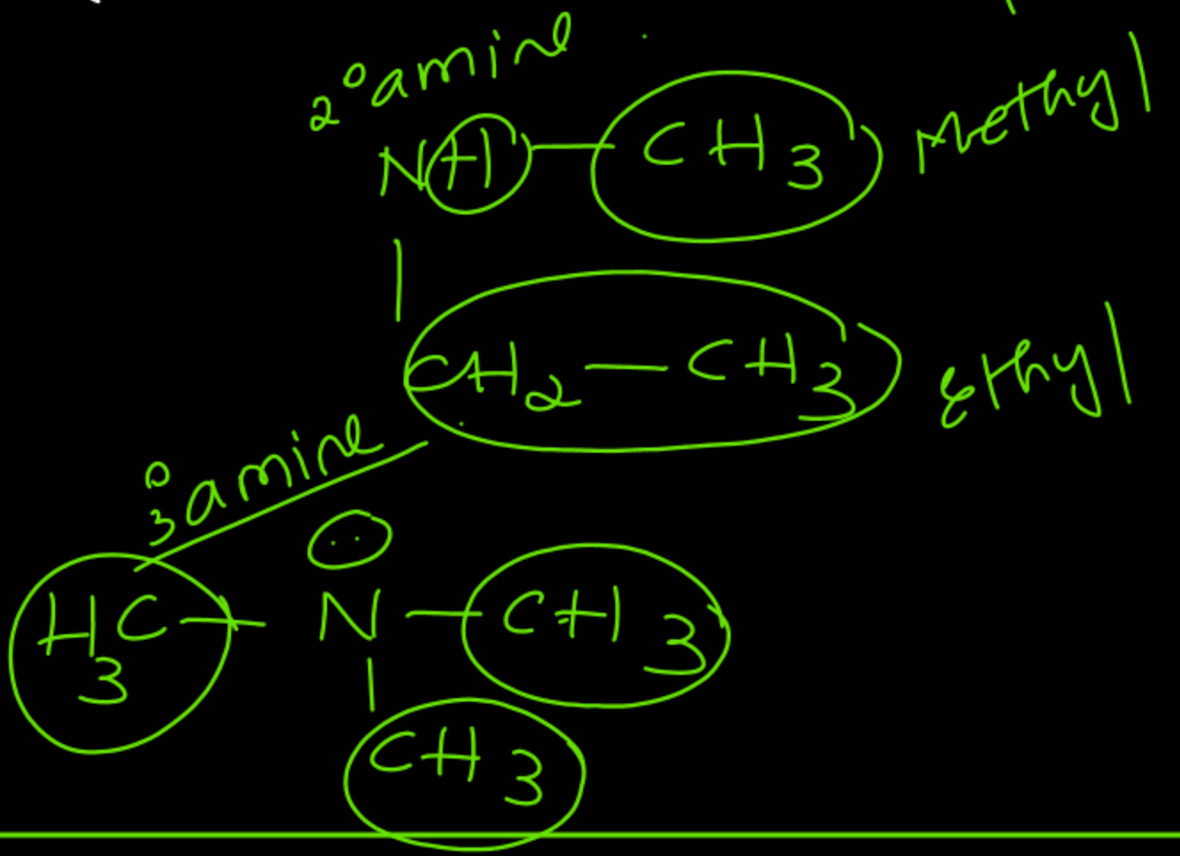


$R-NH_2 \rightarrow 1^\circ$

$R-\underset{\underset{R}{|}}{N}-H \rightarrow 2^\circ$

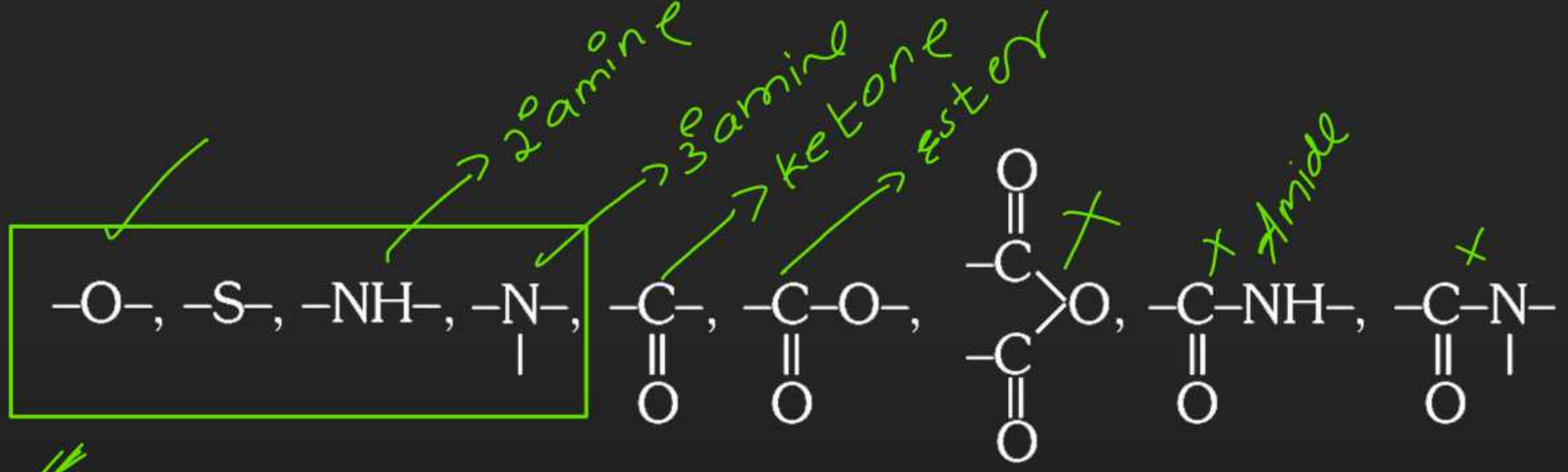
$R-\underset{\underset{R}{|}}{N}-R \rightarrow 3^\circ$

$H_2N-\underbrace{CH_2-}CH_2-CH_3$ propyl



$\underset{CH_2-CH_3}{\underset{|}{NH}}-CH_3$

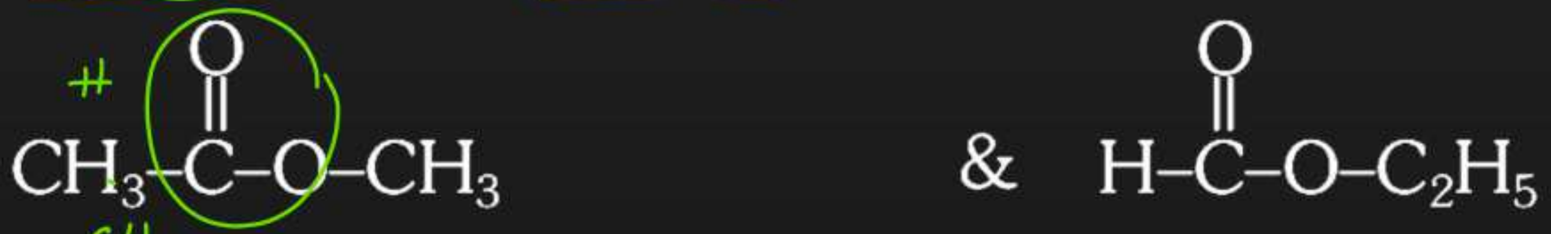
$H_3C-\underset{CH_3}{\underset{|}{\overset{\cdot\cdot}{N}}}-CH_3$



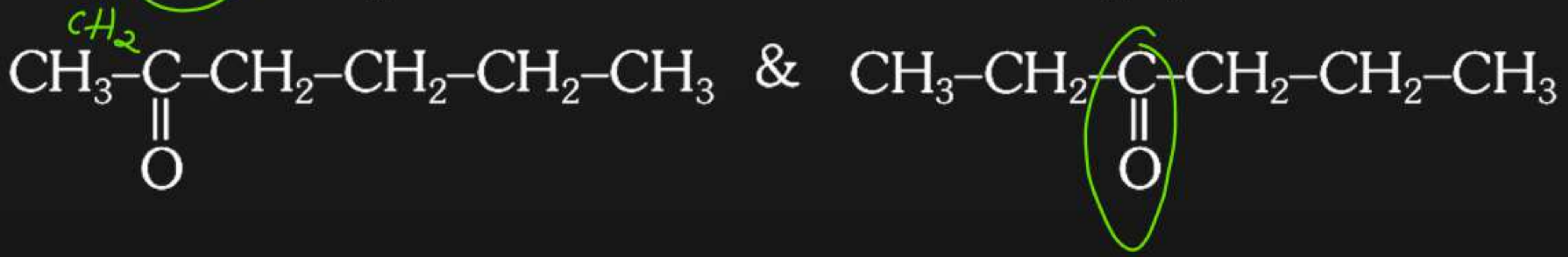
$-O-$, $-S-$, $-NH-$, $-\underset{|}{N}-$, $-\underset{\substack{\|\\ O}}{C}-$, $-\underset{\substack{\|\\ O}}{C}-O-$, $\begin{matrix}-\overset{\substack{O\\ \|}}{C}\diagdown \\ \qquad O, \\ -\underset{\substack{\|\\ O}}{C}\diagup\end{matrix}$ $-\underset{\substack{\|\\ O}}{C}-NH-$, $-\underset{\substack{\|\\ O}}{C}-\underset{|}{N}-$

Ex. $CH_3-O-CH_2-CH_2-CH_3$ & $H_3C-CH_2-O-CH_2-CH_3$

Ex. $CH_3-CH_2-NH-CH_2-CH_3$ & $CH_3-NH-CH_2-CH_2-CH_3$



Ex. $CH_3-\overset{\substack{O\\ \|}}{C}-O-CH_3$ & $H-\overset{\substack{O\\ \|}}{C}-O-C_2H_5$

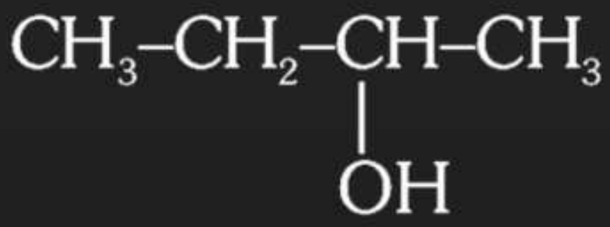


Ex. $CH_3-\underset{\substack{\|\\ O}}{C}-CH_2-CH_2-CH_2-CH_3$ & $CH_3-CH_2-\underset{\substack{\|\\ O}}{C}-CH_2-CH_2-CH_3$

QUESTION

$C_4H_{10}O$ Structural isomers ⇒7 [4 alcohol and 3 ethers] total 7 structural isomers are possible.

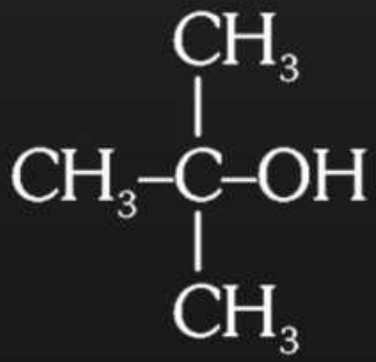
Ans : **Alcohol :** $CH_3-CH_2-CH_2-CH_2-OH$



$CH_3-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3$

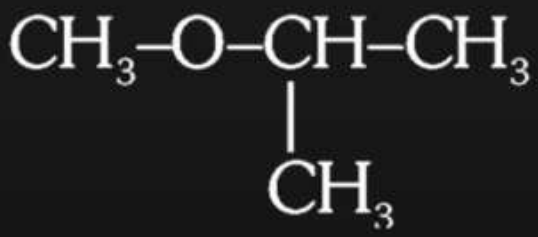
$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH$

and



$CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-OH$

Ethers : $CH_3-O-CH_2-CH_2-CH_3$, $C_2H_5-O-C_2H_5$,



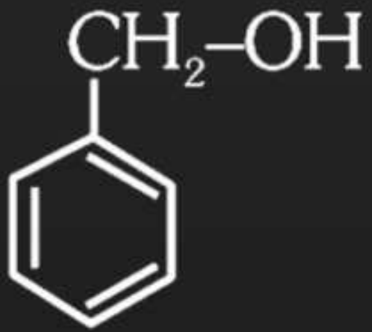
$CH_3-O-\underset{CH_3}{\underset{|}{CH}}-CH_3$

QUESTION

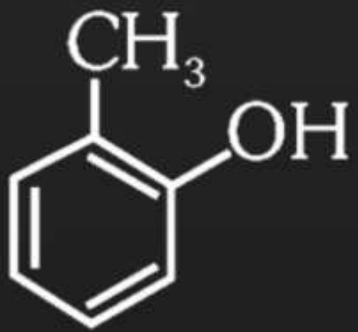
Aromatic isomers of C_7H_8O.

Ans :

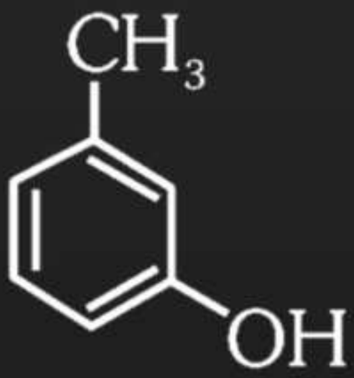
(a)



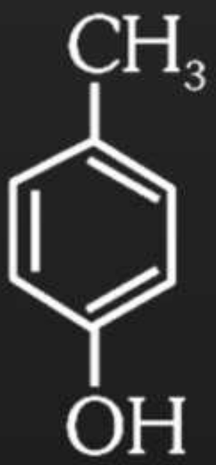
(b)



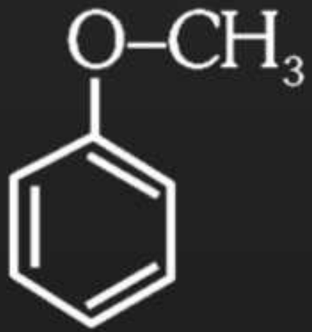
(c)



(d)



(e)

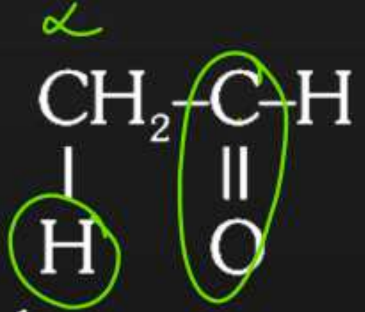


- a, b – Functional isomers
- b, c – Position isomers
- c, d – Position isomers
- a, d – Functional isomers
- a, e – Functional isomers
- a, c – Functional isomers

Note : Alcoholic and phenolic groups are Functional isomers.

TAUTOMERISM OR DESMOTROPISM

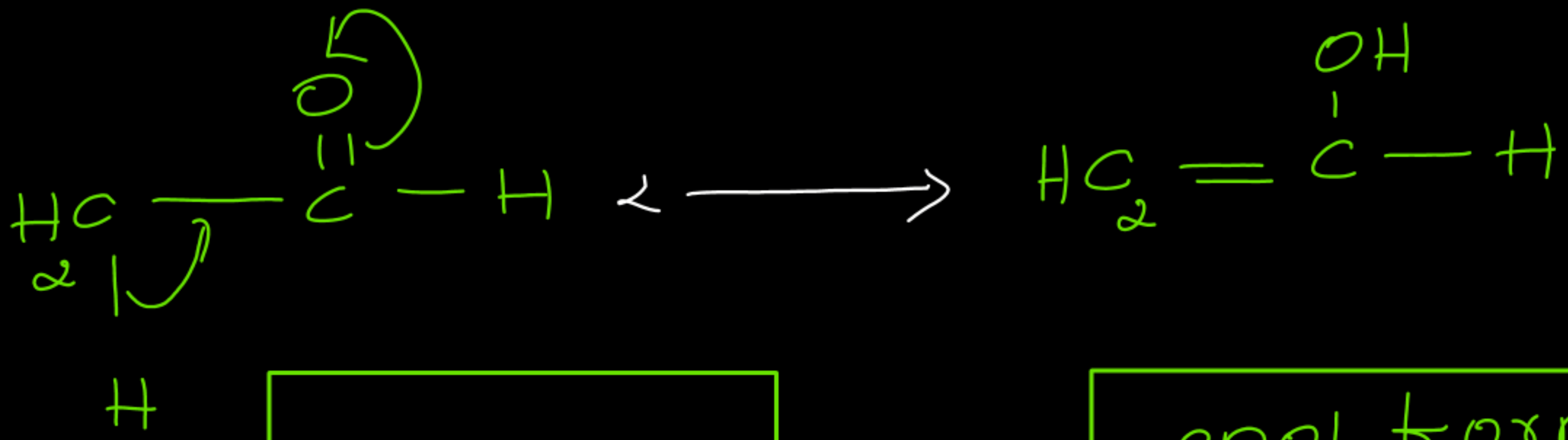
- Tautomers have same molecular formula but different structural formula due to migration of active hydrogen from one polyvalent atom to another polyvalent atom. This pnenomena is known as tautomerism.
- Desmotropism means bond turning. [Desmos = Bond; Tropos = Turn]



$$\underset{\underset{H}{|}}{\overset{\alpha}{CH_2}}-\underset{\underset{O}{\|}}{C}-H$$

α–Hydrogen or active H

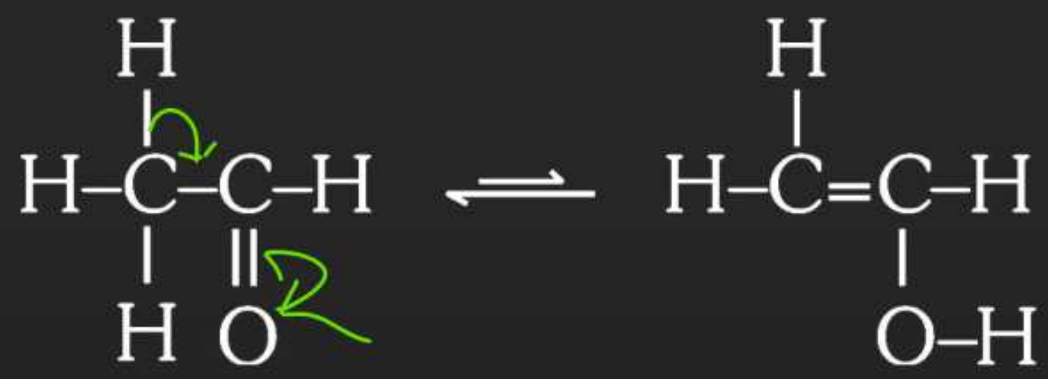
α–H of carbonyl compound is active H



$$\underset{\underset{H}{|}}{\underset{\alpha}{HC}}-\overset{\overset{O}{\|}}{C}-H \longleftrightarrow H\underset{\alpha}{C}=\overset{\overset{OH}{|}}{C}-H$$

keto form

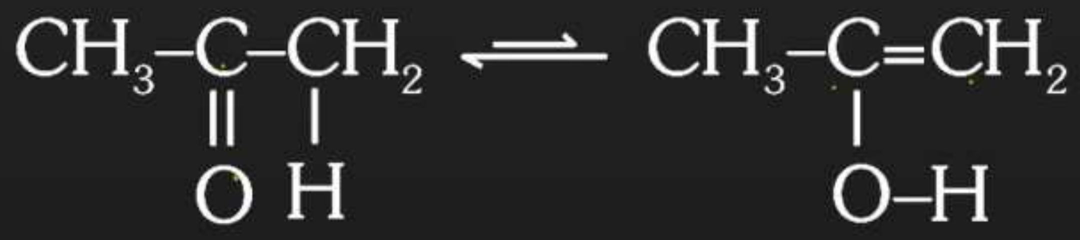
enol form

Ex. 

$$H{-}\overset{\displaystyle H}{\underset{\displaystyle H}{C}}{-}\underset{\displaystyle O}{\overset{}{\underset{\Vert}{C}}}{-}H \rightleftharpoons H{-}\overset{\displaystyle H}{C}{=}\underset{\displaystyle O{-}H}{C}{-}H$$

7σ

3σ

Ex. 

$$CH_3{-}\underset{\displaystyle O}{\underset{\Vert}{C}}{-}\underset{\displaystyle H}{CH_2} \rightleftharpoons CH_3{-}\underset{\displaystyle O{-}H}{C}{=}CH_2$$

keto

ene + ol = enol

Note : (1) Tautomers exist in dynamic equilibrium.

(2) By shifting of H–atom, π bond also changes its position.

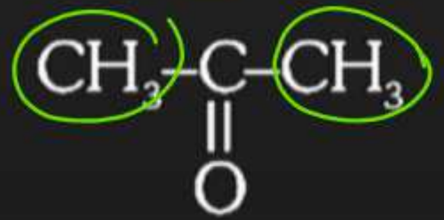
(I) Condition for Tautomerism :

(a) **For carbonyl compounds :** Carbonyl compounds having at least one active-H (α–H) show tautomerism

(i) 

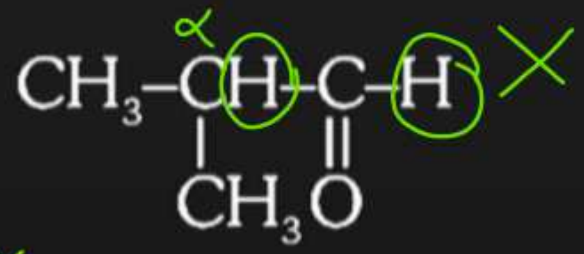
$CH_3-C(=O)-H$

3 α H, ✓ shows tautomerism.

(ii) 

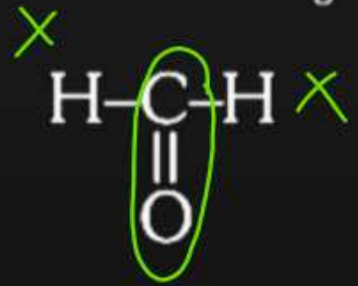
$CH_3-C(=O)-CH_3$

6 α H, ✓ shows tautomerism

(iii) 

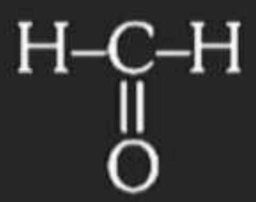
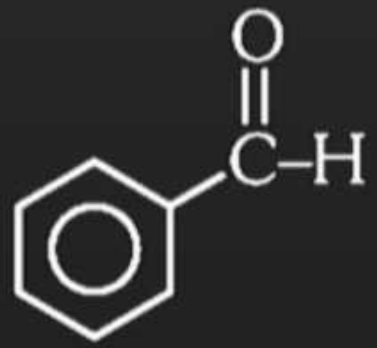
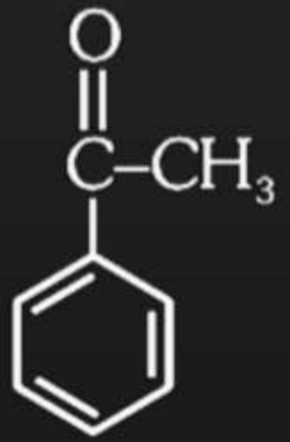
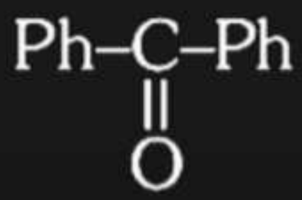
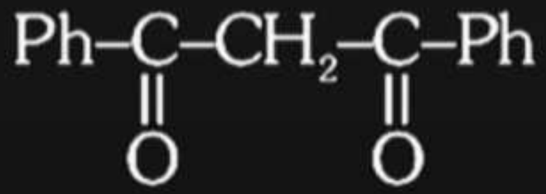
$CH_3-CH(CH_3)-C(=O)-H$

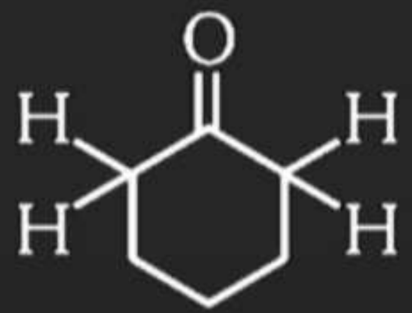
1 α H, shows tautomerism

(iv) 

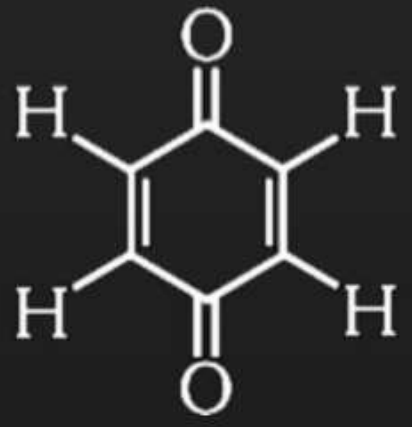
$H-C(=O)-H$

No α H, No tautomerism

(iv)	 $\mathrm{H-\underset{\underset{O}{\|}}{C}-H}$	No α H,	No tautomerism
(v)		No α H,	No Tautomerism
(vi)	 (Acetophenone)	3 α H,	shows tautomerism (Acetophenone)
(vii)	 $\mathrm{Ph-\underset{\underset{O}{\|}}{C}-Ph}$ (Benzophenone)	No α H,	No tautomerism (Benzophenone)
(viii)	 $\mathrm{Ph-\underset{\underset{O}{\|}}{C}-CH_2-\underset{\underset{O}{\|}}{C}-Ph}$	2 α H,	shows tautomerism

(ix) 

4 α H, shows tautomerism

(x) 

α–H, attached sp^2 carbon does not initiate in tautomerism

Question

A species having carbon with sextet of electrons and can act as electrophile is called

A. pentavalent carbon

B. carbanion

C. carbon free radical

[✓ D.] carbocation

(31 Jan 1st Shift 2024)

Question

The correct order of nucleophilicity is

How strong the given Nucleophile

$OH^{\ominus} > H_2O$

(A) $F^- > OH^-$ ✗

(B) $H_2\ddot{O} > :\ddot{O}H^{\ominus}$

(C) $R\ddot{O}H > R\ddot{O}^-$

(D) $NH_2^{\ominus} > NH_3$

$C^{\oplus}$

$RO^{\ominus} > ROH$

$C^{\oplus}$ ← $e^{\ominus}$ donate supporting

$OH^{\ominus}$, $F^{\ominus}$

2nd period

N, O, F

Electronegativity

C ⇇

(26 Jun 2nd Shift 2022)

Question

The IUPAC name of the alkane  is

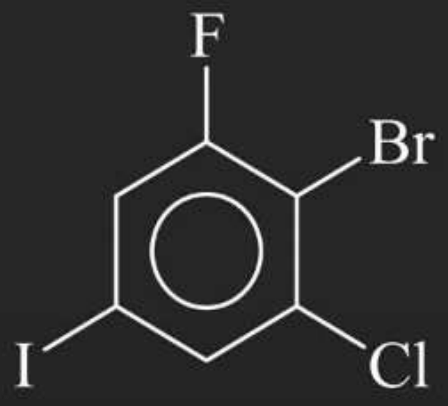
A 2,2,6,6,7-pentamethyloctane

B 2,3,3,7,7-pentamethyloctane

C 5-tert-butyl-2-isopropyl-2-methylpentane

D 2-isopropyl-2,6,6-trimethylheptane.

Question

The correct name of 

is

A 1-bromo-2-chloro-6-fluoro-4-iodobenzene

B 1-bromo-6-chloro-2-fluoro-4-iodobenzene

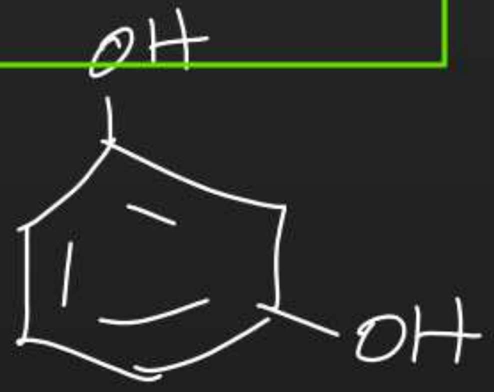
C [✓ 2-bromo-1-chloro-3-fluoro-5-iodobenzene]

D 2-bromo-3-chloro-1-fluoro-5-iodobenzene

Question

What is the minimum number of carbon atoms of an alkane must have to form an isomer?

- **A** 4
- **B** 3
- **C** 2
- **D** 1

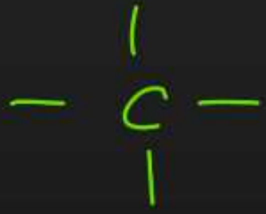


Resorcinol

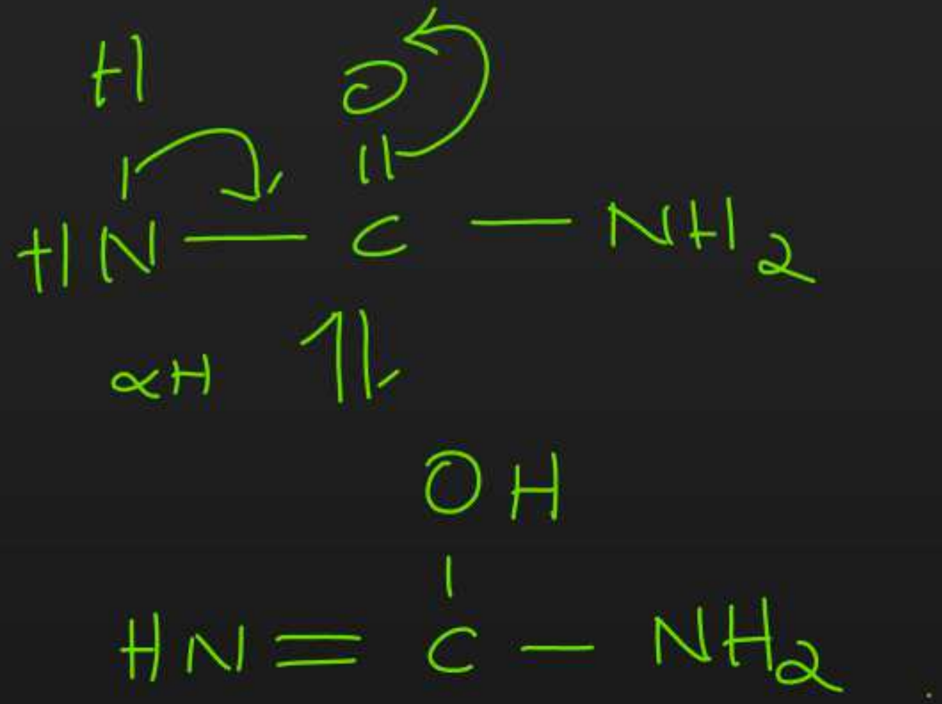
Question

The type of isomerism observed in urea molecule is

- **A** functional isomers ×
- **B** optical isomers



- **C** positional isomers ×
- **D** tatomerism



Question

How many chain isomers could be obtained from the alkane C_6H_{14}?

C_nH_{2n}

C_nH_{2n+2}

$C_6H_{2(6)+2}$

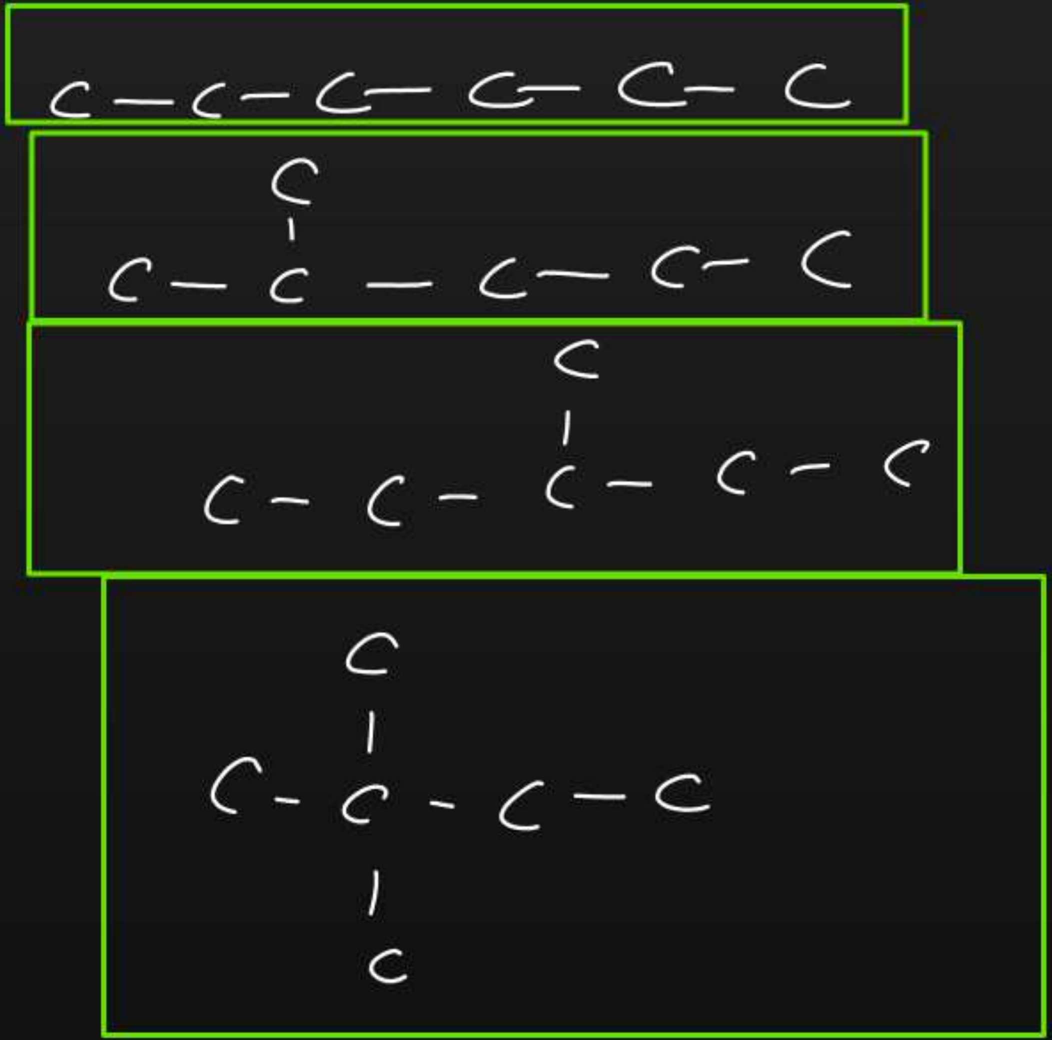
C_6H_{14}

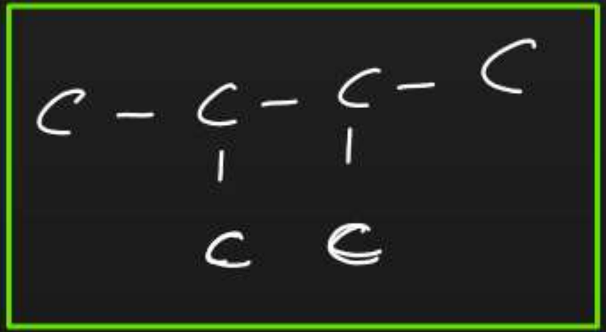
A Four

[✓ B] Five

C Six

D Seven





Question

An isomer of ethanol is

H_3C-CH_2-OH

$\downarrow$

$H_3C-O-CH_3$

- A methanol
- B diethyl ether
- C acetone
- [✓ D] dimethyl ether

Question

In which of the following, functional group isomerism is not possible?

(A) Alcohols

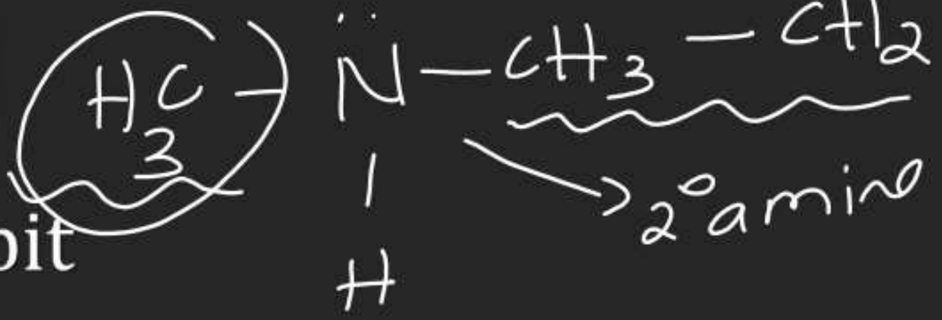
(B) Aldehydes

[✓ (C) Alkyl halides]

(D) Cyanides

Question

Amines exhibit

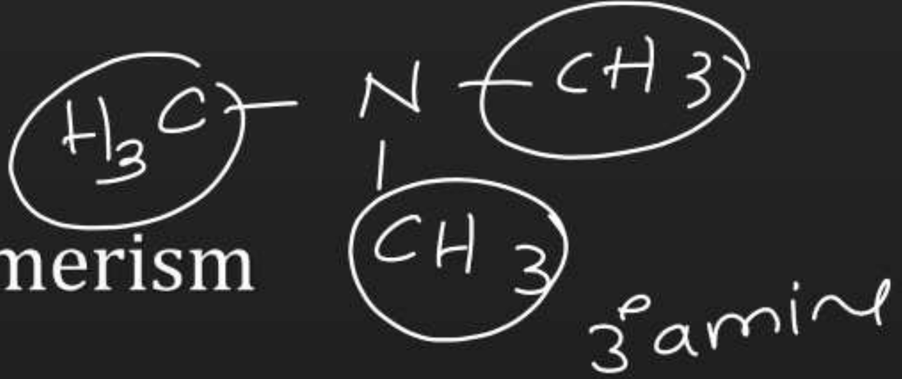


$H_3C-\underset{\underset{H}{|}}{\ddot{N}}-CH_3-CH_2$

2° amine

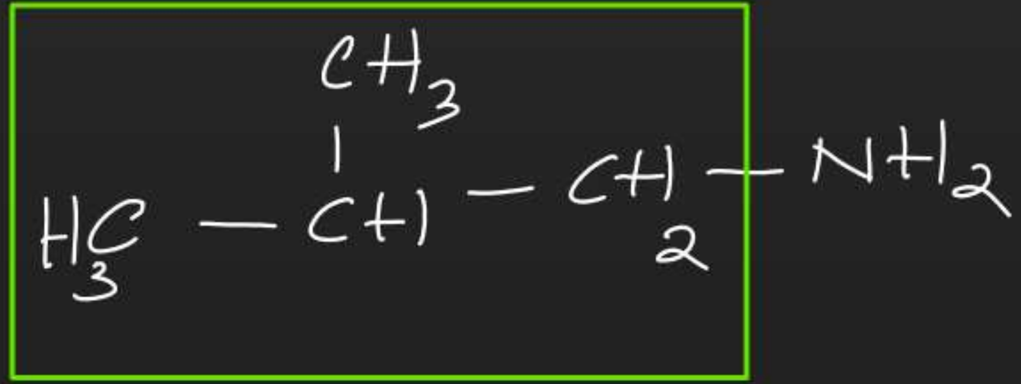
$H_3C-CH_2-CH_2-CH_2-NH_2$.

n-butanamine.



$H_3C-\underset{\underset{CH_3}{|}}{N}-CH_3$

3° amine

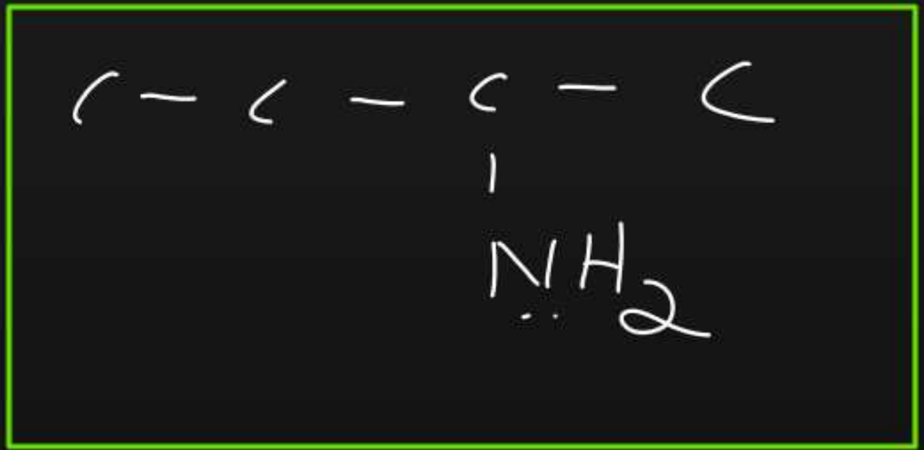


$H_3C-\overset{\overset{CH_3}{|}}{CH}-CH_2-NH_2$

Isobutylamine

- **A** ✓ position isomerism
- **B** ✓ functional isomerism
- **C** metamerism ✓
- **D** ✓ all are correct

$C-C-C-C-C-\ddot{N}H_2$



$C-C-\underset{\underset{\ddot{N}H_2}{|}}{C}-C$

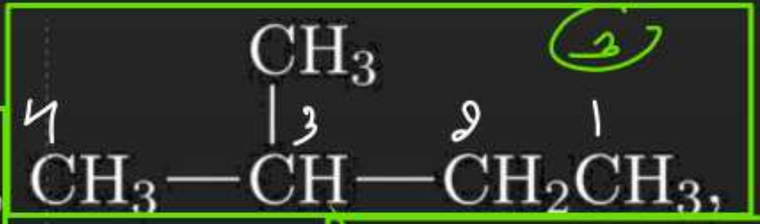
Question

The type of isomerism shown by the following compounds is

5 4 3 2 1

$CH_3CH_2CH_2CH_2CH_3$,

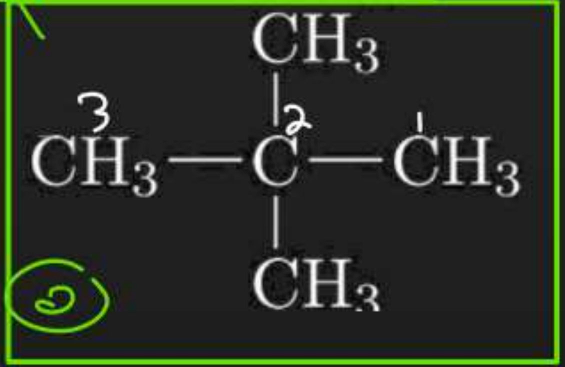
①



$CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2CH_3$,

4 3 2 1

②

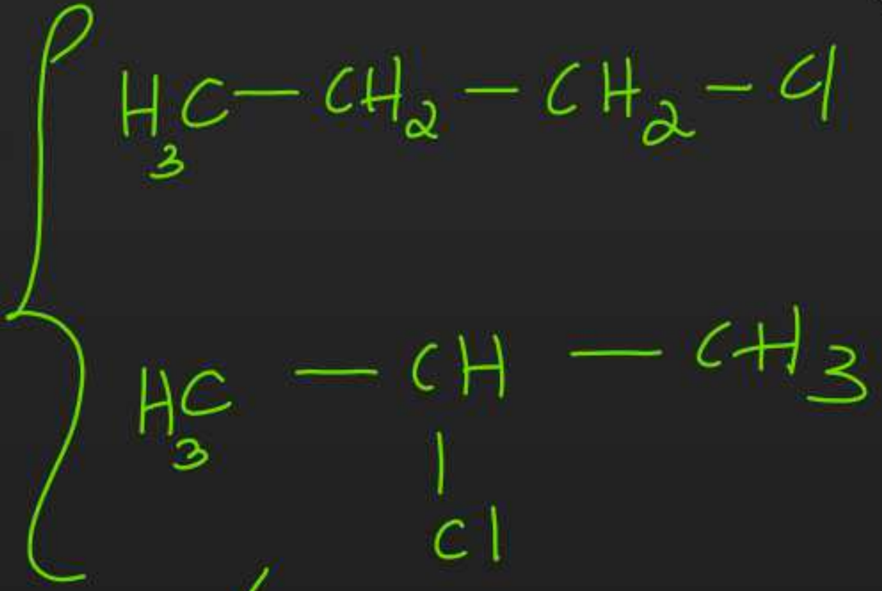


$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

3 2 1

②

- **A** position isomerism
- **B** metamerism ×
- **C** ring-chain isomerism
- **D** chain isomerism. ✓



$H_3C-CH_2-CH_2-Cl$

$H_3C-\underset{\underset{Cl}{|}}{CH}-CH_3$

position isomer

O
||
C

–O–

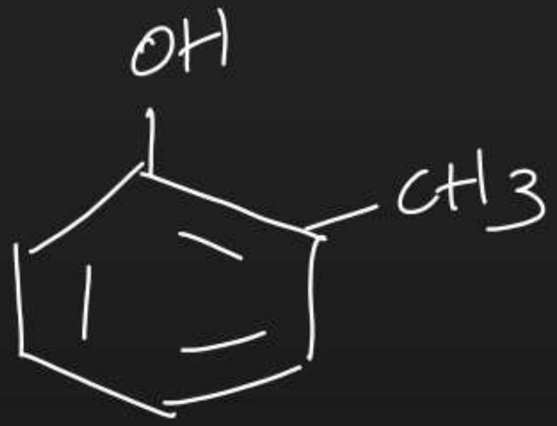
–S–

COO

Question

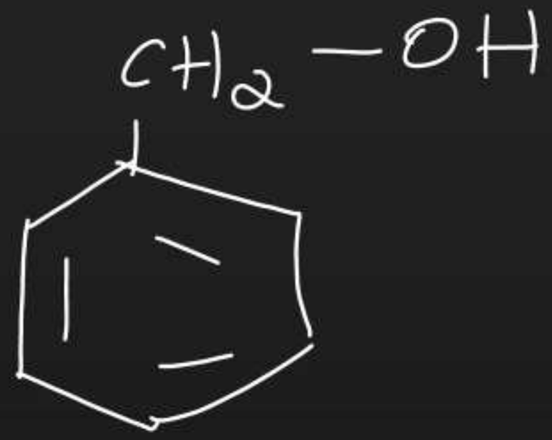
o-Hydroxytoluene and benzyl alcohol are

- **A** position isomers
- **~~B~~** functional isomers
- **C** chain isomers ×
- **D** none of these



o-cresol

phenol



alcohol

ELECTRONIC EFFECTS

There are four effects which affect the chemical reaction due to transfer of electron

(1) Inductive effect ✓

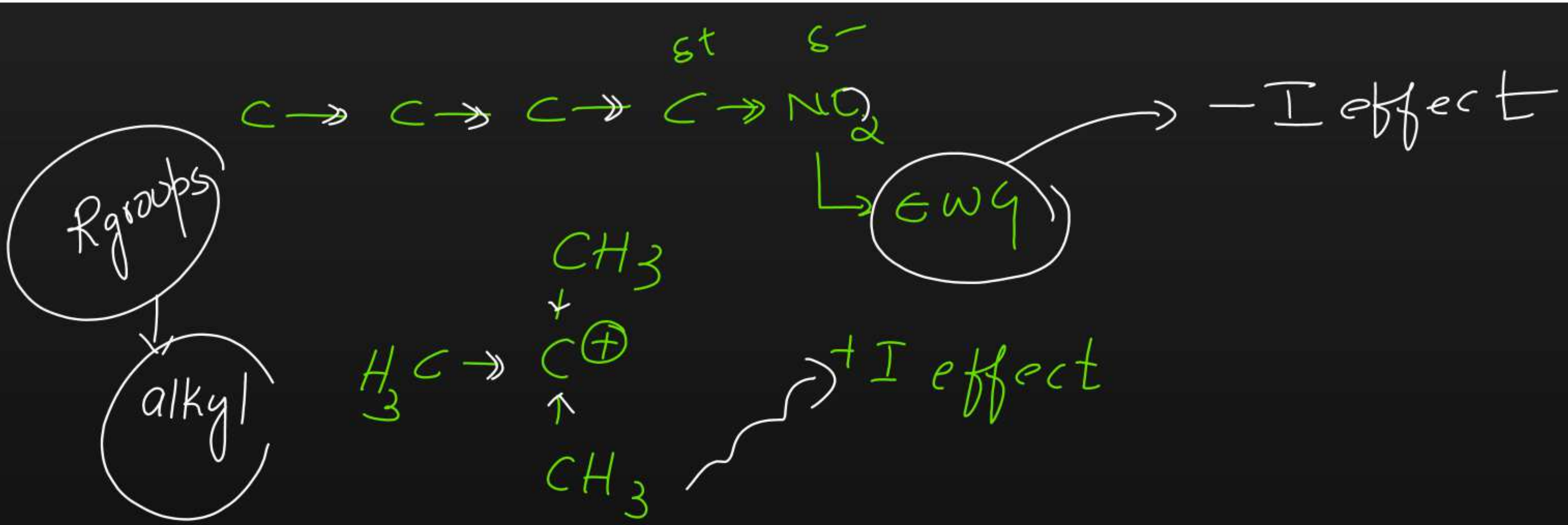
(2) Mesomeric effect ✓

(3) Hyperconjugation ✓

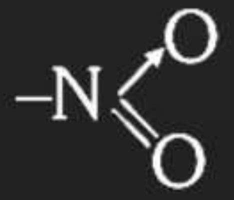
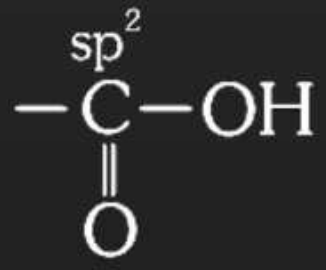
(4) Electromeric effect ✓

INDUCTIVE EFFECT (I-EFFECT)

Polarity induced in non polar σ bond due to presence of adjacent polar bond is known as inductive effect.



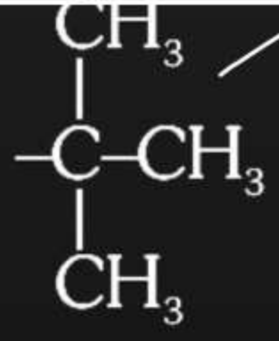
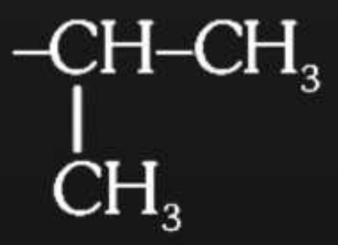
–I groups : → E.W.G.

$-\overset{\oplus}{O}R_2 > -\overset{\oplus}{N}R_3 > -\overset{\oplus}{N}H_3 > -NO_2 > -\overset{sp}{C}\equiv N > -\overset{sp^2}{C}(=O)-OH$

$-X > -OR > -OH > -C\equiv CH > -NH_2 > Ph > -CH=CH_2 > H (I \approx O)$

+I groups :

$-\overset{\ominus}{N}H > -\overset{\ominus}{O} > -CO\overset{\ominus}{O} > -C(CH_3)_2-CH_3 > -CH(CH_3)-CH_3 > -CH_2-CH_3 > -CT_3$

→ t-butyl

→ isopropyl

→ Ethyl

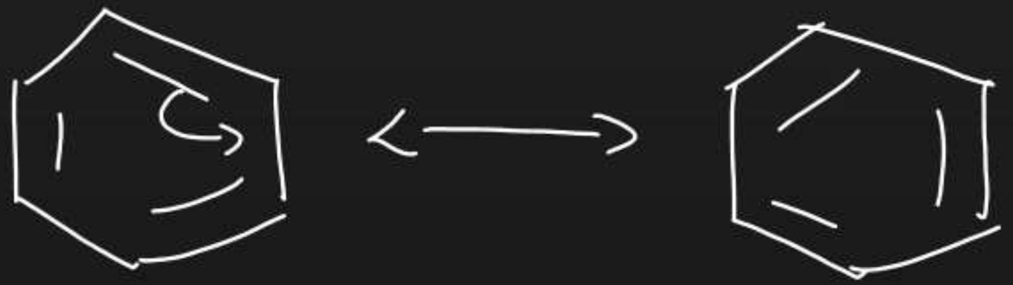
→ methyl

T, D, H → E.D.G.

$-CD_3 > -CH_3 > T > D > H (I \approx O)$

RESONANCE OR MESOMERIC EFFECT

Delocalization of πe^- is called as resonance or complete transfer of πe^- from one atom to another atom when they are in conjugation with difference of only one σ bond is called as Resonance.



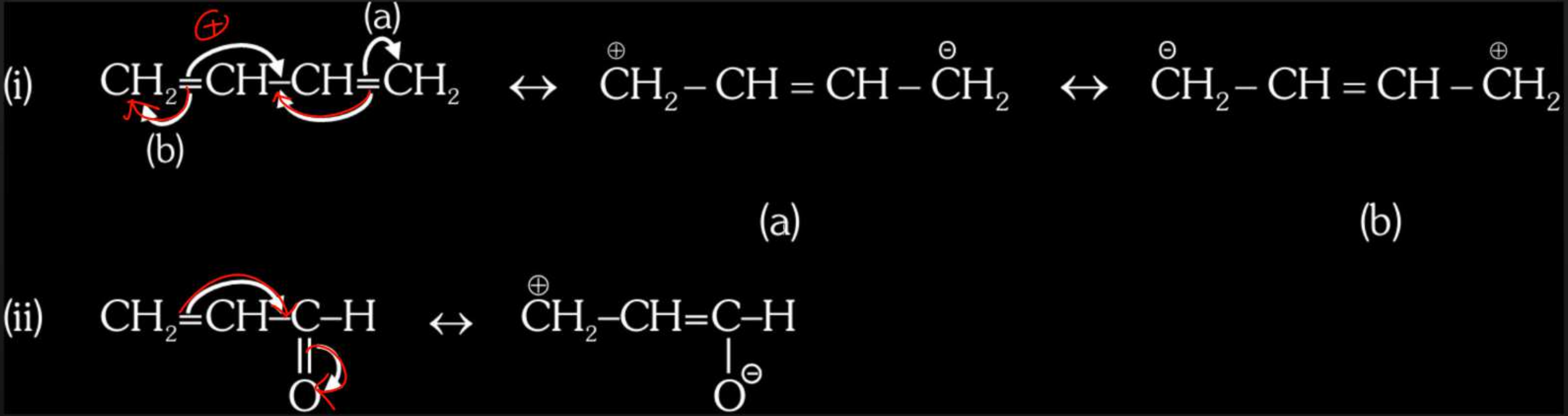
① ②

Types of conjugations :

(1) π−π conjugation.

If there are two π bonds in conjugation then e− of one π bond are transferred towards another π bond.

Ex.



(i) $$CH_2=CH-CH=CH_2 \leftrightarrow \overset{\oplus}{C}H_2-CH=CH-\overset{\ominus}{C}H_2 \leftrightarrow \overset{\ominus}{C}H_2-CH=CH-\overset{\oplus}{C}H_2$$

(ii) $$CH_2=CH-\underset{\underset{O}{\parallel}}{C}-H \leftrightarrow \overset{\oplus}{C}H_2-CH=\underset{\underset{O^{\ominus}}{|}}{C}-H$$

(2) π– lone pair conjugation

If there is lone pair or a negative charge and π bond are in conjugation then lone pair of e⁻ or negative charge are transferred towards π bond.

Ex. (i)

$CH_2=CH-\ddot{O}H \leftrightarrow \overset{\ominus}{C}H_2-CH=\overset{\oplus}{O}H$

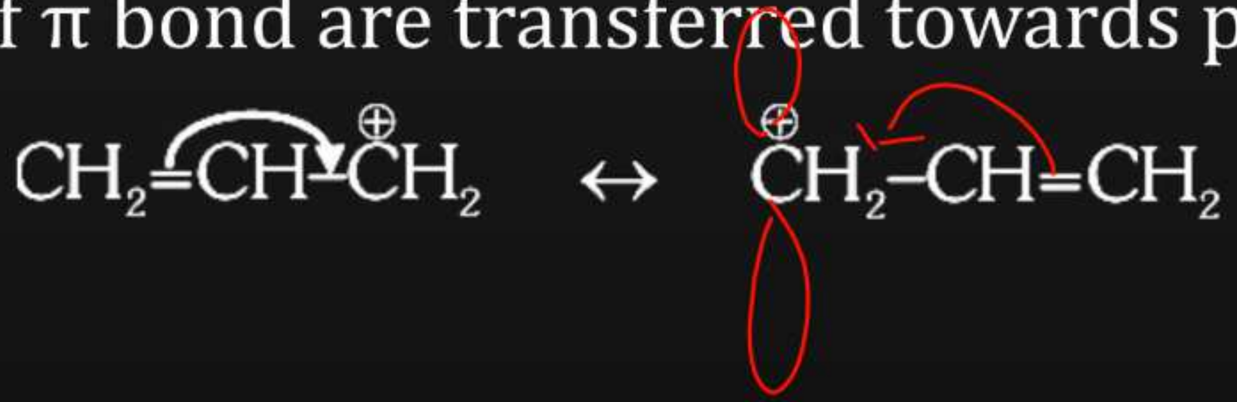
(ii)

$CH_2=CH-\overset{\ominus}{C}H_2 \leftrightarrow \overset{\ominus}{C}H_2-CH=CH_2$

(3) π– vacant orbital conjugation

If there is positive charge (vacant orbital) and π bond are in conjugation then e⁻ of π bond are transferred towards positive charge.

Ex.



$CH_2=CH-\overset{\oplus}{C}H_2 \leftrightarrow \overset{\oplus}{C}H_2-CH=CH_2$

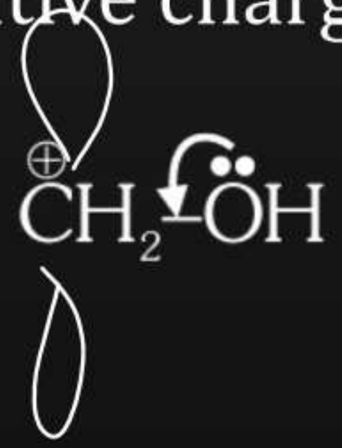
(4) π & odd electron shifting

If there is unpaired e^- and π bond are in conjugation.

Ex. $\dot{C}H_2=CH-\dot{C}H_2 \leftrightarrow \dot{C}H_2-CH=CH_2$ [⌒= transfer of unpaired e^-]

(5) lone pair - vacant orbital conjugation

If there is lone pair or negative charge and positive charge (vacant orbital) are in conjugation then e^- of lone pair or negative charge are transferred towards positive charge.



Ex. $\overset{\oplus}{C}H_2-\ddot{O}H \leftrightarrow CH_2=\overset{\oplus}{\ddot{O}}H$

(4) π– unpaired electron conjugation

If there is unpaired e⁻ and π bond are in conjugation.

Ex. 
$CH_2{=}CH{-}\dot{C}H_2 \leftrightarrow \dot{C}H_2{-}CH{=}CH_2$ [⌒ = transfer of unpaired e^-]

(5) lone pair - vacant orbital conjugation

If there is lone pair or negative charge and positive charge (vacant orbital) are in conjugation then e⁻ of lone pair or negative charge are transferred towards positive charge.

Ex. 
$\overset{\oplus}{C}H_2{-}\ddot{O}H \leftrightarrow CH_2{=}\overset{\oplus}{O}H$

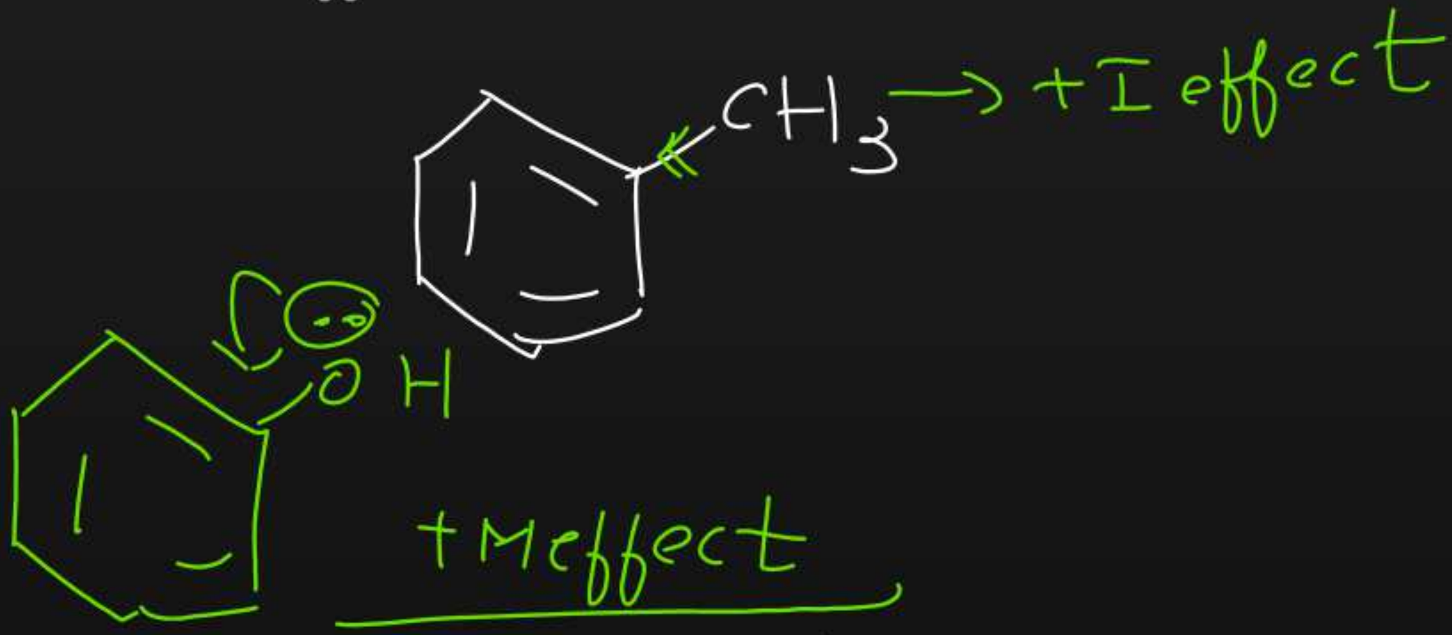
M-effect : Delocalisation of electron in conjugated system (due to presence of EWG or EDG) is known as 'M' effect.

(1) **+M effect :** Group that donates the electron pair to conjugated system is known as +M effect exerting groups and the phenomena is known as +M effect.

+M group : Lone pair containing group like

e.g. $-\ddot{N}H_2, -\ddot{\underset{\cdot\cdot}{O}}H, -\ddot{\underset{\cdot\cdot}{O}}R, -\ddot{N}R_2, -\ddot{\underset{\cdot\cdot}{S}}H, -\ddot{N}HR, -\ddot{\underset{\cdot\cdot}{X}}:, -\ddot{N}HCOCH_3$

e.g.



$\dfrac{\text{+M effect}}{\text{+R effect}}$

–OH group lone pair donor

So + M of –OH group

(2) **−M effect :** Group, that withdraws electron pair from the conjugated system, is known as −M effect exerting groups and the phenomena is known as −M effect.

−M group : —CHO, —COOH, —COOR, —COR, $—NO_2$, —CN, —COX, $—CONH_2$, $—SO_3$

e.g:

−CHO group withdrawing e^-.

So −CHO is −M group

−I effect

$\longrightarrow$ −M / −R effect

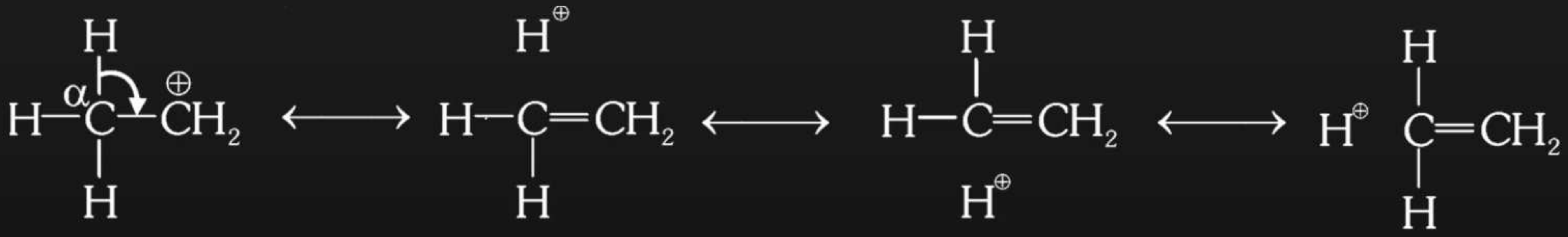
HYPERCONJUGATION EFFECT (H-EFFECT)

Complete transfer of e– of C–H σ bond towards π bond or positive charge or unpaired electron is called as H-effect (permanent effect). It is also called as No bond resonance (given by Nathen and Baker).

CONDITIONS OF H-EFFECT

1. If there is C–H σ bond and positive charge are in conjugation

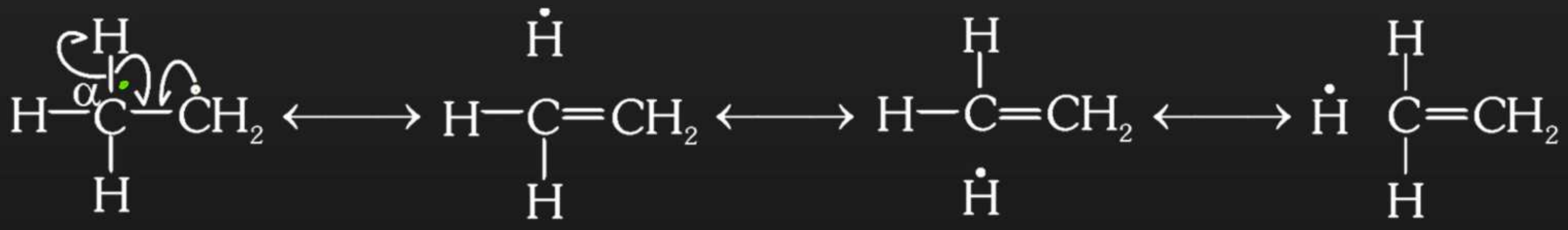
   Carbon which is attached to positively charged carbon is called as α –C and H which is attached to α –C is called as α – H. So if number of α – H are more, then there will be more number of hyperconjugating structures, so more stable will be the carbocation.



all are called as hyperconjugating structures or canonical structures.

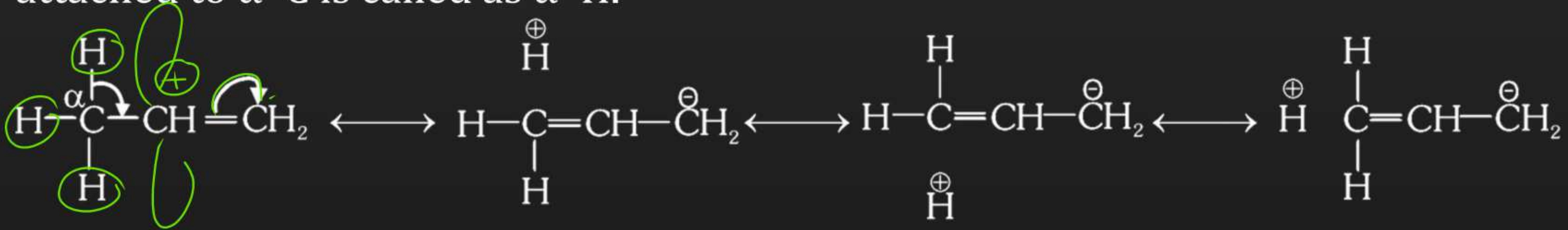
2. If there is C–H σ bond and unpaired electron are in conjugation then there will be H-effect.

Carbon, which is attached to C having unpaired e–, is called as α–C and H which are attached to α-C are called as α-H.

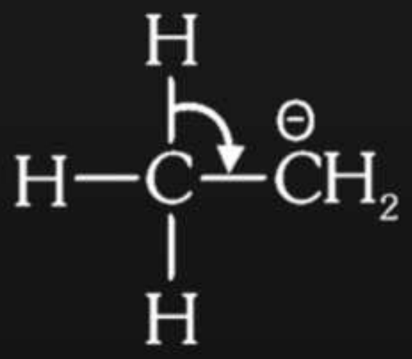


3. If there is C–H σ bond and π bond are in conjugation then there will be H-effect.

sp^3 carbon which is attached to double bonded C is called as α–C and H attached to α–C is called as α–H.


$$H_3\overset{\alpha}{C}-CH=CH_2 \longleftrightarrow \overset{\oplus}{H}\;H_2C=CH-\overset{\ominus}{C}H_2 \longleftrightarrow H_2C=CH-\overset{\ominus}{C}H_2\;\overset{\oplus}{H} \longleftrightarrow \overset{\oplus}{H}\;H_2C=CH-\overset{\ominus}{C}H_2$$

Note : If there is C—H σ bond and negative charge in conjugation then there will be no H-effect.


$$H_3C-\overset{\ominus}{C}H_2$$

(No H - effect)

no shifting of C—H σ bond, because anion is having complete octet. ($8e^-$)

Stability of carbocation / Free Radical /Alkene

- Stability $\propto$ No. of hyperconjugating structures $\propto$ No. of α H.

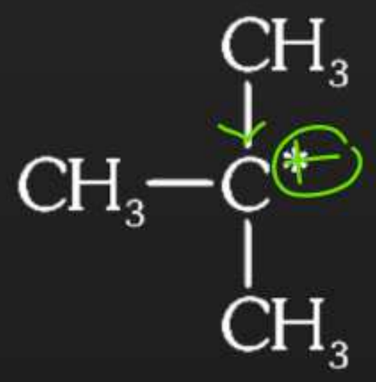
Hyperconjugation

Example : Give stability order for Carbocation

Inductive

+I

(i)



$$CH_3-\overset{*}{C}(CH_3)_2$$

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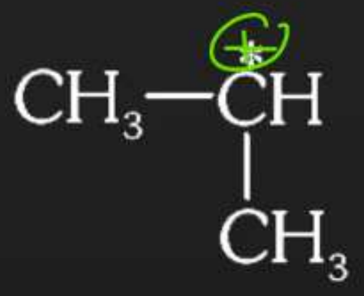


$$CH_3-\overset{*}{C}H-CH_3$$

> $CH_3-\overset{*}{C}H_2$ > $\overset{*}{C}H_3$ (* = +/•)

9 α-H

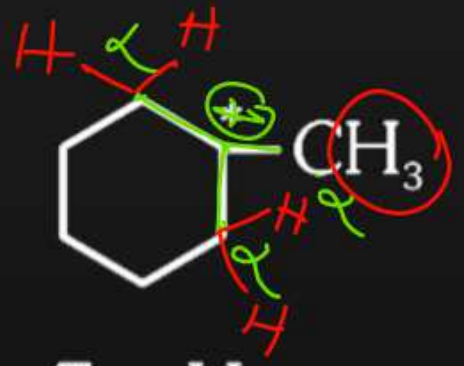
Maximum stable

6 α-H

3 α-H

Zero α-H

(ii)



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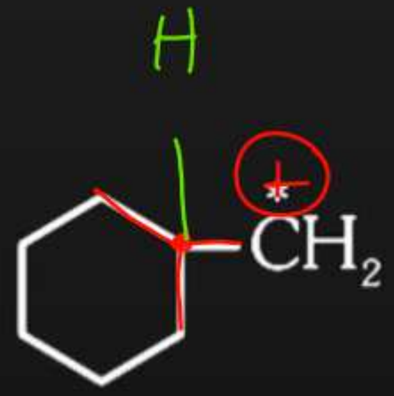


(* = +/•)

7 α-H

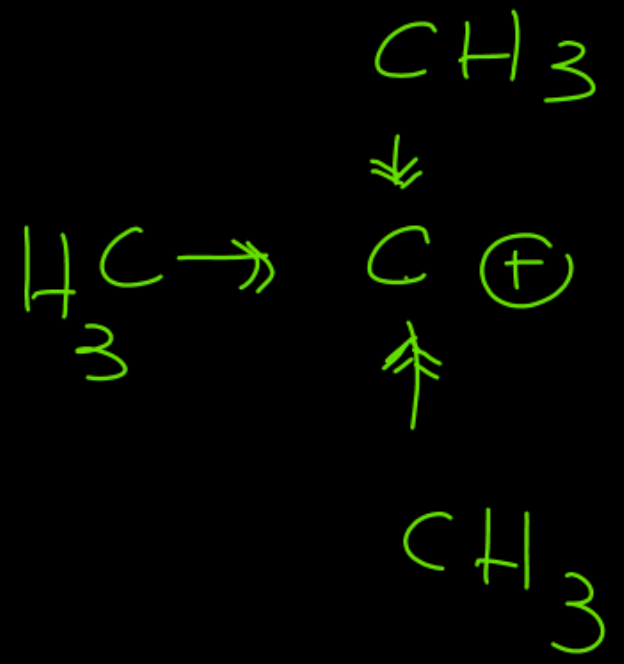
Maximum stable

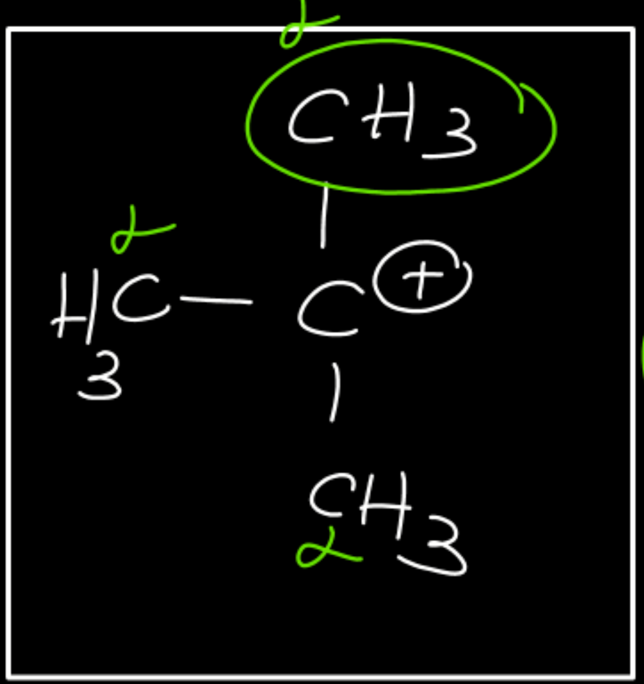
4 α-H

1 α-H

Inductive effect

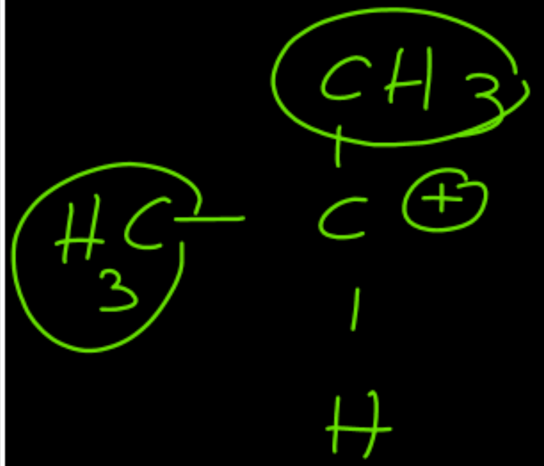
Hyper conjugation

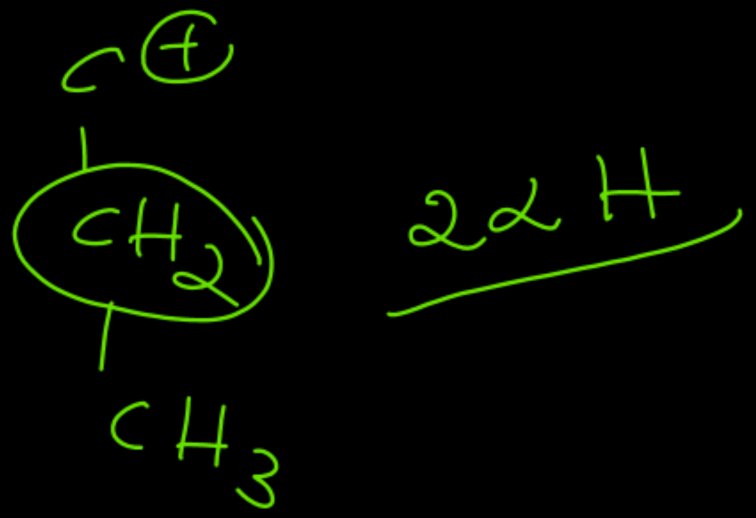




6

αH



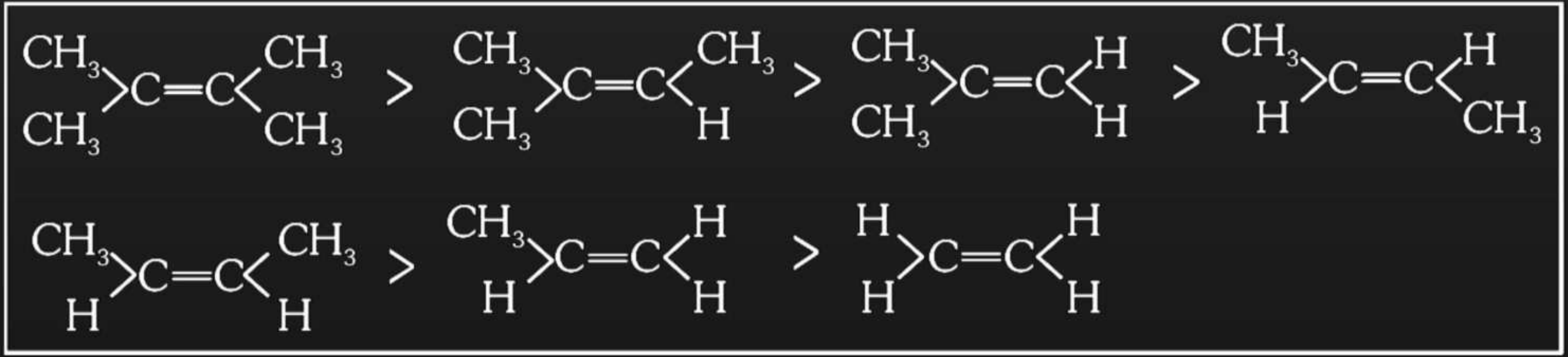


(iii) $CH_3\text{–}CH{=}CH_2 \quad > \quad CH_2{=}CH_2$

3 α-H   Zero α-H

more stable

(iv) Stability order of alkenes will be



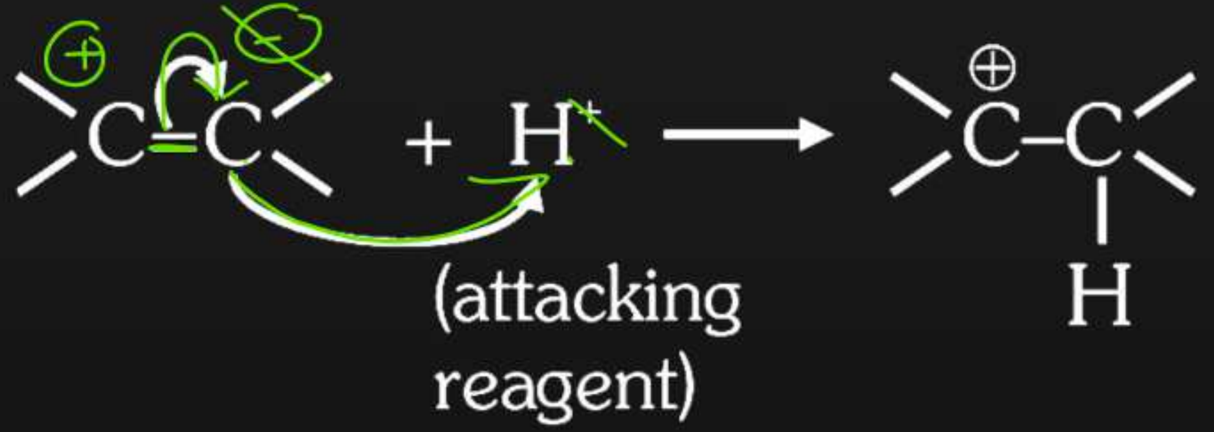
$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>C=C<\!\!\begin{matrix}CH_3\\CH_3\end{matrix} \;>\; \begin{matrix}CH_3\\CH_3\end{matrix}\!\!>C=C<\!\!\begin{matrix}CH_3\\H\end{matrix} \;>\; \begin{matrix}CH_3\\CH_3\end{matrix}\!\!>C=C<\!\!\begin{matrix}H\\H\end{matrix} \;>\; \begin{matrix}CH_3\\H\end{matrix}\!\!>C=C<\!\!\begin{matrix}H\\CH_3\end{matrix}$$

$$\begin{matrix}CH_3\\H\end{matrix}\!\!>C=C<\!\!\begin{matrix}CH_3\\H\end{matrix} \;>\; \begin{matrix}CH_3\\H\end{matrix}\!\!>C=C<\!\!\begin{matrix}H\\H\end{matrix} \;>\; \begin{matrix}H\\H\end{matrix}\!\!>C=C<\!\!\begin{matrix}H\\H\end{matrix}$$

ELECTROMERIC EFFECT : (E Effect)

Complete transfer of a shared pair of π-electrons from one atom to another atom in presence of attacking reagent, is known as 'E' effect.

(i) **Positive Electromeric Effect (+ E effect) :** In this effect the π -electrons of the multiple bond are transferred to that atom to which the reagent gets attached. For example :



(ii) **Negative Electromeric Effect (–E effect) :** In this effect the π-electrons of the multiple bond are transferred to that atom, to which the attacking reagent does not get attached. For example.

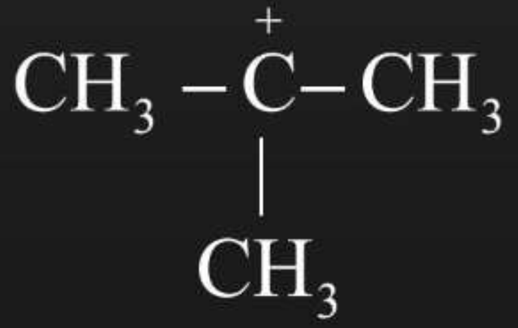
Question

Which of the following is least stable?

(A) $CH_3-CH_2-\overset{+}{C}H_2$

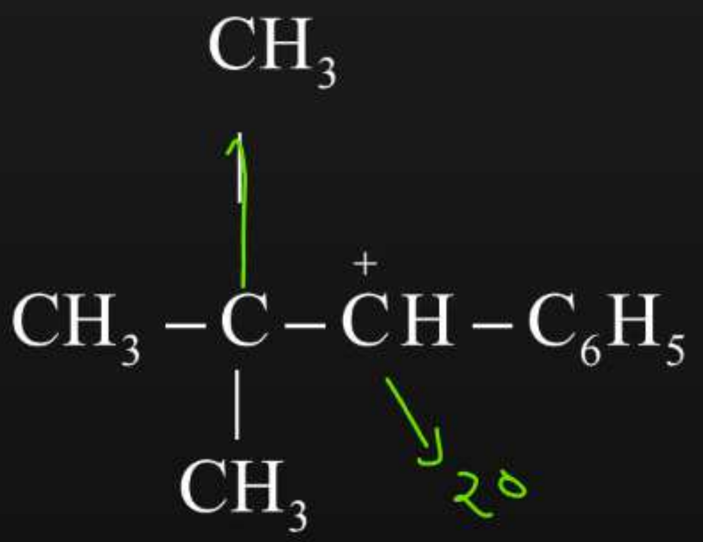
(B) $CH_3-\overset{+}{C}H-CH_2-CH_3$

(C)



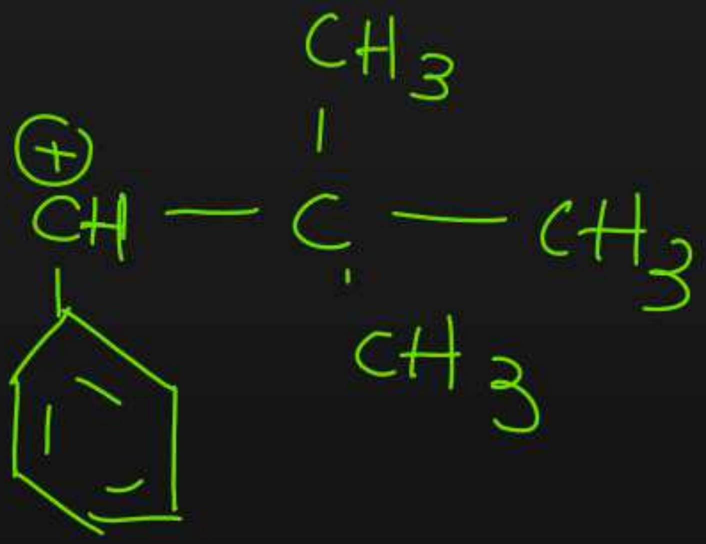
$CH_3-\overset{+}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

(D)



$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\overset{+}{C}H-C_6H_5$

2°



Question

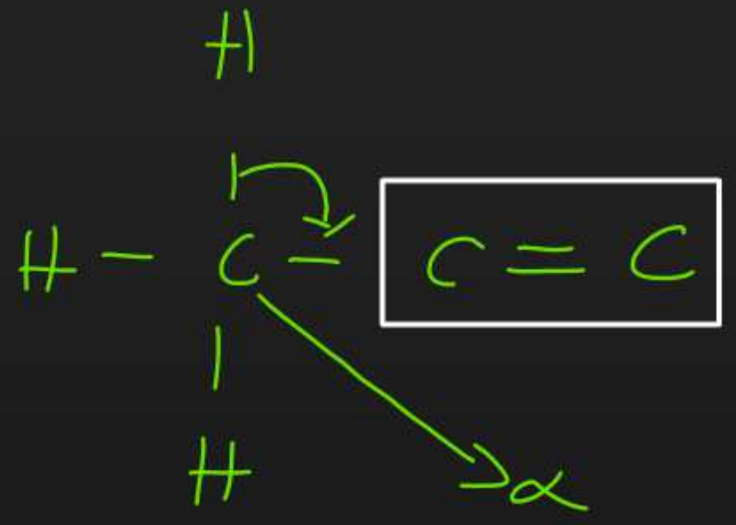
In hyperconjugation, the atom involved is:

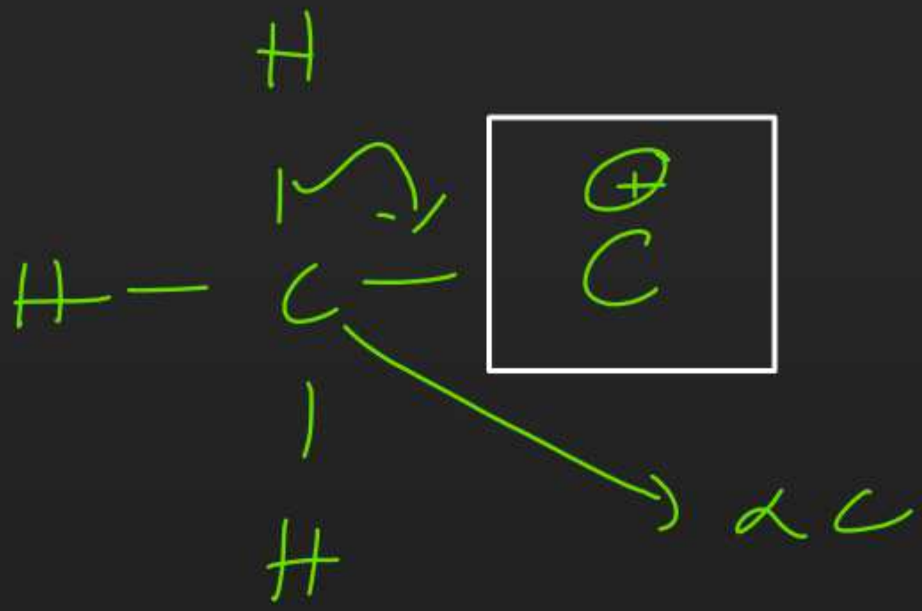
(A) β-H atom

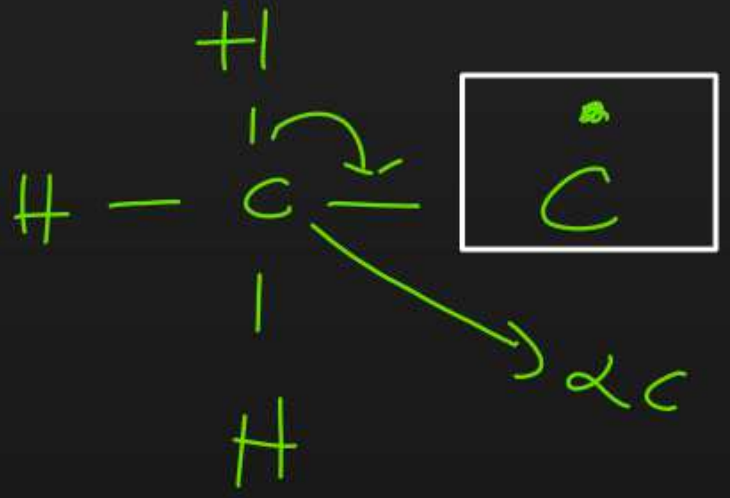
[✓ (B)] α-H atom

(C) γ-H atom

(D) All of these







Question

EDG

The + *I*-effect (inductive effect) is shown by

(A) $-CH_3$

(B) $-OH$

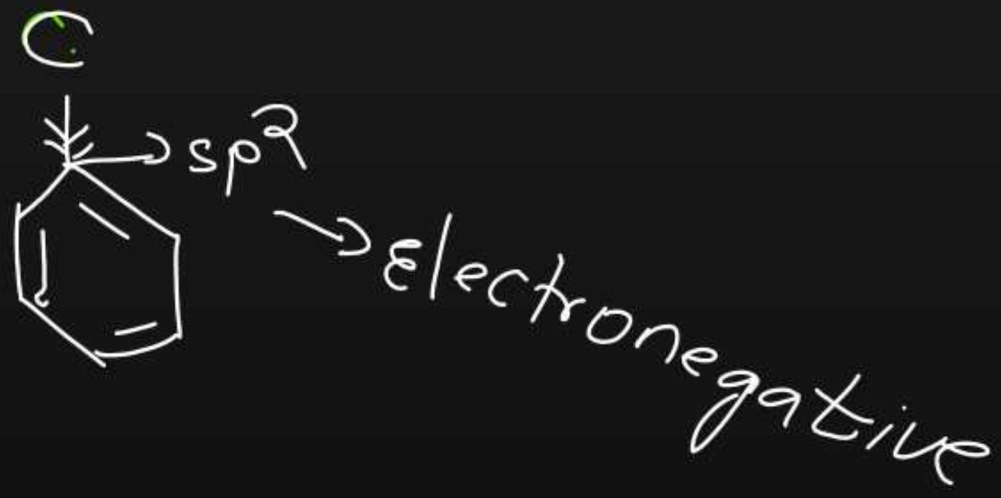
(C) $-F$

(D) $-C_6H_5$

$C \leftleftarrows CH_3$

$C \rightrightarrows \ddot{\underset{\cdot\cdot}{O}}H$

$C \rightrightarrows F$



Question

C_3H_7 $C-C-C$ C_2H_5 CH_3

The increasing order of + *I*-effect shown by H, CH_3, C_2H_5 and C_3H_7 is

(A) $-H < -CH_3 < -C_2H_5 < -C_3H_7$ ✓

(B) $-H > -CH_3 > -C_2H_5 > -C_3H_7$

(C) $-H < -C_2H_5 < -CH_3 < -C_3H_7$

(D) None of these

$-I$

EWG → takers

$-M$

$+I$

EDG → helper.

$+M$

$-E$

$+E$

away from $CN^{\ominus}$

towards H^+

$NO_2^{\oplus}$

$OH^{\ominus}$

Question

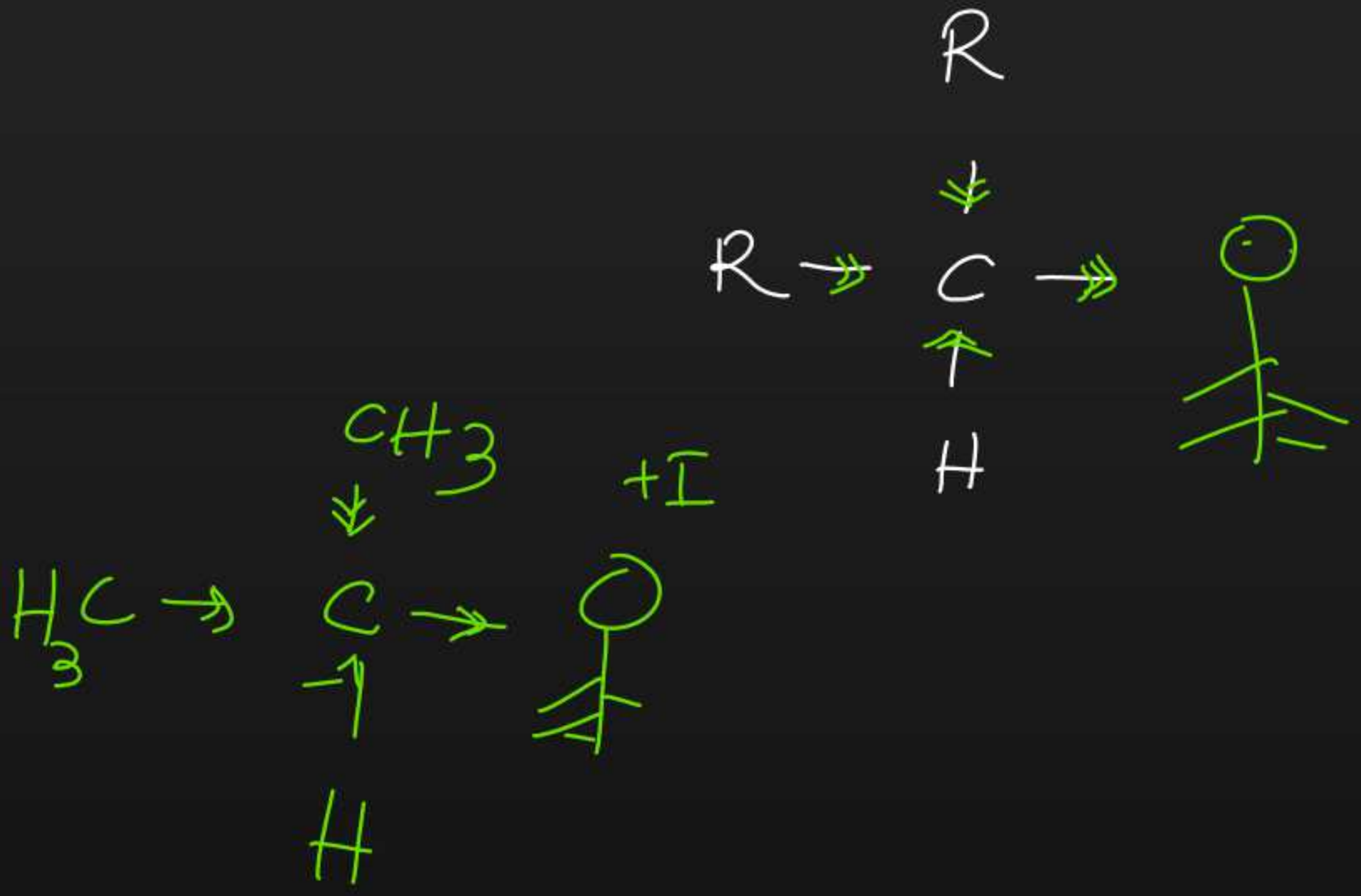
The + *I*-effect is shown by:

(A) $-\text{COOH}$

(B) $-\text{CH}_3$

(C) $-\text{CH}_2\text{CH}_3$

(D) $-\text{CH}R_2$



Question

Shifting of electrons of multiple bond under the influence of a reagent is called.

Ⓐ I-effect

[✓ Ⓑ] E-effect

Ⓒ M-effect

Ⓓ None of these.

QUESTION-15

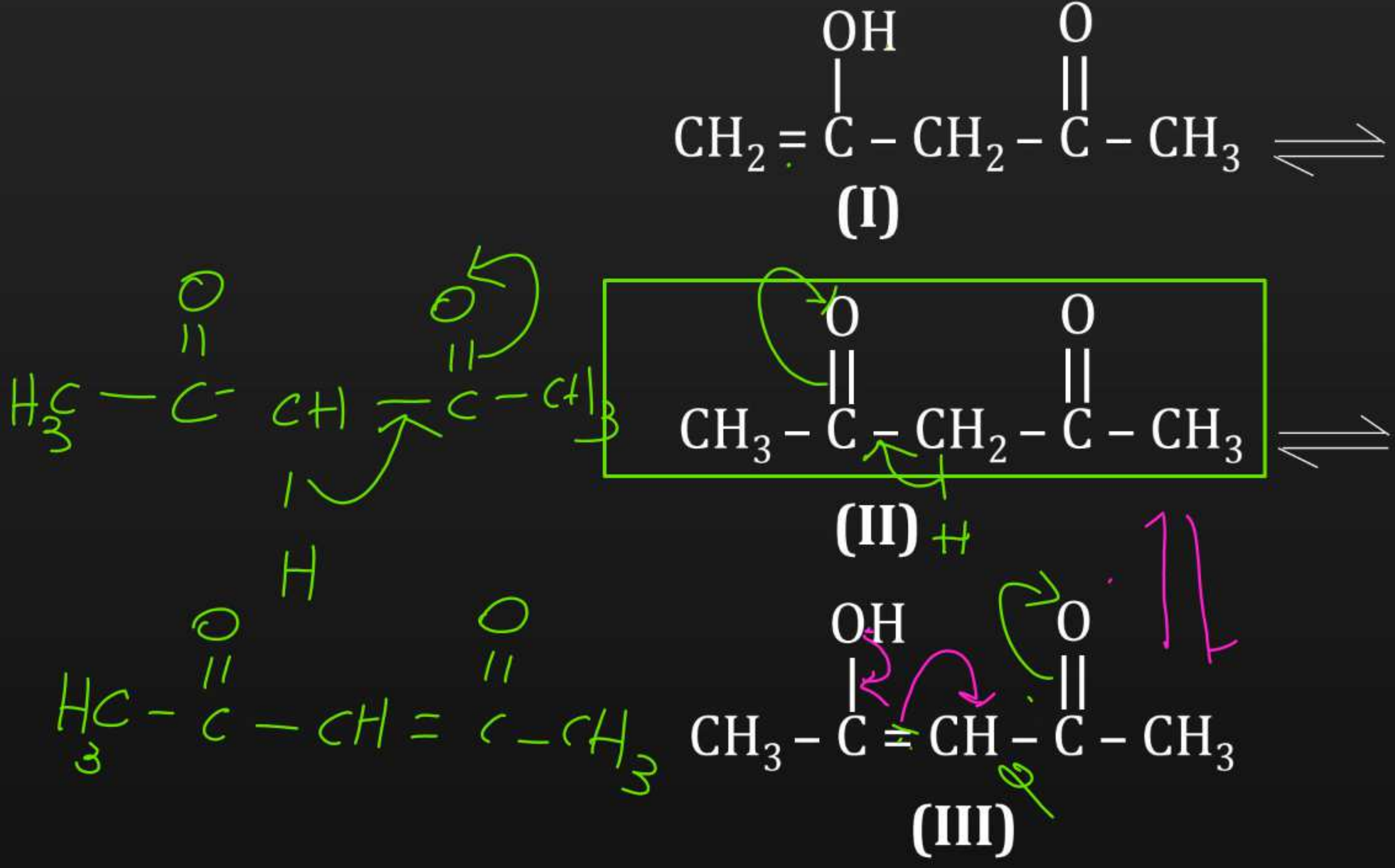
The order of stability of the following tautomeric compound is:

(A) I > II > III ✗

(B) III > II > I ✗

(C) II > I > III

(D) II > III > I ✓



$CH_2=\overset{\overset{OH}{|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3 \rightleftharpoons$ (I)

$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3 \rightleftharpoons$ (II)

$CH_3-\overset{\overset{OH}{|}}{C}=CH-\overset{\overset{O}{\|}}{C}-CH_3$ (III)

Thank

You