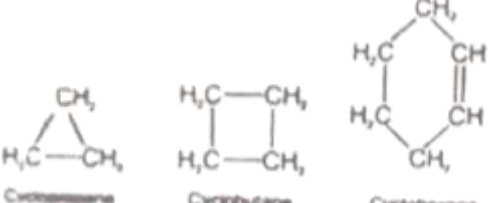
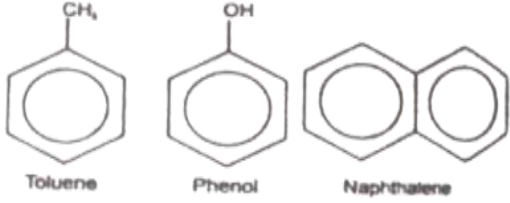


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Give Short Answers of the Following Questions

1. Differentiate between Alicyclic and Aromatic compounds.

Ans.

Alicyclic Compounds	Aromatic Compounds
The homocyclic compounds which contain ring of three or more carbon atoms and resembling the aliphatic compounds are called alicyclic compounds	The homocyclic compounds which contain at least one benzene ring are called aromatic compounds.
They may be saturated or unsaturated.	They may contain one or more benzene rings.
They have low percentage of carbon.	They have high percentage of carbon.
 Cyclopropane Cyclobutane Cyclohexene	 Toluene Phenol Naphthalene

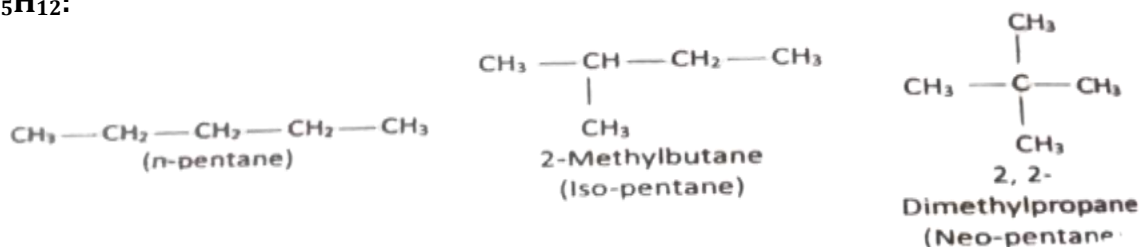
2. Define the term isomerism. Give examples.

Ans. Isomerism:

“Two or more compounds having the same molecular formula but different structural formulas and properties are said to be isomers and the phenomenon is called isomerism.”

Examples:

C_5H_{12} :



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3. How functional group isomerism differs from metamerism? Give examples.

Ans.

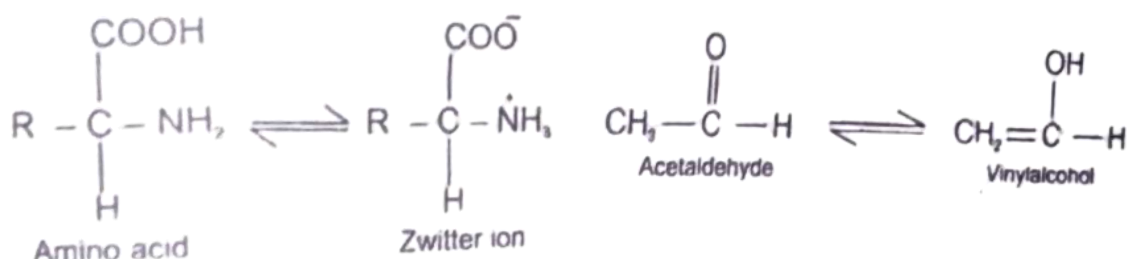
Functional Group Isomersim	Metamerism
The compounds having the same molecular formula but different functional groups are said to exhibit functional group isomerism.	This type of isomerism arises due to the unequal distribution of carbon atoms on either side of the functional group.
Such compounds belong to different homologous series.	Such compounds belong to the same homologous series.
Examples: C₃H₆O: $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{H}$ Propanal $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3$ Propanone	Example: C₄H₁₀O: $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ Diethyl ether $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ Methyl-n-propyl ether
C₃H₈O: $\text{CH}_3\text{CH}_2 - \text{CH}_2 - \text{OH}$ 1-Propanol $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_3$ Methoxy Ethane	C₅H₁₀O: $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{CH}_3$ Diethyl ketone (Pentan-3-one) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ Methyl-n-propyl ketone (Pentan-2-one)

4. Define Tautomerism with an example.

Ans. Tautomerism:

This type of isomerism arises due to shifting of proton (H⁺) from one atom to other in the same molecule.

Examples:



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5. Justify that in alkanes sigma bonds are inert.

Ans. Inertness of σ -bond:

In a σ -bond, the electrons are very tightly held between the two nuclei which makes it a very stable bond. A lot of energy is required to break it. Moreover, the electrons present in a σ -bond can neither attack on any electrophile nor a nucleophile can attack on them. Due to the inertness of σ -bonds, alkanes are unreactive.

6. Why alkanes are called paraffins?

Ans. Alkanes are Paraffins:

The word "paraffins" is derived from Latin words 'parum' little, 'affins' affinity. Alkanes are called paraffins due to:

(i) Non-polar Nature:

The electronegativity values of carbon (2.5) and hydrogen (2.1) do not differ appreciably and the bonding electrons between C-H and C-C are equally shared making them almost non-polar. In view of this, the ionic reagents such as acids, alkalies, oxidizing agents, etc. find no reaction site in the alkane molecules to which they could be attached.

(ii) Inertness of σ -bond:

In a σ -bond, the electrons are very tightly held between the nuclei which makes it a very stable bond. A lot of energy is required to break it. Moreover, the electrons present in a σ -bond can neither attack on any electrophile nor a nucleophile can attack on them.

7. Differentiate between hydrogenolysis and hydrogenation.

Ans.

Hydrohenolysis	Hydrogenation
1. The addition of hydrogen accompanied by bond cleavage is called hydrogenolysis.	1. The addition of hydrogen to an unsaturated compound in the presence of a catalyst is called hydrogenation.
2. It is carried out in pd-charcoal cavity.	2. It is carried out in presence of Ni, Pt or Pd etc.
Examples: (i) $R - X + H - H \xrightarrow[\Delta]{Pd-Charcoal} R - H + HX$ Alkane (ii) $CH_3 - Cl + H - H \xrightarrow[\Delta]{Pd-Charcoal} CH_4 + HCl$	Example: (i) $CH_2 = CH_2 + H_2 \xrightarrow[200^\circ C]{Ni} CH_3 - CH_3$ Ethene Ethene (ii) Vegetable oil + $H_2 \xrightarrow[200^\circ C]{Ni} \text{vegetable Ghee}$

8. Give general mechanism of electrophilic addition reactions of alkene.

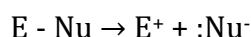
Ans. General Mechanism of Electrophilic Addition Reactions of Alkene:

It involves three steps:

Step 1: To Generate Electrophile:

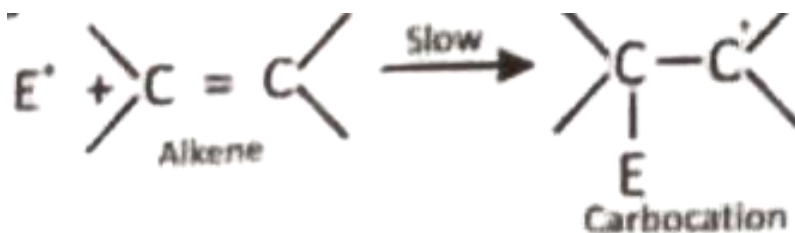
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The reagent E- Nu ionizes to give an electrophile and nucleophile.



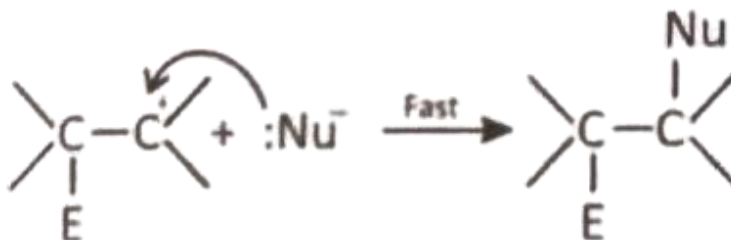
Step 2: Attack of Electrophile and Formation of Carbocation:

The electrophile attacks the carbon – carbon double bond and forms a covalent bond with one carbon and other carbon bears positive charge. As a result a carbocation is formed.



Step 3: Attack of Nucleophile:

The nucleophile now attacks the carbocation to form an addition product.



Since the reaction is initiated by addition of electrophile, so it is called electrophilic addition reaction.

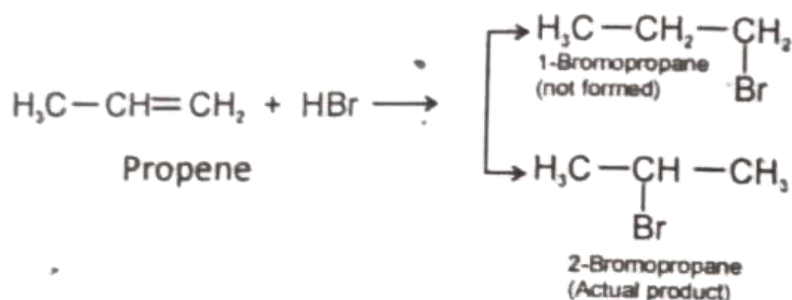
9. What is Markownikov's rule? Give example also.

Ans. Markownikov's Rule:

Statement:

"In the addition of an unsymmetrical reagent to an unsymmetrical alkene, the negative part of the adding reagent goes to that carbon, constituting the double bond, which has least number of hydrogen atoms."

Example:

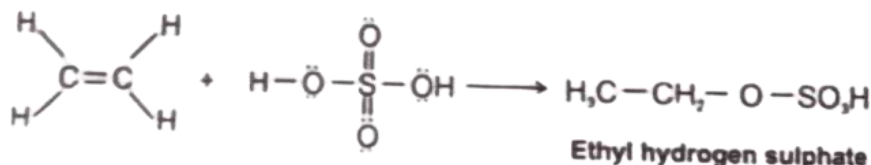


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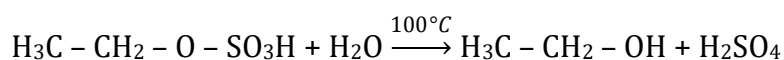
10. How would you convert ethane into ethyl alcohol?

Ans. Conversion of Ethene into Ethyl Alcohol:

When ethene is treated with cold concentrated sulphuric acid (H_2SO_4), it is dissolved because it forms ethyl hydrogen sulphate.



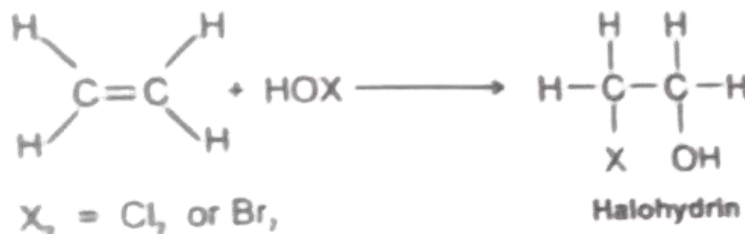
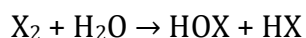
The ethyl hydrogen sulphate on boiling with water decomposes to give ethyl alcohol.



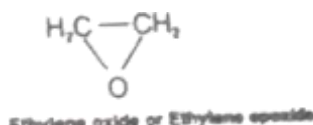
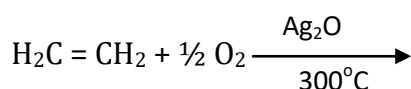
11. Convert ethane to (a) Halohydrin (b) Ethylene oxide

Ans. (a) Ethene to Halohydrin:

If the halogenations of an alkene is carried out in an aqueous solution, haloalcohol is formed called Halohydrin. In this reaction, molecules of the solvent become reactants too.



(b) Ethene to Ethylene Oxide:



12. How Ethylene Glycol is prepared from ethane?

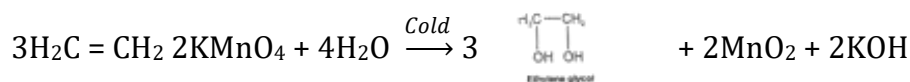
Ans. Baeyer's Test:

- Dilute 1% alkaline KMnO_4 solution is called Baeyer's reagent.
- It is pink in colour and acts as mild oxidizing agent.
- Baeyer's reagent is used to test the presence of unsaturation in the molecules.

Reaction:

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When alkenes are treated with Baeyer's reagent at low temperature, hydroxylation of double bond occurs resulting in the formation of dihydroxy compounds known as vicinal glycols. The pink colour of KMnO_4 is discharged during the reaction.

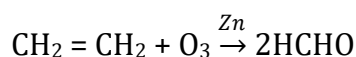


13. What is ozonolysis? Describe it giving example. Also give its mechanism.

Ans. Ozonolysis:

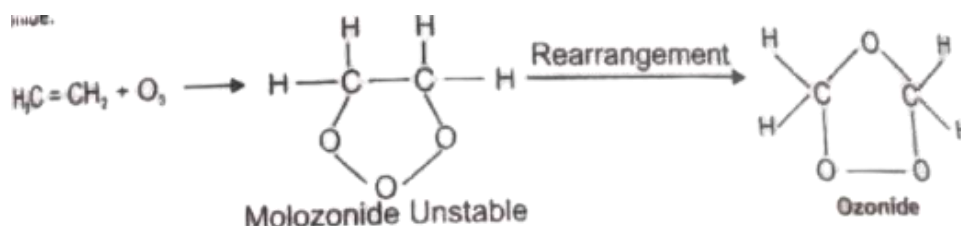
“The cleavage of an unsaturated molecule by reacting with ozone is called ozonolysis.”

Ozone (O_3) is a highly reactive allotropic form of oxygen. It reacts vigorously with ethene (or other alkenes) to formaldehyde (or other carbonyl compounds.)

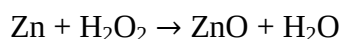
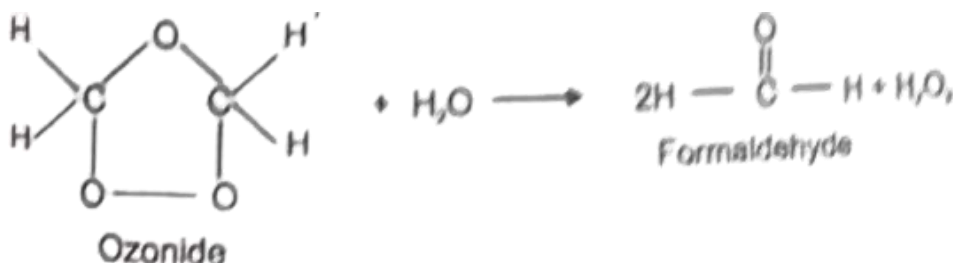


Mechanism:

(i) Ozone reacts with ethene to form molozonide. Molozonide rearranges spontaneously to form an ozonide.



(ii) Ozonides are unstable compounds and are reduced directly by treatment with zinc and H_2O . The reduction produces carbonyl compounds (aldehydes or ketones).



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14. Define the following:

- i) Cycloalkanes ii) Isomerism iii) Conjugated dienes iv) Industrial effect

Ans. (i) Cycloalkanes: Cycloalkanes are saturated hydrocarbons with carbon atoms arranged in a ring structure, containing only single bonds.

General formula: $C_n H_{2n}$

ii) Isomerism

Two or more compounds having the same molecular formula but different structural formulas and properties are said to be isomers and the phenomenon is called isomerism.

iii) Conjugated dienes

Conjugated dienes are organic compounds that contain two double bonds separated by a single bond. The double bonds are alternating (i.e., conjugated) in the carbon chain.

iv) Inductive effect

The inductive effect refers to the transmission of charge through a chain of atoms in a molecule by the polarization of sigma bonds. It occurs when an atom or group of atoms in a molecule either donates electron density (electron-donating) or withdraws electron density (electron-withdrawing) through the sigma bonds.

15. Differentiate between:

- i) Aliphatic and Aromatic hydrocarbons ii) Homolytic and Heterolytic fission
iii) Electrophile and Nucleophile

Ans. i) Aliphatic and Aromatic hydrocarbons

Property	Aliphatic Hydrocarbons	Aromatic Hydrocarbons
Structure	Open chain (straight or branched) or non-aromatic rings	Contain one or more benzene rings (aromatic rings)
Bonding	May have single, double, or triple bonds.	Contain delocalized π -electrons in a ring structure
Stability	Less stable than aromatics	Highly stable due to resonance
Types	Alkanes, alkenes, alkynes, and cycloalkanes	Benzene, toluene, naphthalene, etc.
Reactivity	Generally more reactive	Less reactive toward addition reactions
Example	Ethane (C_2H_6), propene (C_3H_6). Butyne (C_4H_6).	Benzene (C_6H_6), Toluene (C_7H_8)

ii) Homolytic and Heterolytic fission

Feature	Homolytic Fission	Heterolytic Fission
Bond breaking	Bond breaks evenly	Bond breaks unevenly
Electron distribution	Each atom gets one electron	One atom gets bonding electrons
Produces	Free radicals	Ions (cation and anion)

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Occurs in	Non-polar solvents or under high energy (e.g. UV light)	Polar solvents or in presence of electrophiles/nucleophiles
Example	$\text{Cl-Cl} \rightarrow \text{Cl}^\bullet + \text{Cl}^\bullet$	$\text{H-Cl} \rightarrow \text{H}^+ + \text{Cl}^-$

iii) Electrophile and Nucleophile

Property	Electrophile	Nucleophile
Definition	Electron-deficient species	Electron-rich species
Electron behavior	Accepts electron pairs	Donates electron pairs
Charge	Often positively charged or neutral	Often negatively charged or neutral
Affinity	Attracted to electron-rich centers	Attracted to electron-deficient centers
Role in reactions	Acts as a Lewis acid	Acts as a Lewis base
Example	H^+ , NO_2^+ , AlCl_3 , BF_3	OH^- , NH_3 , Cl^- , CN^-

16. Explain why alkanes do not undergo addition reactions.

Ans. Alkanes do not undergo addition reactions because:

- They are saturated hydrocarbons, meaning all carbon-carbon bonds are single (σ) bonds.
 - These σ -bonds are strong and stable, and there are no regions of high electron density like double or triple bonds for an electrophile to attack.
 - Addition reactions typically occur with unsaturated compounds (like alkenes or alkynes), which have π -bonds that are more reactive.
- In short, Alkanes lack π -bonds, making them chemically inert toward addition reactions and more likely to undergo substitution reactions instead.

17. How elimination reaction is considered the opposite of an addition reaction.

Ans. An elimination reaction is considered the opposite of an addition reaction because:

- In an addition reaction, atoms or groups are added to a molecule, typically converting a double or triple bond into a single bond.
- In an elimination reaction, atoms or groups are removed from a molecule, typically forming a double or triple bond from a single bond.

Alkanes do not undergo elimination reactions under normal conditions because:

- Elimination reactions require a molecule to have a leaving group (like -OH, -Br, -Cl) on one carbon and a B-hydrogen (on an adjacent carbon).
- Alkanes consist of only C-C and C-H single bonds and do not have good leaving groups naturally.
- They are also non-polar and chemically stable, making it hard to break bonds without strong reagents or high energy.

In short, Alkanes lack both the leaving groups and reactive centres needed for elimination, so they do not undergo elimination reactions unless first converted to more reactive derivatives (like alkyl halides).

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18. Compare the carbocation stability in propene and 2-butene.

Ans. (i) Propene ($\text{CH}_3\text{-CH=CH}_2$)

- If a proton is removed from the double bond, the most likely carbocation formed is the allyl carbocation ($\text{CH}_2 = \text{CH} - \text{CH}_2^+$).
- This allylic carbocation is resonance-stabilized, meaning the positive charge is delocalized over two carbon atoms.
- **Stability:** Relatively stable due to resonance.

(ii) 2-Butene ($\text{CH}_3\text{-CH=CH-CH}_3$)

- Ionization typically leads to a secondary carbocation ($\text{CH}_3\text{-C}^+\text{H-CH=CH}_3$).
- There is no resonance stabilization unless rearrangement occurs.
- **Stability:** Less stable than the allylic carbocation of propene.

19. Give the molecular formula C_5H_{10} , list all possible structural isomers that are alkenes.

Ans. C_5H_{10} Alkene Isomers:

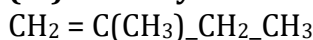
(i) Pent-1-ene



(ii) Pent-2-ene



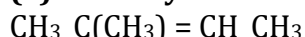
(iii) 2-Methylbut-1-ene



(iv) 3-Methylbut-1-ene



(v) 2-Methylbut-2-ene



20. When propene (C_3H_6) undergoes electrophilic addition with HBr, it forms 2-bromopropane as the major product. Explain why 2-bromopropane is favored over 1-bromopropane using the concept carbocation stability.

Ans. When propene ($\text{CH}_3\text{-CH=CH}_2$) reacts with HBr, the reaction proceeds via an electrophilic addition mechanism. The major product is 2-bromopropane, and this can be explained using carbocation stability:

Explanation:

1. Electrophilic attack:

The π electrons of the double bond attack the H^+ from HBr.

This can lead to two possible carbocations:

- Path A (less stable): H^+ adds to the CH_2 end, forming a primary carbocation ($\text{CH}_3\text{-CH-CH}_2^+$)
- Path B (more stable): H^+ adds to the CH end, forming a secondary carbocation ($\text{CH}_3\text{-C}^+\text{H-CH}_3$)

2. Carbocation stability:

- Primary carbocations are less stable
- Secondary carbocations are more stable due to hyperconjugation and inductive effects from surrounding alkyl groups

3. Nucleophilic attack:

- Br^- then attacks the more stable secondary carbocation, leading to 2-bromopropane.

Conclusion:

2-bromopropane is the major product because its formation proceeds through a more stable secondary carbocation, following Markovnikov's rule.

21. Explain why conjugated alkenes may show different reactivity compared to isolated alkenes.

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Ans. As Conjugated alkenes show different reactivity compared to isolated alkenes due to delocalization of π electrons across alternating double and single bonds.

Aspect	Conjugated Alkenes	Isolated Alkenes
Structure	Alternating double and single bonds.	Double bonds separated by two or more single bonds.
Electron delocalization	π - electrons are delocalized across the system.	π - electrons are localized between two atoms.
Stability	More stable due to resonance.	Less stable.
Reactivity	Can undergo special reactions (e.g. 1, 4-addition).	React through normal electrophilic addition only.
UV/Visible absorption	Often absorb at longer wavelengths.	Less likely to absorb in the visible range.

22. Explain how inductive effects from alkyl groups stabilize carbocations in alkenes.

Ans. Inductive effects from alkyl groups help stabilize carbocations in alkenes by donating electron density through sigma (σ) bonds toward the positively charged carbon.

- Carbocations are electron-deficient species (positively charged carbon).
- Alkyl groups (like $-\text{CH}_3$ or $-\text{CH}_2\text{CH}_3$) have a slight electron-releasing character.
- Through the inductive effect, they push electron density toward the carbocation, reducing its positive charge and making it more stable.

Relative stability of carbocation due to inductive effects:

Tertiary carbocation (3 alkyl groups) → Most stable

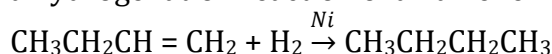
- **Tertiary carbocation** (3 alkyl groups)
- **Primary carbocation** (1 alkyl group)
- **Methyl carbocation** (no alkyl groups) → Least stable

23. Write the equation for each reaction.

- $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ with H_2 (Ni catalyst)
- $\text{CH}_3\text{CH}=\text{CH}_2$ with Cl_2
- $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_3$ with H_2O (H_2SO_4 catalyst)

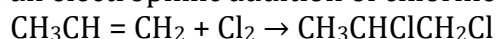
Ans. i. $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ with H_2 (Ni catalyst)

This is a hydrogenation reaction of an alkene.



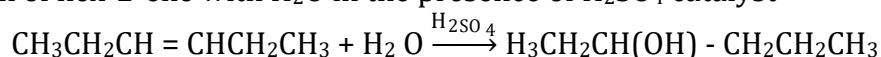
ii. $\text{CH}_3\text{CH}=\text{CH}_2$ with Cl_2

This is an electrophilic addition of chlorine to an alkene.



iii. $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_3$ with H_2O (H_2SO_4 catalyst)

It is Hydration of hex-2-ene with H_2O in the presence of H_2SO_4 catalyst



24. Write structural formulas for each of the following compounds.

- (i) Isobutylene (ii) 2,3,4,4-Tetramethyl-2-pentene (iii) 2,5-Heptadiene

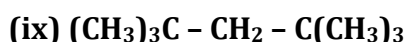
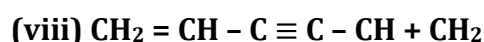
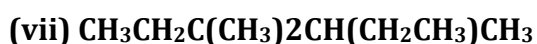
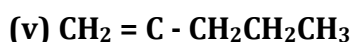
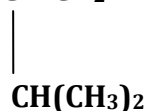
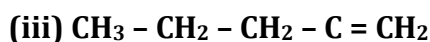
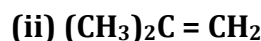
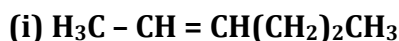
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- (iv) 4,5-Dimethyl-2-hexene (v) Vinyl acetylene (vi) 1,3-pentadiene
 (vii) 1-Butyne (viii) 3-n-propyl-1,4-pentadiene (ix) Vinyl bromide
 (x) But-1-en-3-yne (xi) 4-Methyl-2-pentyne (xii) Isopentane

Ans. Structural Formula

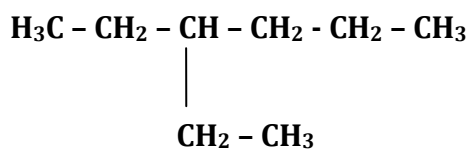
i. Isobutylene $\begin{array}{c} \text{CH}_3 - \text{C} = \text{CH}_2 \\ \\ \text{CH}_3 \end{array}$ (IUPAC Name = 2-Methylpropene)	ii. 2,3,4,4-Tetramethyl-2-pentene $\begin{array}{c} \text{CH}_3 \\ \\ {}^5\text{CH}_3 - {}^4\text{C} = {}^3\text{C} = {}^2\text{C} - {}^1\text{CH}_3 \\ \quad \quad \\ \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \end{array}$
iii. 2,5-Heptadiene ${}^7\text{CH}_3 - {}^6\text{CH} = {}^5\text{CH} - {}^4\text{CH}_2 - {}^3\text{CH} = {}^2\text{CH} - {}^1\text{CH}_3$	iv. 4,5-Dimethyl-2-hexene $\begin{array}{c} {}^6\text{CH}_3 - {}^5\text{CH} - {}^4\text{CH} - {}^3\text{CH} = {}^2\text{CH} - {}^1\text{CH}_3 \\ \quad \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
v. Vinyl acetylene $\text{H}_2\text{C} = \text{CH} - \text{C} \equiv \text{CH}$	vi. 1,3 - Pentadiene ${}^5\text{CH}_3 - {}^4\text{CH} = {}^3\text{CH} - {}^2\text{CH} - {}^1\text{CH}_2$
vii. 1-Butyne ${}^4\text{CH}_3 - {}^3\text{CH}_2 - {}^2\text{C} \equiv {}^1\text{CH}$	viii. 3-n-Propyl -1, 4-pentadiene $\begin{array}{c} {}^5\text{CH}_2 = {}^4\text{CH} - {}^3\text{CH} - {}^2\text{CH} = {}^1\text{CH}_2 \\ \\ \text{CH}_2 - \text{CH}_2 - \text{CH}_2 \end{array}$
ix. Vinyl bromide $\text{H}_2\text{C} = \text{CH} - \text{Br}$	x. But -1-en-3-yne ${}^1\text{CH}_2 - {}^2\text{CH} - {}^3\text{C} \equiv {}^4\text{CH}$
xi. 4-Methyl-2-pentyne $\begin{array}{c} {}^5\text{CH}_3 - {}^4\text{C} - {}^3\text{C} = {}^2\text{C} - {}^1\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$	xii. Isobutylene $\begin{array}{c} {}^4\text{CH}_3 - {}^3\text{CH}_2 - {}^2\text{CH} - {}^1\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$

25. Write down names of the following compounds according to IUPAC - System.

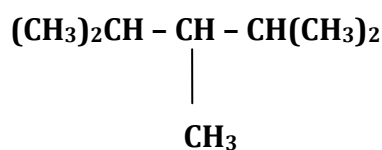


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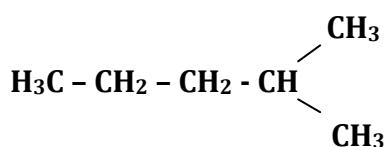
(a)



(b)



(c)



Ans. IUPAC Names

iv. $\text{H}_3\text{C}^1 - ^2\text{CH} = ^3\text{CH} - ^4\text{CH}_2 - ^5\text{CH}_2 - ^6\text{CH}_3$ 2-Hexene	v. $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} = \text{CH}_2 \end{array}$ 2-Methylpropene
vi. $^5\text{CH}_3 - ^4\text{CH}_2 - ^3\text{CH}_2 - ^2\text{C} = ^1\text{CH}_2$ $\quad \quad \quad $ $\quad \quad \quad \text{CH}_3 - \text{HC} - \text{CH}_3$ 2-Isopropyl-1-pentene	vii. $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$ 1,3 - Butadiene
viii. $^1\text{CH}_2 = ^2\text{C} - ^3\text{CH}_2^4\text{CH}_2^5\text{CH}_3$ $\quad \quad \quad $ $\quad \quad \quad \text{C}_2\text{H}_5$ 2-Ethyl-1-pentene	ix. $\begin{array}{c} ^1\text{CH}_3 \\ \\ ^2\text{CH}_2 \\ \\ \text{CH}_3 - \text{CH}_2 - ^3\text{CH} \\ \\ ^4\text{CH}_2 \\ \\ ^5\text{CH}_3 \end{array}$ 3-Ethylpentane
x. $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3^1\text{C} - ^2\text{CH}_2 - ^3\text{C} - ^4\text{CH} - \text{CH}_3 \\ \quad \\ \text{CH}_3 \quad ^5\text{CH}_2 \\ \\ ^6\text{CH}_3 \end{array}$ 3,3,4-Trimethylhexene	xi. $^1\text{CH}_2 = ^2\text{CH} - ^3\text{C} \equiv ^4\text{C} - ^5\text{CH} = ^6\text{CH}_2$ 1,5-Hexadien-3-yne

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i. $ \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2 - \text{C} - \text{CH}_3 \\ \quad \\ \text{CH}_3 \quad \text{CH}_3 \end{array} $ 2,2,4,4 - tetranethylPentane	ii. ${}^1\text{CH}_2 = {}^2\text{CH} - {}^3\text{C} \equiv {}^4\text{CH}$ 1-Buten-3-yne
iii. $ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2 - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $ 2,2 - dimethylbutane	a) $\text{H}_3 - {}^1\text{C} - {}^2\text{CH}_2 - {}^3\text{CH} - {}^4\text{CH}_2 - {}^5\text{CH}_2 - {}^6\text{CH}_3$ $\text{CH}_2 - \text{CH}_3$ 3-ethylhexene
b) $ \begin{array}{c} {}^1\text{CH}_3 - {}^2\text{CH} - {}^3\text{CH} - {}^4\text{CH} - {}^5\text{CH}_3 \\ \quad \quad \\ \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \end{array} $ 2,3,4- trimethylpenane	c) $\text{H}_3{}^5\text{C} - {}^4\text{CH}_2 - {}^3\text{CH}_2 - {}^2\text{CH} - {}^1\text{CH}_3$ CH_3 2-Methylpentane