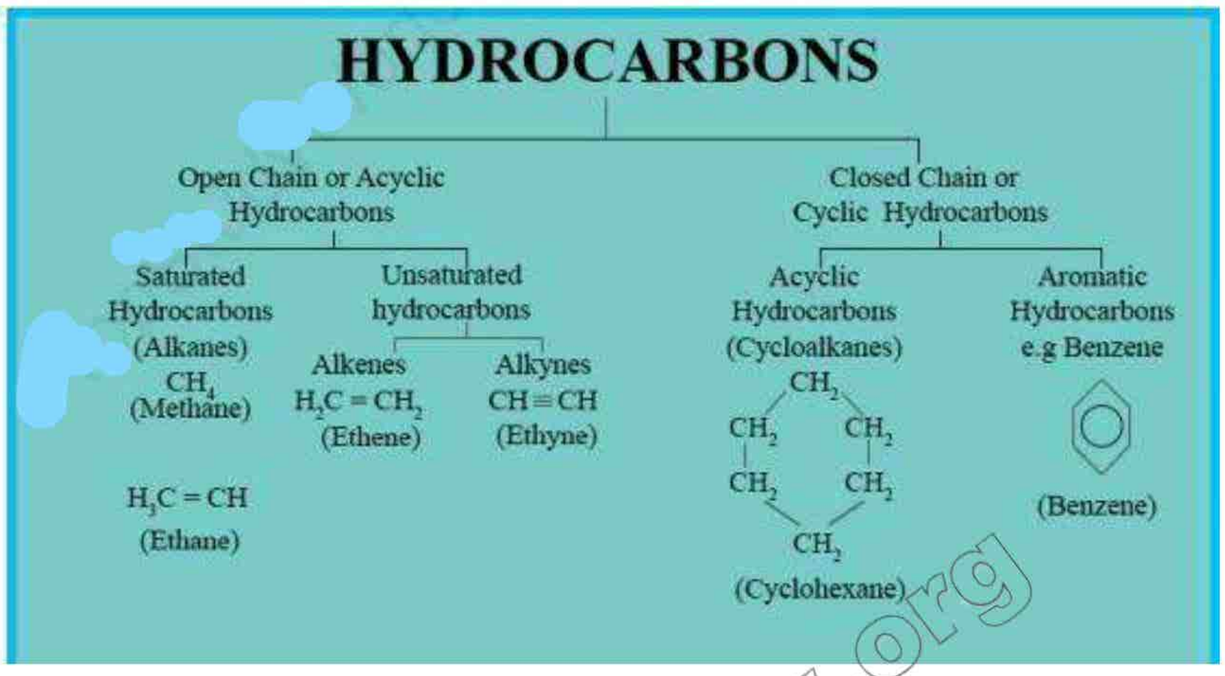
Chapter#8
Aliphatic Hydrocarbons

1. How are the hydrocarbons classified?

Ans:



2. Mention physical properties of alkanes (Mention any four properties as an answer to short question)

Ans: Following are the physical properties of alkanes:

1. Alkanes containing up to four carbon atoms are colourless, odourless gases while pentane to heptadecane (C_5 to C_{17}) are colourless, odourless liquids. The higher members from C_{18} onwards are waxy solids which are also colourless and odourless.

2. Alkanes are non-polar or very weakly polar and are insoluble in polar solvents like water, but soluble in non-polar solvents like benzene, ether, carbon tetra chloride, *etc.*

3. Their physical constants like boiling .points, melting points, density, *etc.* increase with the increase in number of carbon atoms, whereas solubility decreases with increase in molecular mass. The boiling point increases by 20 to 30 °C for addition of each CH_2 group to the molecule. The boiling points of alkanes having branched chain structures are lower than their isomeric normal chain alkanes, e.g. n-butane has a higher boiling point-0.50 C than isobutane (-11 .7°C).

4. The melting points of alkanes also increase wit1h the increase in molecular mass but this increase

is not so regular.

3. Why alkanes are called so? Give reason.

Ans: The alkanes or paraffins (Latin: parum = little, affins = affinity) under ordinary condition are inert towards acids, alkalis, oxidizing and reducing agents.

The unreactivity of alkanes under normal conditions may be explained on the basis of the non-polarity of the bonds forming them. 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 nonpolar. 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.

4. Which type of reactions alkanes undergo?

Ans: Alkanes undergo two types of reactions:

1. Substitution Reactions

2. Thermal and Catalytic Reactions

These reactions take place at high temperature or on absorption of light energy through the formation of highly reactive free radicals.

5. Why sigma bond is inert?

Ans: The unreactivity of alkanes can be explained on the basis of inertness of a sigma bond. In a sigma bond the electrons are very tightly held between the nuclei which make it a very stable bond. A lot of energy is required to break it. Moreover the electrons present in a sigma bond can neither attack on any electrophile nor a nucleophile can attack on them. Both these facts make alkanes less reactive.

6. What are the uses of methane?

Ans: Methane is used:

(i) As a fuel and as an illuminating gas

(ii) For the preparation of methyl chloride, dichloromethane, chloroform and carbon tetrachloride.

(iii) For the industrial preparation of methyl alcohol, formaldehyde and hydrogen cyanide.

(iv) For the preparation of carbon black used in paints, printing inks and automobile tyres.

(v) Is used to manufacture urea fertilizer.

7. Why alkenes are called so?

Ans: They are also known as Olefins (derived from Latin word olefiant meaning oil forming) because lower members form oily products on treatment with chlorine or bromine.

8. Mention physical properties of alkenes (Mention any four properties as an answer to short question)

Ans: Following are the physical properties of alkenes:

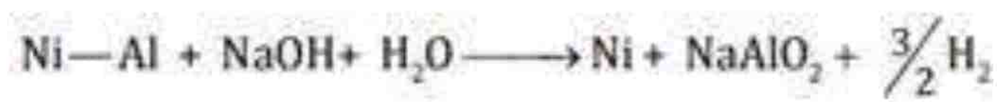
1. First three members i.e. ethene, propene and butene are gases at room temperature while C_5 to C_{15} are liquids and the higher members are solids
2. They are insoluble in water but soluble in alcohol.
3. They have characteristic smell and burn with luminous flame.
4. Unlike alkanes, they show weakly polar properties because of sp^2 hybridization.

9. Why pi bond is reactive?

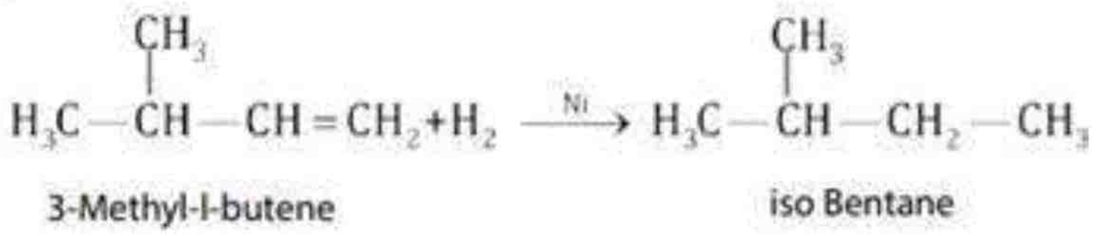
Ans: In the formation of a π-bond, the partially filled p-orbitals overlap in a parallel fashion. The probability of finding electron is thus away from the line joining the two nuclei. Due to this reason π-electrons are less firmly held between the nuclei. A π-bond is, therefore, a weak bond as compared to a sigma bond. During a reaction it breaks comparatively easily rendering alkenes as reactive group of compounds. Moreover, the loosely held π-electrons are more exposed to attack by the electrophilic reagents. Alkenes, therefore, undergo electrophilic reactions very easily.

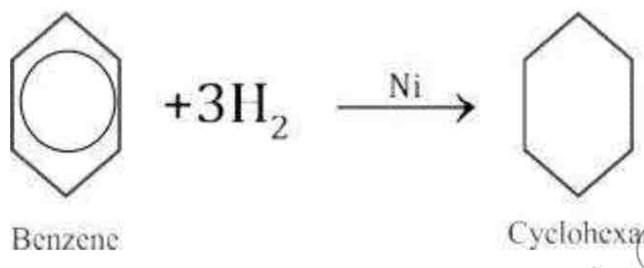
10. What is Raney-Nickel catalyst?

Ans: It is prepared by treating a Ni — Al alloy with caustic soda.



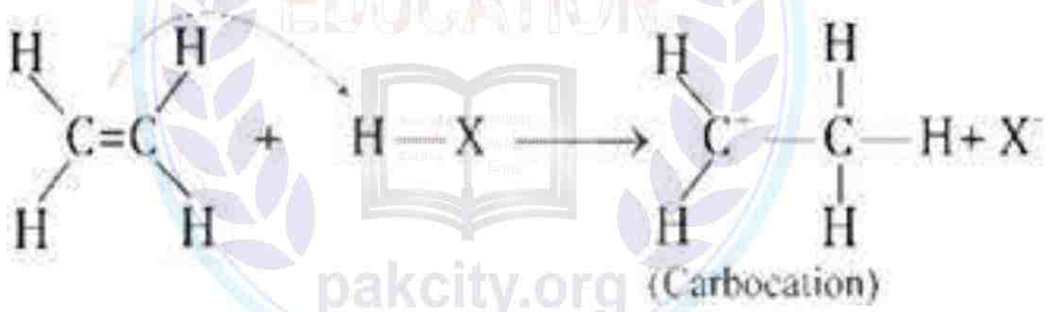
Most alkenes are hydrogenated over Raney nickel at about 100 °C and up to 3 atmospheric pressure.

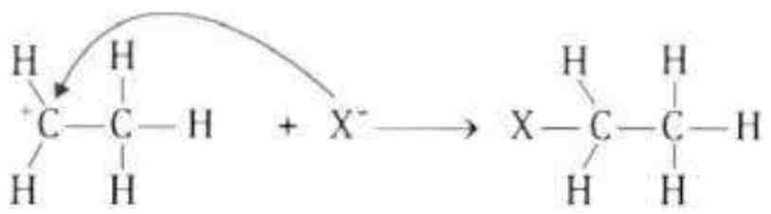




11. State Markovnikov's rule.

Ans: 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.





12. Give uses of ethane.

Ans: Ethene is used:

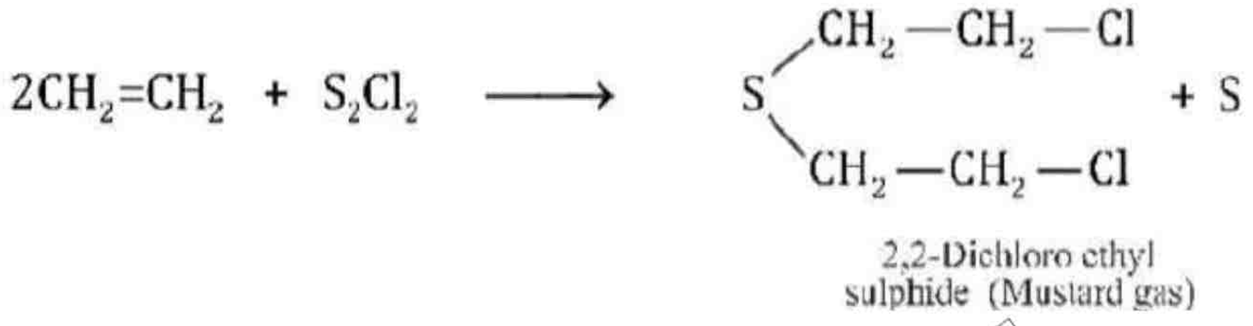
1. for the manufacture of polythene, a plastic material used for making toys, cables, bags, boxes,

etc.

2. for artificial ripening of the fruits.

3. as a general anesthetic.

4. for preparing 'Mustard gas' a chemical used in World War I. The name comes from its mustard like odour. It is not a gas, but a high boiling liquid that is dispersed as a mist of tiny droplets. It is a powerful vesicant i.e., causes blisters.



2,2-Dichloro ethyl sulphide (Mustard gas)

5. as a starting material for a large number of chemicals of industrial use such as glycols (antifreeze), ethyl halide, ethyl alcohol, etc.

13. Mention physical properties of alkynes (Mention any four as an answer to short question)

Ans: Following are the physical properties of alkynes:

1. They are colourless, odourless, except acetylene which has a garlic like odour,

2. The first three members are gases (ethyne, propyne, butyne) at room temperature, the next eight members (C_5 - C_{12}) are liquids and higher members are solids.

3. The melting points, boiling points and densities increase gradually with the increase in molecular masses.

4. They are nonpolar and dissolve readily in solvents like ether, benzene and carbon tetrachloride

14. Tell about reactivity of alkynes.

Ans: In alkynes, the carbon atoms are held together by a triple bond, a s-bond and two p-bonds. The electron density between the carbon atoms is very high which draws atoms very close to each other. Electrons in a triple bond are, therefore, less exposed and less reactive towards electrophilic reagents.

15. Why alkynes have acidic nature?

Ans: In ethyne and other terminal alkynes like propyne, the hydrogen atom is bonded to the carbon atom with sp-s overlap. An sp hybrid orbital has 50% s-character in it and renders the carbon atom more electronegative than sp^2 and sp^3 hybridized carbons. As a result, the sp hybridized carbon atom of a terminal alkyne pulls the electrons more strongly making the attached hydrogen atom slightly acidic.

$$H—C\equiv C^{\delta-}—H^{\delta+}$$

$$R—C\equiv CH + NaNH_2 \xrightarrow{\text{liq } NH_3} R—C\equiv C^-Na^+ + NH_3$$

$$HC\equiv CH + 2Na \longrightarrow Na^+C^-\equiv C^-Na^+ + H_2$$

Sodium acetylide

16. Give uses of ethyne.

Ans: Ethyne is used:

1. In oxyacetylene torch which is in turn used for welding and cutting metals.
2. For the preparation of alcohols, acetic acid and acetaldehyde.
3. For the manufacture of polymers like PVC, polyvinyl acetate, polyvinyl ethers, orlon and neoprene rubber.
4. To prepare acetylene tetrachloride a solvent for varnishes, resins, and rubber.
5. For ripening of fruits.

17. Compare reactivity of alkanes, alkenes, alkynes.

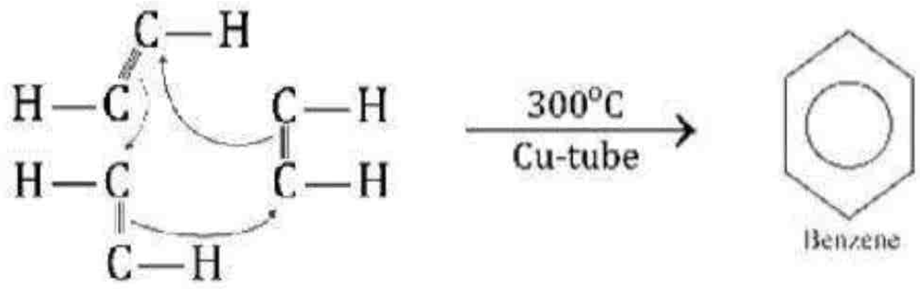
Ans: The general decreasing reactivity order of alkanes, alkenes and alkynes is as follows:

Alkenes > Alkynes > Alkanes

A π-bond in alkenes is not only weak but its electrons are more exposed to an attack by an electrophilic reagent. Both these facts make the alkenes a very reactive class of compounds. Alkynes although contain two π -bonds are less reactive than alkenes towards electrophilic reagents. This is because the bond distance between the two triple bonded carbon atoms is very short and hence the π-electrons are not available to be attacked by electrophilic reagents. Alkynes are, however, more reactive than alkenes towards nucleophilic reagents

18. How would you establish that benzene is a polymer of acetylene?

Ans: When acetylene is passed through a copper tube at 300°C, it polymerizes to benzene.



19. How do you distinguish between1-Butyne and 2-Butyne? OR How Ammonical solution of $AgNO_3$ can be used to distinguish between 1-Butyne and 2-Butyne?

Ans: 1-Butyne is a terminal alkyne and thus acidic in nature. It therefore reacts with cuprous chloride Cu_2Cl_2 in presence of NH_4OH to produce a red precipitate. In 2-Butyne triple bond is not terminal hence triple bonded carbon atoms do not have a hydrogen atom attached and therefore lack acidic character. It gives no reaction with cuprous chloride Cu_2Cl_2 in presence of NH_4OH.

$$\underset{\text{1-Butyne}}{2CH_3CH_2—C\equiv CH} + Cu_2Cl_2 + 2NH_4OH \longrightarrow \underset{\text{red ppt.}}{2CH_3CH_2—C\equiv C\cdot Cu\downarrow} + 2NH_4Cl + 2H_2O$$

$$\underset{\text{2-Butyne}}{CH_3—C\equiv C—CH_3} + Cu_2Cl_2 + 2NH_4OH \longrightarrow \text{No reaction}$$

20. Write mechanism for Kolbe's electrolytic method for preparation of an alkane.

Ans:

$$2H_3C-\overset{O}{\overset{\|}{C}}-O^-K^+ \rightleftharpoons[H_2O] 2H_3C-\overset{O}{\overset{\|}{C}}-O^- + 2K^+$$

At Anode

$$2H_3C-\overset{O}{\overset{\|}{C}}-O^- \xrightarrow{\text{Electrolysis}} 2H_3C-\overset{O}{\overset{\|}{C}}-\dot{O} + 2e^-$$

$$2H_3C-\overset{O}{\overset{\|}{C}}-\dot{O} \longrightarrow 2\dot{C}H_3 + 2CO_2$$

$$\dot{C}H_3 + \dot{C}H_3 \longrightarrow H_3C-CH_3$$

At Cathode

$$2H_2O + 2e^- \longrightarrow 2\bar{O}H + H_2$$

$$2K^+ + 2\bar{O}H \longrightarrow 2KOH$$

21. Convert methane into i. Formaldehyde ii. Nitromethane

Ans:

Methane into Formaldehyde

$$CH_4 + [O] \xrightarrow[400^\circ C/200atm]{Cu} \underset{\text{Methyl alcohol}}{H_3C-OH}$$

$$H_3C-OH + [O] \xrightarrow[400^\circ C/200atm]{Cu} \underset{\text{Formaldehyde}}{HCHO} + H_2O$$

Methane into Nitromethane

$$CH_4 + HONO_2 \xrightarrow{450^\circ C} \underset{\text{Nitromethane}}{CH_3NO_2} + H_2O$$

22. Prepare Ethane from i. Ethyl alcohol ii. Ethyl chloride

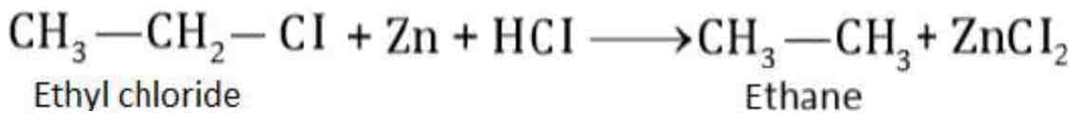
Ans:

Ethane from Ethyl alcohol

$$\underset{\text{Ethyl alcohol}}{CH_3-CH_2-OH} \xrightarrow[140-170^\circ C]{75\%\ H_2SO_4} CH_2=CH_2$$

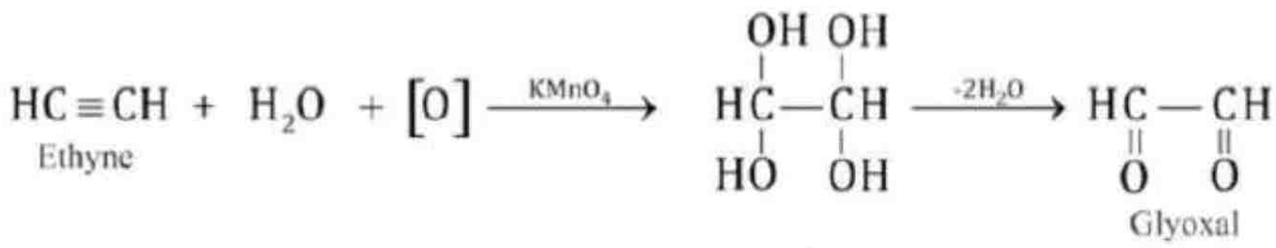
$$CH_2= CH_2 + H_2 \xrightarrow[200-300^\circ C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

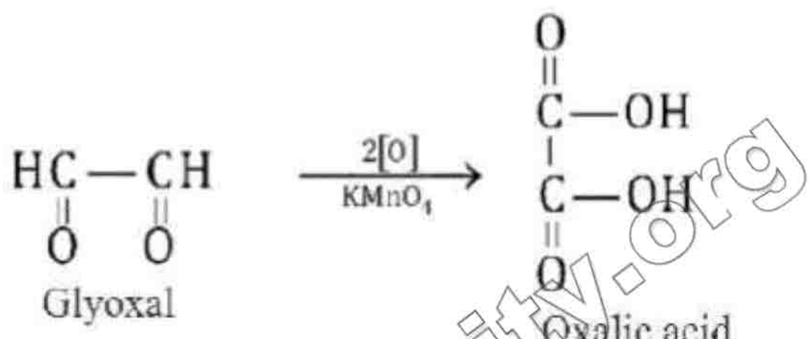
Ethane from Ethyl chloride



23. Write the chemical equation when alkaline $KMnO_4$ reacts with ethyne.

Ans:





24. Ethene can be converted to ethyl alcohol. Write equation.

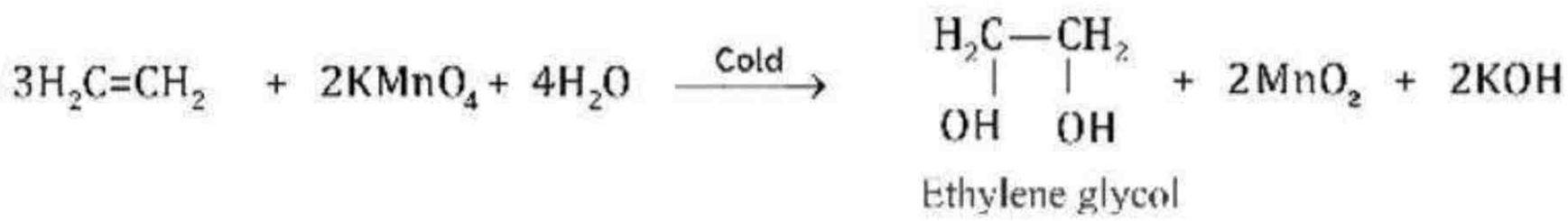
Ans:

25. What is Baeyer's test? What is it used for?

Ans:

When alkenes are treated with mild oxidizing reagents like dilute (1%) alkaline $KMnO_4$ solution (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 $KMnO_4$ solution is discharged during the reaction. This test is used to check the presence of unsaturation

in the molecules. For example,

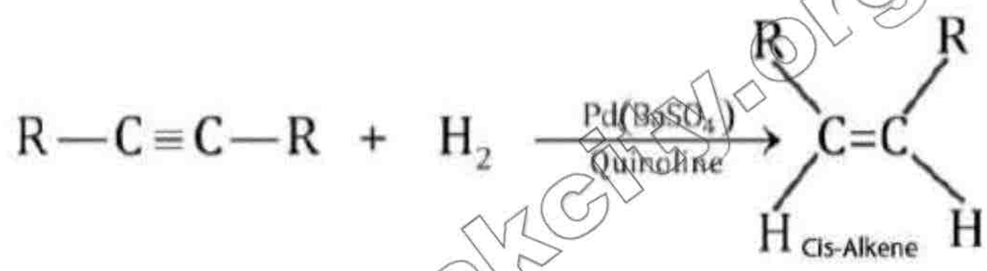


26. How cis and trans alkenes are produced? Give reactions.

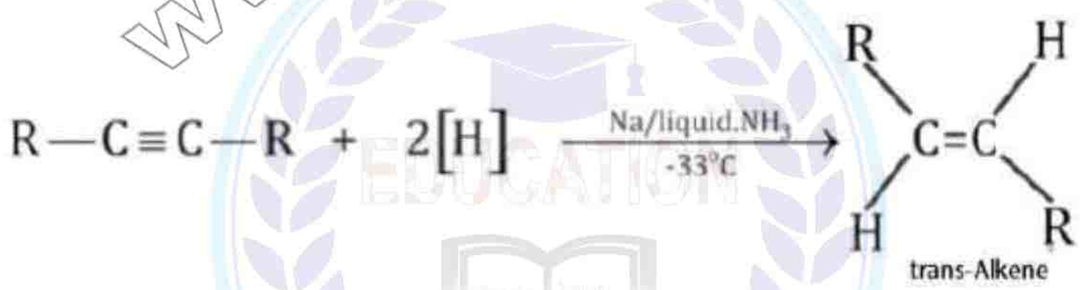
Ans:

Controlled hydrogenation of alkynes with hydrogen gas in an equimolar ratio over heated

catalysts, gives alkenes. The catalyst is finely divided palladium supported on $BaSO_4$ and poisoned by treatmentwith quinoline (Lindlar's catalyst).



A trans alkene can be obtained by treating an alkyne with Na in liquid NH3 at -33°C.

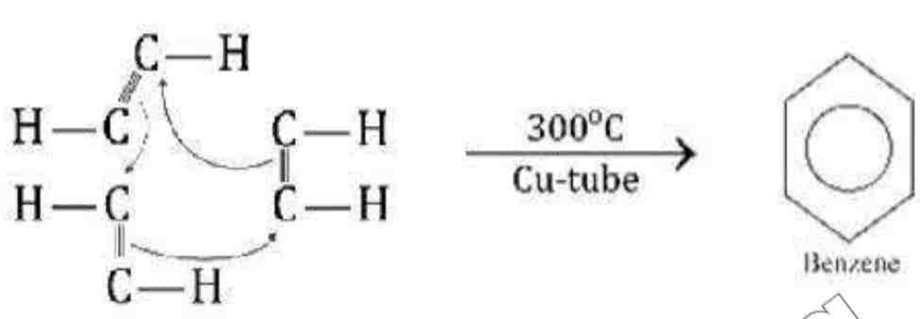


27. How will you synthesize following compounds from ethyne (acetylene). i. Benzene ii. Chloroprene OR Convert (i) acetylene to benzene (ii) vinyl acetylene to chloroprene

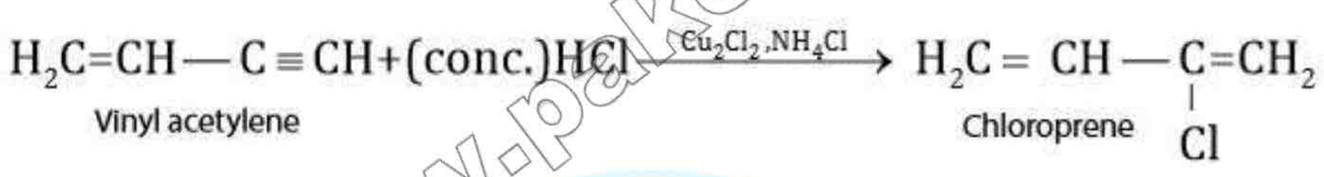
Ans:

(i) acetylene to benzene

When acetylene is passed through a copper tube at 300°C, it polymerizes to benzene.

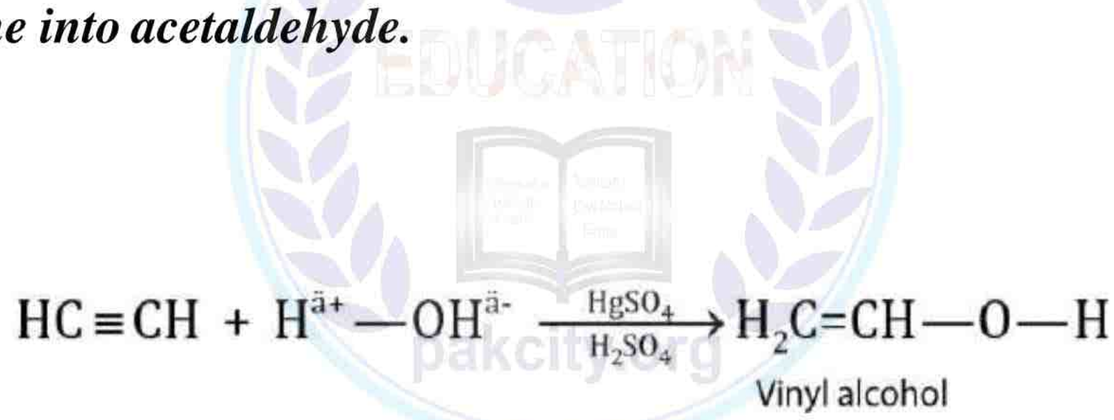


(ii) vinyl acetylene to chloroprene



28. Convert ethyne into acetaldehyde.

Ans:



29. What happens when vicinal dihalide is treated with Zinc dust?

Ans:

Vicinal dihalides have two halogens on adjacent carbon atoms. Dehalogenation occurs when dihalide is treated with Zinc dust in an anhydrous solvent like methanol or acetic acid.

$$R-\underset{X}{\underset{|}{CH}}-\underset{X}{\underset{|}{CH_2}}-Zn \xrightarrow{CH_3OH} H_2C=CH-R + ZnX_2$$

Viccinal dihalide — Alkene

$$H_3C-\underset{Br}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}-CH_3 + Zn \xrightarrow{CH_3OH} H_3C-CH=CH-CH_3 + ZnBr_2$$

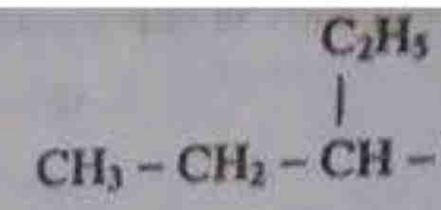
2,3-Dibromobutane — 2-Butene

30. Write the structural formula for each of the following compounds.

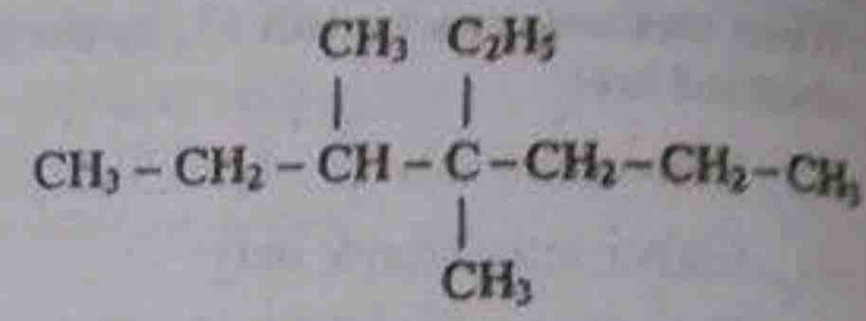
i) 2-Methylpropane.
ii) Neopentane.
iii) 3-Ethylpentane.
iv) 4-Ethyl-3,4-dimethylheptane.
v) 2,2,3,4-Tetramethylpentane
vi) 4-Iso-Propylheptane.
vii) 2,2-Dimethylbutane.
viii) 2,2-Dimethylpropane.

Ans:

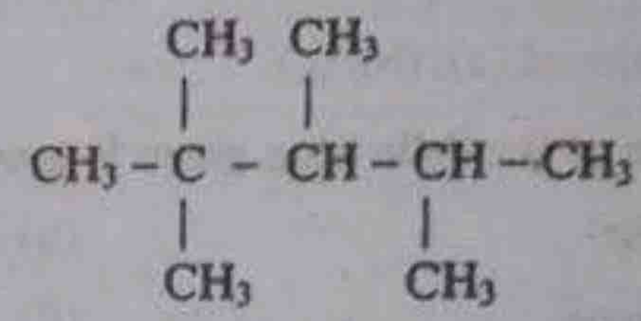
3-ethylpentane



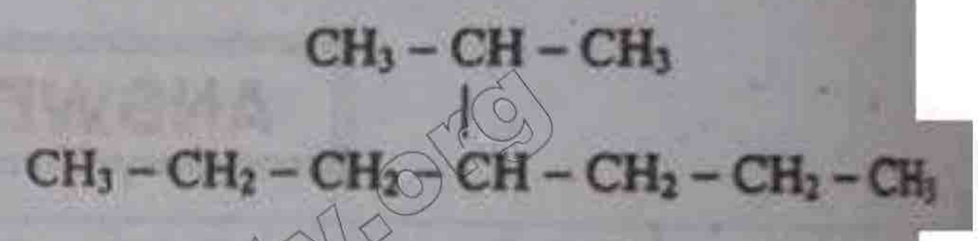
4-ethyl-3, 4-dimethylheptane



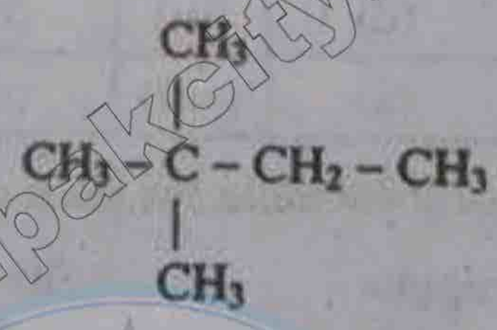
2, 2, 3, 4-tetramethylpentane



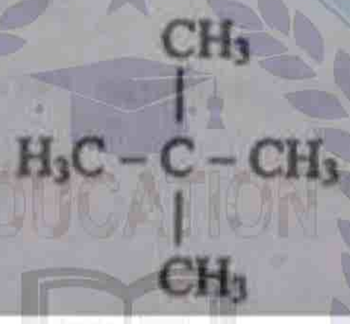
4-iso-propylheptane



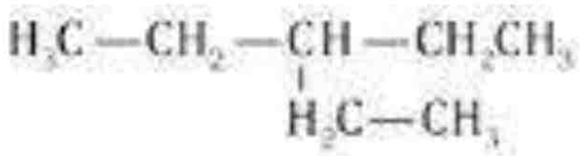
2, 2-dimthyl butane

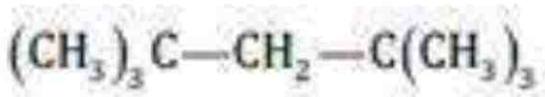


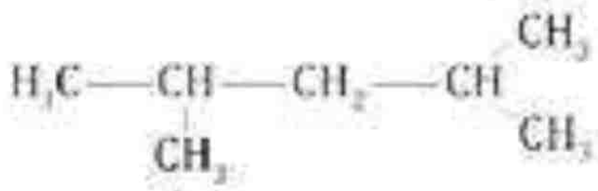
2, 2-dimethylpropane

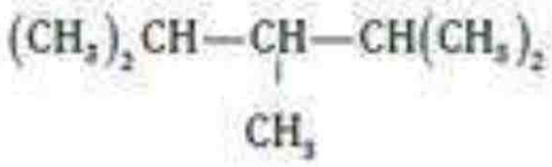


31. Write IUPAC names of the following compounds

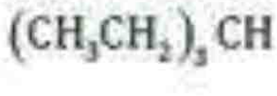
(i) 

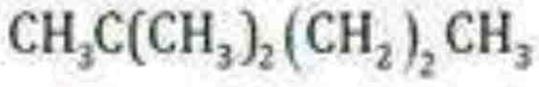
(ii) 

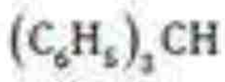
(iii) 

(iv) 

(v) 

(vi) 

(vii) 

(viii) 

Ans:

i. 3-methylpentane

ii. 2,2,4,4-tetramethylpentane

iii. 2,4-dimethylpentane

iv. 2,3,4-trimethylpentane

v. 3,3,4-trimethylhexane

vi. 3-ethylpentane

vii. 2,2-dimethylpentane

viii. triphenylmethane

32. Give the correct IUPAC names of the following compounds:

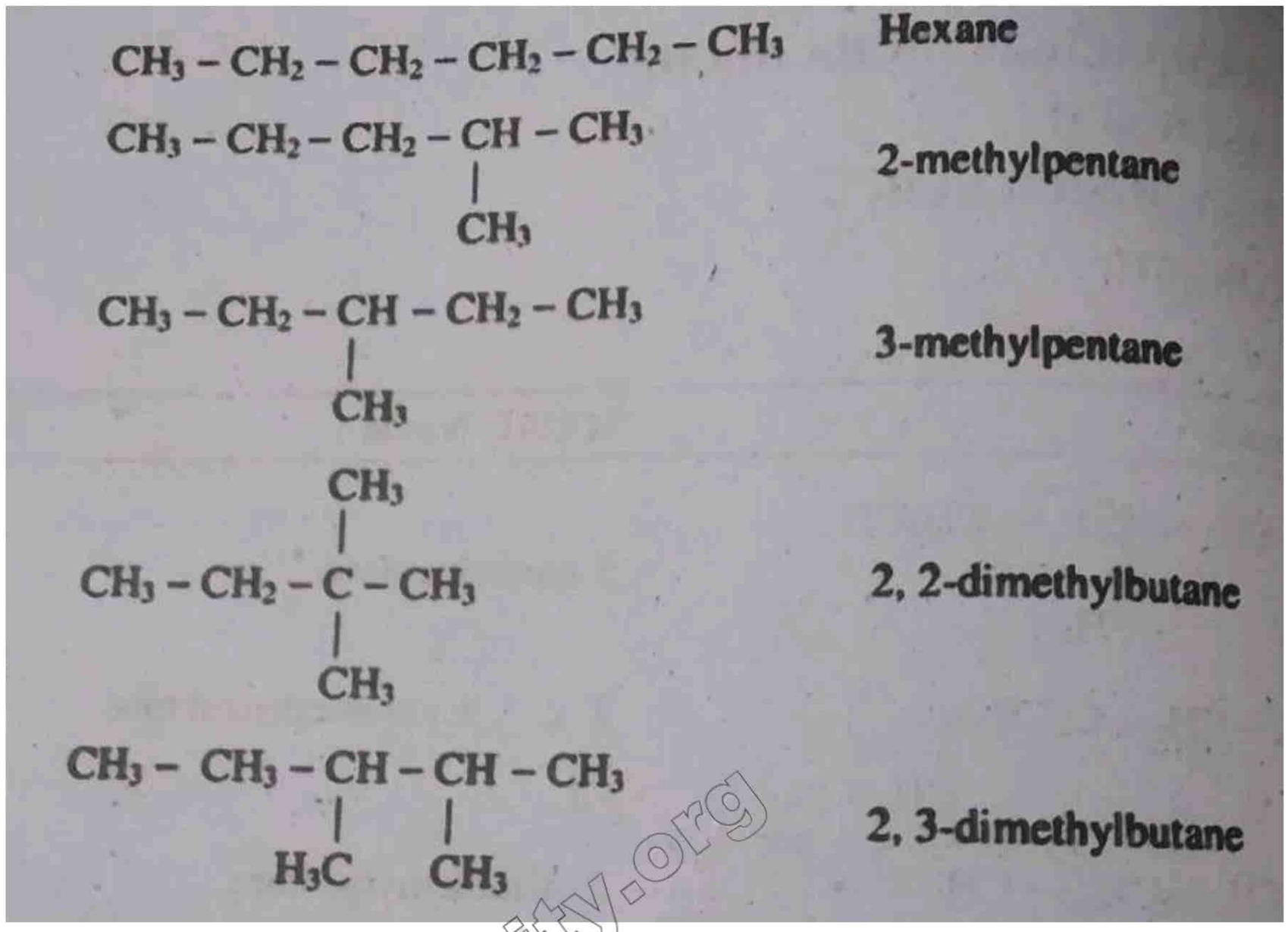
I) 4-Methylpentane
II) 3,5,5-Trimethylhexane
III) 2-Methyl-3-Ethylbutane

Ans:

		Correct Name
4-methylpentane	$CH_3-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-CH_2-CH_3$	2-methyl pentane
3, 5, 5-trimethylhexane	$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{\vert}{CH}}-CH_2-\underset{\displaystyle CH_3}{\underset{\vert}{\overset{\displaystyle CH_3}{\overset{\vert}{C}}}}-CH_3$	2,2,4-trimethyl hexane
2-methyl-3-ethylbutane	$CH_3-\underset{\displaystyle H_3C}{\underset{\vert}{CH}}-\underset{\displaystyle C_2H_5}{\underset{\vert}{CH}}-CH_3$	2,3-dimethyl pentane

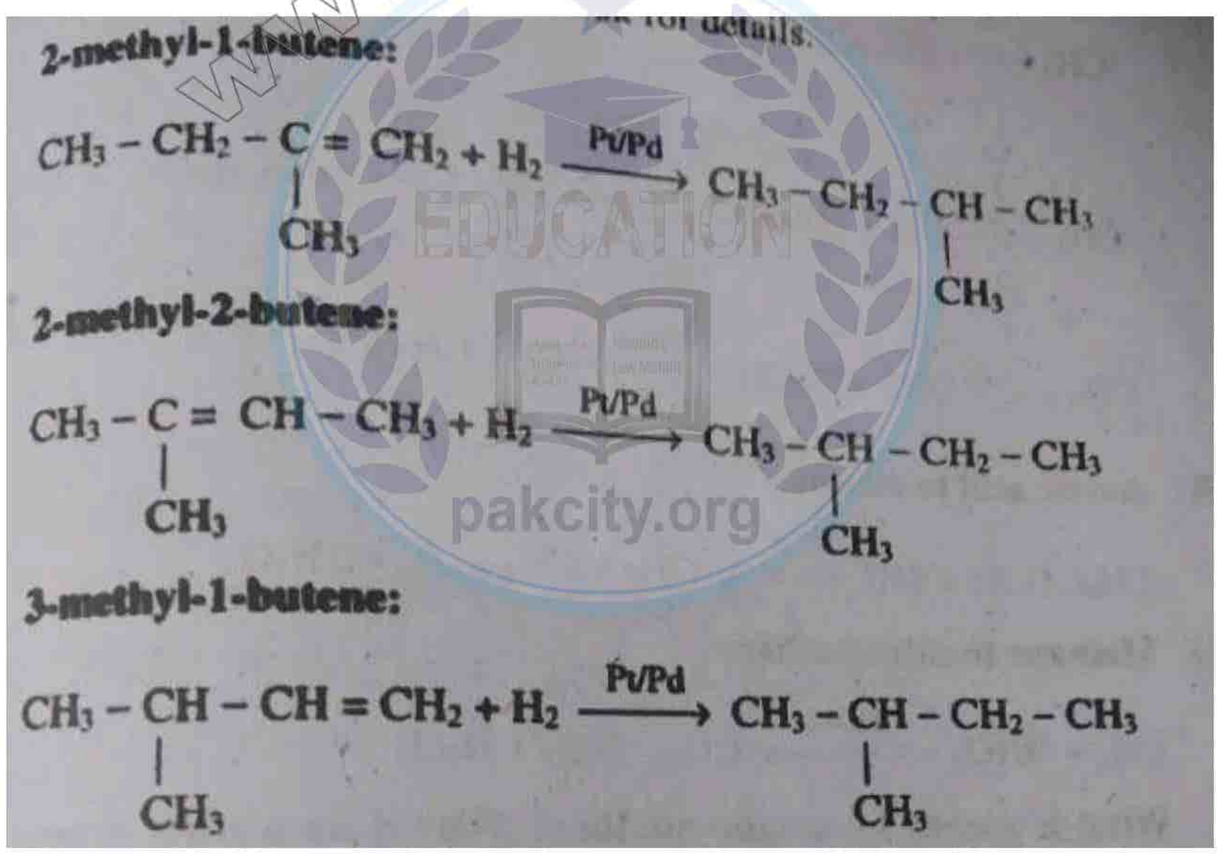
33. Write structural formulas of isomeric hexanes and give their IUPAC names.

Ans:



34. Three different alkanes yield 2-methylbutane when they are hydrogenated in thepresence of a metal catalyst. Give their structures and write equations for the reactions involved.

Ans:



35. How will you bring about the following conversions?

i) Methane to ethane ii) Ethane to methane

iii) Acetic acid to ethane iv) Methane to nitromethane.

Ans:

(i) Methane into ethane:

$$CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$$

$$2CH_3Cl + 2Na \longrightarrow CH_3 - CH_3 + 2NaCl$$

(ii) Ethane into methane:

$$CH_3 - CH_3 + Cl_2 \xrightarrow{hv} CH_3 - CH_2Cl + HCl$$

$$CH_3 - CH_2Cl + KOH_{(aq)} \longrightarrow CH_3 - CH_2 - OH + KCl$$

$$CH_3 - CH_2 - OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3 - \overset{\overset{O}{\|}}{C} - H + H_2O$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3 - \overset{\overset{O}{\|}}{C} - OH$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - OH + NaOH \longrightarrow CH_3 - \overset{\overset{O}{\|}}{C} - ONa + H_2O$$

$$CH_3 - \overset{\overset{O}{\|}}{C} - ONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

(iii) Acetic acid to ethane:

$$CH_3COOH + 6HI \xrightarrow{P} CH_3 - CH_3 + 3I_2 + 2H_2O$$

(iv) Methane to nitromethane:

$$CH_4 + HNO_3 \xrightarrow{450°C} CH_3 - NO_2 + H_2O$$

36. Write structural formulas for each of the following compounds:

i) Isobutylene
ii) 2,3,4,4-Tetramethyl-2-pentene
iii) 2 ,5-Heptadiene
iv) 4,5-Dimethyl-2-hexene
v) Vinylacetylene
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:

i. $CH_3-C(CH_3)=CH_2$

ii. $CH_3-CH=C(CH_3)-C(CH_3)(CH_3)-CH_3$

iii. $H_3C-CH=CH-CH_2-CH=CH-CH_3$

iv. $CH_3-CH=CH-C(CH_3)-CH(CH_3)-CH_3$

v. $CH_2=CH-C\equiv CH$

vi. $CH_2=CH-CH=CH-CH_3$

vii. $CH\equiv C-CH_2-CH_3$

(viii) $CH_2=CH-CH(CH_2-CH_2-CH_3)-CH=CH_2$

(ix) $CH_2=CH-Br$

(x) $CH\equiv C-CH=CH_2$

(xi) $CH_3-C\equiv C-CH(CH_3)-CH_3$

(xii) $CH_3-CH_2-CH(CH_3)-CH_3$

37. Name the following compounds by IUPAC system.

Ans:

$CH_3-CH=CH(CH_2)_2CH_3$	2-hexene
$(CH_3)_2C=CH_2$	2-methyl-1-propene
$CH_3-CH_2-CH_2C(=CH_2)-CH(CH_3)_2$	2-isopropyl-1-pentene
$CH_2=CH-CH=CH_2$	1, 4-butadiene
$CH_2=C(C_2H_5)-CH_2-CH_2-CH_3$	2-ethyl-1-pentene
$HC\equiv C-CH_3$	Propyne
$CH_3-C\equiv C-CH_3$	2-butyne
$CH_2=CH-C\equiv C-CH=CH_2$	1, 5-hexadiene-3-yne
$HC\equiv C-CH=CH-C\equiv CH$	3-hexene-1, 5-diyne
$H_2C=CH-C\equiv CH$	1-butene-3-yne

38. Give structure formulas of the alkenes expected to form by the dehydrohalogenationof the following compounds with a strong base:

i) 1 –Chloropentane ii) 2-Chloro-3-methyl butane iii) l-Chloro-2,2-dimethyl propane.

Ans:

1-Chloropentane:

$$CH_3-CH_2-CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2 + KOH \xrightarrow[(alc)]{} \underset{\text{1-pentene}}{CH_3-CH_2-CH_2-CH=CH_2} + KCl + H_2O$$

2-chloro-3-methyl butane:

$$CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3 + KOH \xrightarrow[(alc)]{} \underset{\text{2 methyl-2-butene}}{CH_3-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3} + KCl + H_2O$$

1-chloro-2, 2-dimethyl propane:

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_2-Cl \longrightarrow$$ As β-hydrogen is not available so reaction is not possible.

39. Write down chemical equations for the preparation of propene from the following equations:

i) $CH_3-CH_2-CH_2-OH$ ii) $CH_3-C=CH$

iii) Iso-Propyl chloride

Ans:

(i) $$CH_3-CH_2-CH_2-OH \xrightarrow[140-170^\circ C]{75\%\ H_2SO_4} CH_3-CH=CH_2+H_2O$$

(ii) $$CH_3-C\equiv CH + H_2 \xrightarrow[\text{Quinoline}]{Pd(BaSO_4)} CH_3-CH=CH_2$$

(iii) $$CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3 + KOH \xrightarrow[100^\circ C]{\text{alcohol}} CH_3-CH=CH_2+KCl+H_2O$$

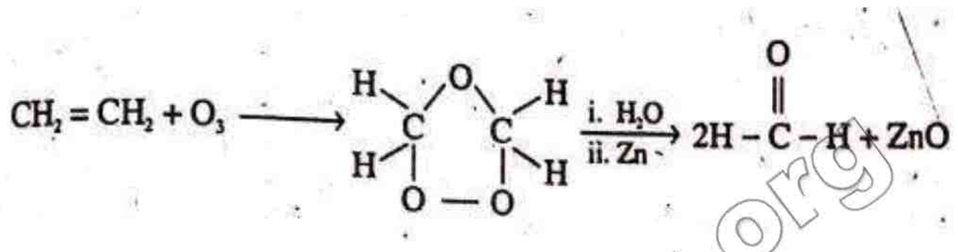
40. How can you establish that ethylene contains a double bond?

Ans:

Baeyer's Test: Purple colour of $KMnO_4$ discharged

$$3H_2C=CH_2 + 2KMnO_4 + 4H_2O \longrightarrow 3\ \underset{OH}{\overset{CH_2-CH_2}{|\quad\quad|}}\ + 2MnO_2 + 2KOH$$

Ozonolysis: Ozone added along double bond indicating point of unsaturation



41. Starting from ethene, outline the reactions for the preparation of following compounds.
i) 1,2-Dibromoethane ii) Ethyne iii) Ethane
iv) Ethylene glycol

Ans:

1,2-dibromoethane

$$CH_2=CH_2 + Br_2 \xrightarrow{CCl_4} Br-CH_2-CH_2-Br$$

Ethyne:

(a) $CH_2=CH_2 + Br_2 \xrightarrow{CCl_4} Br-CH_2-CH_2-Br$

(b) $Br-CH_2-CH_2-Br + 2KOH \xrightarrow[(alc)]{80°C} CH\equiv CH + 2KBr + 2H_2O$

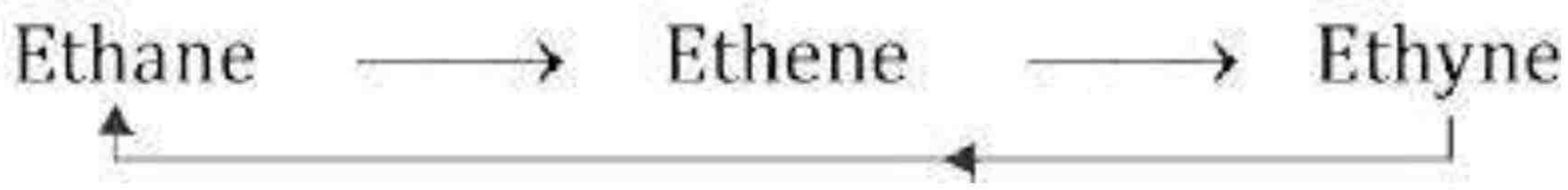
Ethane:

$$CH_2=CH_2 + H_2 \xrightarrow[250°C]{Ni} CH_3-CH_3$$

Ethylene glycol:

$$3H_2C=CH_2 + 2KMnO_4 + 4H_2O \xrightarrow{\bar{O}H} 3\ \underset{CH_2-OH}{\overset{CH_2-OH}{|}}\ + 2MnO_2 + 2KOH$$

42. How the following conversion is carried out?



Ans:

First Step:

Ethane $\longrightarrow$ Ethene

(i) Halogenation in the presence of sunlight:

$$CH_3 - CH_3 + Cl - Cl \xrightarrow{hv} CH_3 - CH_2 - Cl$$

(ii) Dehydrohalogenation:

$$CH_3 - CH_2 - Cl + KOH \xrightarrow[(alc)]{100°C} CH_2 = CH_2 + KCl + H_2O$$

Second Step:

Ethene $\longrightarrow$ Ethyne

(i) Addition of halogen:

$$CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4} Br - CH_2 - CH_2 - Br$$

(ii) Dehydrohalogination:

$$Br - CH_2 - CH_2 - Br + 2KOH \xrightarrow[(alc)]{-HBr,\ 80°C} CH \equiv CH + 2KBr + 2H_2O$$

Third Step:

Ethyne $\longrightarrow$ Ethane

(i) $$CH \equiv CH + H_2 \xrightarrow[Quinoline]{Pd / BaSO_4} CH_2 = CH_2$$

(ii) $$CH_2 = CH_2 + H_2 \xrightarrow[250°C]{Ni} CH_3 - CH_3$$

43. Write down structural formulas for the products that are formed when 1-butene will react with the following reagents:
i) H_2, Pt ii) Br_2 in CCl_4
iii) Cold dil. $KMnO_4$\OH iv) HBr
v) O_2 in the presence of Ag vi) HOCl
vii) dil. H_2SO_4

Ans:

$$CH_2 = CH - CH_2 - CH_3 + H_2 \xrightarrow{Pt} CH_3 - CH_2 - CH_2 - CH_3$$

n-butane

$$CH_2 = CH - CH_2 - CH_3 + Br_2 \xrightarrow{CCl_4} CH_2(Br) - CH(Br) - CH_2 - CH_3$$

1-2-dibromobutane

$$3CH_2 = CH - CH_2 - CH_3 + 2KMnO_4 + 4H_2O \longrightarrow 3CH_2(OH) - CH(OH) - CH_2 - CH_3 + 2MnO_2 + 2KOH$$

$$CH_2 = CH - CH_2 - CH_3 + HBr \longrightarrow CH_3 - CH(Br) - CH_2 - CH_3$$

2-bromobutane

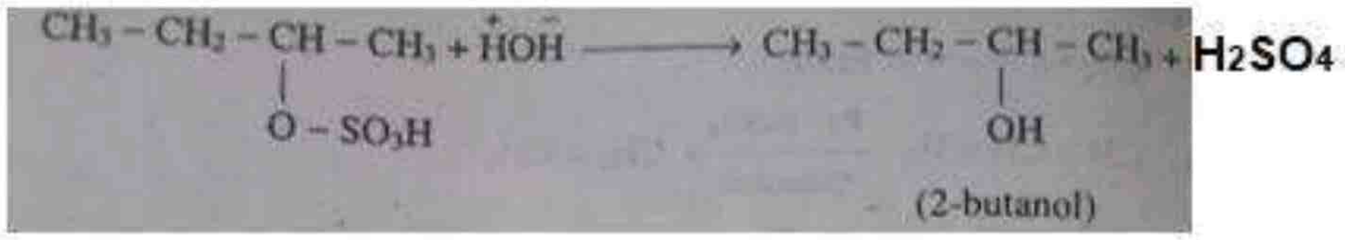
$$CH_3 - CH_2 - CH = CH_2 + \tfrac{1}{2} O_2 \xrightarrow[300°C]{As} CH_3 - CH_2 - CH(O) - CH_2$$

Butylene oxide

$$CH_3 - CH_2 - CH = CH_2 + HOCl \longrightarrow CH_3 - CH_2 - CH(OH) - CH_2(Cl)$$

1-chloro-2-butanol

$$CH_3 - CH_2 - CH = CH_2 + H_2SO_4 \longrightarrow CH_3 - CH_2 - CH(O - SO_3H) - CH_3$$



44. In the following reactions, identify each lettered product.

i) Ethyl alcohol $\xrightarrow{conc.H_2SO_4}$ A $\xrightarrow{Br_2}$ B $\xrightarrow[KOH]{alcoholic}$ C

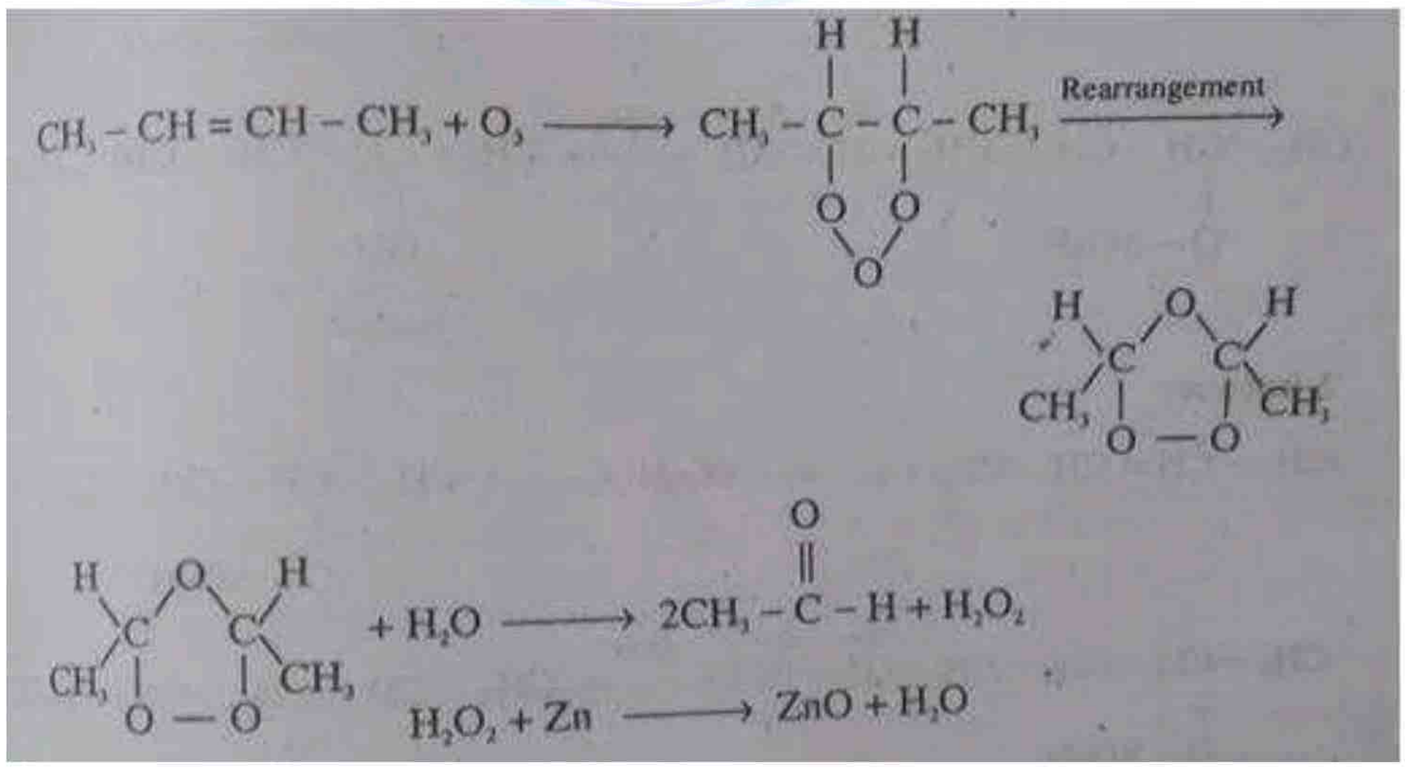
ii) Propene $\xrightarrow{Br_2}$ D $\xrightarrow[KOH]{alcoholic}$ E $\xrightarrow{HCN}$ F

Ans:

(i) A=Ethene B=1,2-dibromoethane C=Ethyne

(ii) D=1,2-dibromopropane E=Propyne F=2-cyano propene

45. After an ozonolysis experiment, the only product obtained was acetaldehyde CH3CHO. Can you guess the structural formula of this compound?



46. The addition of sulphuric acid to an alkene obeys Markownikov's rule. Predict the structures of the alcohols obtained by the addition of the acid to the following compounds.

i) Propene ii) 1-Butene iii) 2-Butene

Ans:

(i) Propene:

$$CH_3-CH=CH_2 + H-O-SO_3H \longrightarrow CH_3-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_3$$

$$CH_3-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_3 + \overset{\delta+}{H}-\overset{\delta-}{O}H \xrightarrow{100^\circ C} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 + H_2SO_4$$

iso-propyl alcohol

1-butene:

$$CH_2=CH-CH_2-CH_3 + H-O-SO_3H \longrightarrow CH_2-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_2-CH_3$$

$$CH_2-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_2-CH_3 + \overset{\delta+}{H}-\overset{\delta-}{O}H \xrightarrow{100^\circ C} CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CH_3 + H_2SO_4$$

2-butanol

2-butene:

$$CH_3-CH=CH-CH_3 + H-O-SO_3H \longrightarrow CH_3-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_2-CH_3$$

$$CH_3-\underset{\displaystyle O-SO_3H}{\underset{|}{CH}}-CH_2-CH_3 + \overset{\delta+}{H}-\overset{\delta-}{O}H \xrightarrow{100^\circ C} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CH_3 + H_2SO_4$$

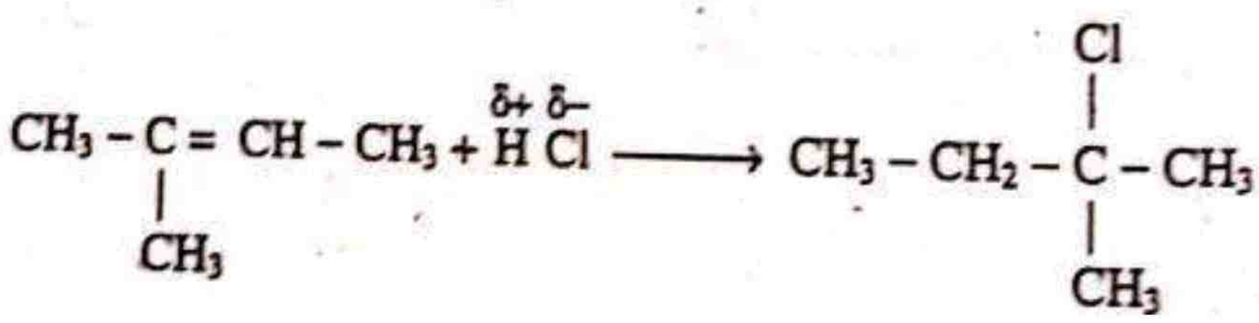
2-butanol

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_3 + \overset{\delta+}{H}\,\overset{\delta-}{Cl} \longrightarrow CH_3-CH_2-\underset{\displaystyle CH3}{\underset{|}{\underset{\displaystyle Cl}{\underset{|}{C}}}}-CH_3$$

As 2-methyl-2-butene is an unsymmetrical compound and HCl is an unsymmetrical reagent so the addition will be according to Markownikov's rule and the product will be 2-chloro-2-methyl butane.

47. Predict the most likely product of the addition of hydrogen chloride to 2-methyl-2-butene. Explain the formation of this product.

Ans: Addition is according to Markownikov's rule and product is 2-chloro2-methyl butane.



48. Distinguish between ethane, ethene, ethyne.

Ans:

Reagent	Ethane	Ethylene	Acetylene
Alkaline $KMnO_4$ soln.	No reaction	Decolourized	Decolourized
Bromine water	No reaction	Decolourized	Decolourized
Ammonical $AgNO_3$	No reaction	No reaction	White ppt. of silver acetylide
Ammonical Cu_2Cl_2	No reaction	No reaction	Red ppt. of copper acetylide
10% H_2SO_4 + $AgSO_4$	No reaction	Ethyl alcohol is formed	Acetaldehyde is formed