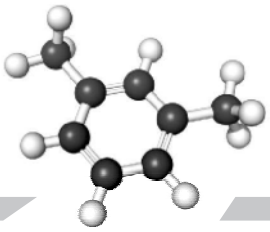
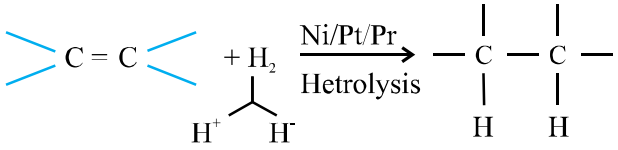


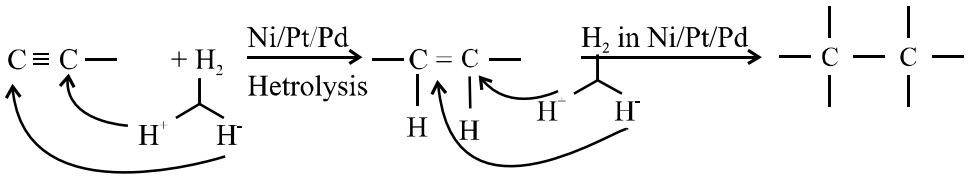
Chapter - 13

Hydro Carbons

- **Preparation of Alkanes :**

(1) From unsaturated hydrocarbons :





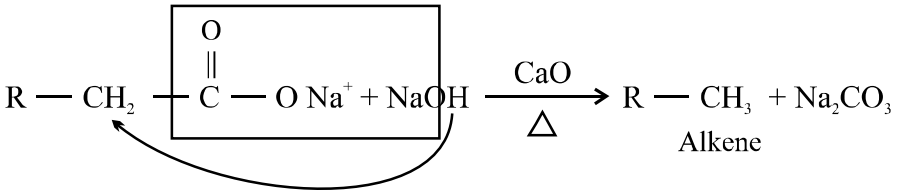
(2) Wurtz reaction $\left[\text{Alkyl Halide} + \text{Na} \xrightarrow[\text{ether}]{\text{Dry}} \text{Higher alkane}\right]$

$$R\text{–}X + 2Na + X\text{–}R \xrightarrow{\text{Dry ether}} R\text{–}R + 2\,NaX$$

(3) Sodalime decarboxylation method :

[Sodium salt of carboxylic acid + NaOH + CaO → Alkane [n_c = 1 less]

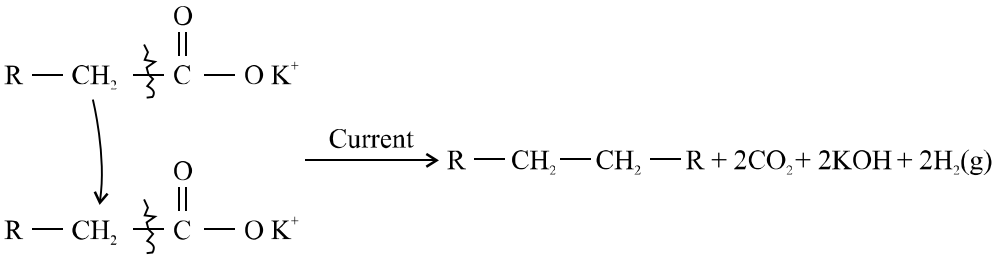
$$R\text{—}CH_2COONa^+ + NaOH \xrightarrow[\Delta]{CaO} ?$$



- **Koble's electrolytic method :**

[Potassium salt of carboxylic acid (aq) $\xrightarrow{\text{Current}}$ Higher alkane]

$$R{-}CH_2COO^-K^+\ (aq) \xrightarrow[\text{Electrolysis}]{} ?$$

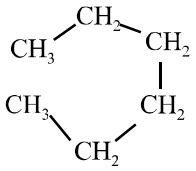


- **Chemical Properties of Alkanes :**

(1) **Halogenation :** One (H) atm is replaced by halogen at a time.

$$CH_4(g) + Cl_2(g) \xrightarrow{h\upsilon} CH_3Cl + CH_2Cl_2 + CHCl_3 + CCl_4$$

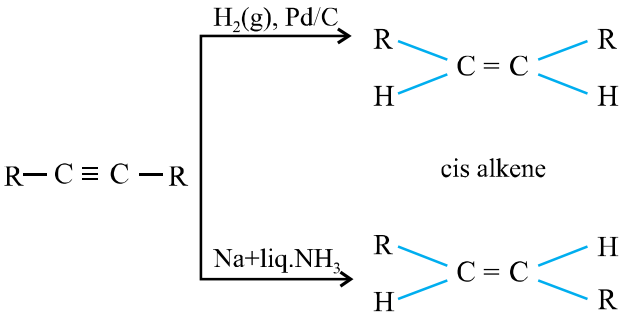
(2) **Aromatisation :** *n*-Hexane $\xrightarrow[773K\ 10\text{-}20atm]{Cr_2O_3 \text{ or } V_2O_5}$  or 



Alkenes

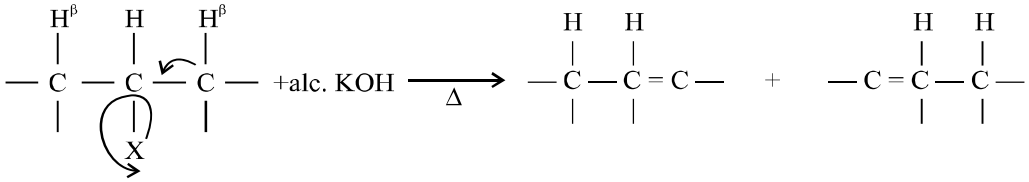
- **Preparation of alkenes :**

(1) From alkynes [Alkyne + H_2 ⟶ Alkene]



(2) From alkyl halide by (dehydrohalognation)

[Alkyl Halides + alc.KOH $\xrightarrow{\Delta}$ Alkene]



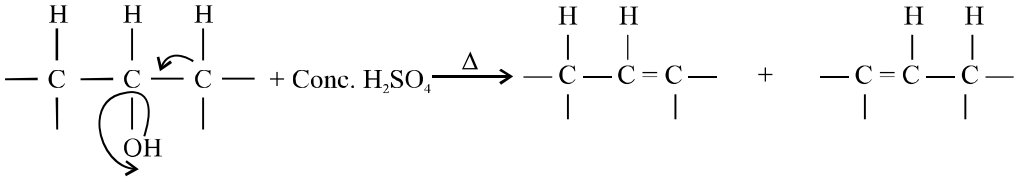
Carbon attached with halogen is α-carbons

Carbon attached with α-carbons is β-carbons

Halogen is removed and 'H'-atom is removed from β-carbon to form (C = C) double bond.

(3) By Dehydration of alcohols (Ion of water molecule)

$$[\text{Alcohol} + \text{Conc.}H_2SO_4 \xrightarrow{\Delta} \text{Alkene}]$$

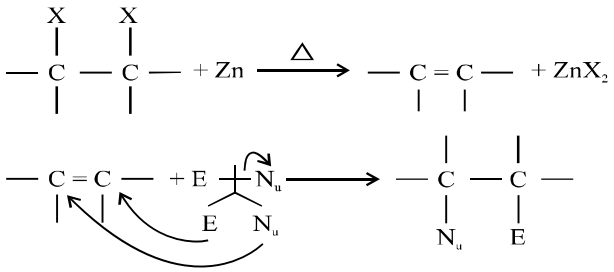


Carbon attached to alcohoic group is α-carbon.

Carbon attached to α-carbon is β-carbon.

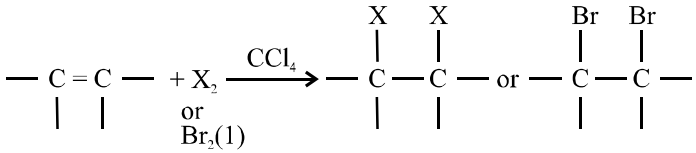
(4) From vicinal dihalides [Compounds in which halogen atom are attached with adjacent carbons]

$$\left[\text{Vicinal dihalide} + Zn \xrightarrow{\Delta} \text{Alkene}\right]$$



Chemical Properties of Alkenes :

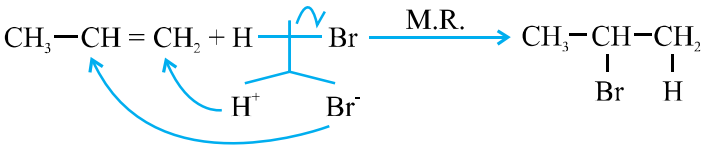
(1) Addition of Halogens : $\left[\text{Alkene} + X_2 \longrightarrow \text{Vicinal dihalide}\right]$



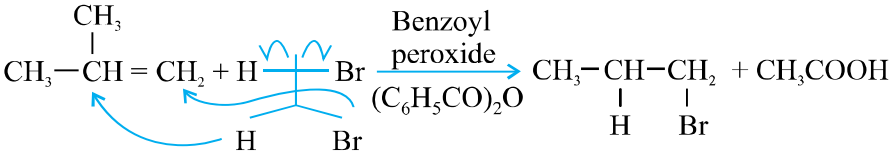
(2) Addition of H—X : $\left[\text{Alkene} + HX \longrightarrow \text{Alkyl halide}\right]$

(A) **Markownikoff's rule (M.R.) :** During electrophillic addition of hydrogen halide, the electron deficient electrophile (E^+) always attack

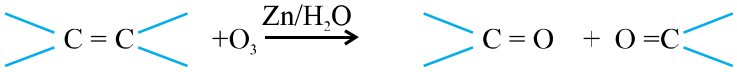
on that doubly/triply bounded carbon atom. which already has greater number of hydrogen atoms.



(B) **Peroxide/Kharasch effect (Anti M.Rule) :** This effect takes place in presence of peroxides when the hydrogen free radical $(\dot{H})$ attacks on that doubly bonded carbon which has lesser number of hydrogen atoms.



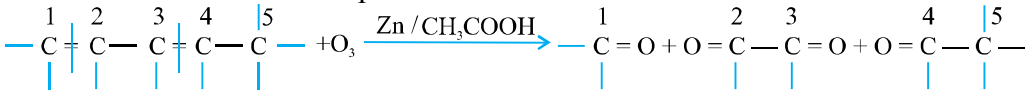
(C) Ozonolysis



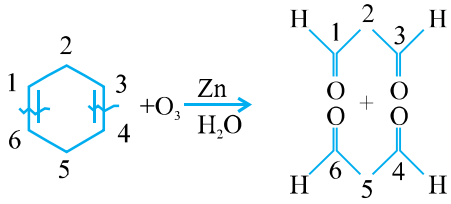
In this reaction all those carbons which form double bonds get findly converted into carbonyl carbons.

If alkenes are symmetrical then both carbonyl compounds are same.

If more than two double bonds are present then we get atleast one compound which has two carbonyl groups at the end. Such bifunctional compounds are formed from that part of alkene which is in between the double bonds.

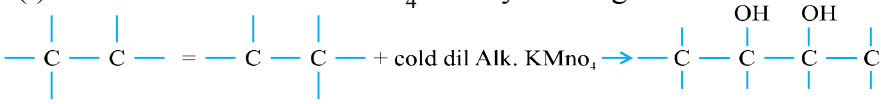


For cyclic alkenes :



(D) With potassium paramagnate :

(i) Cold dilute alkaline $KMnO_4$ = Baeyer's reagent.



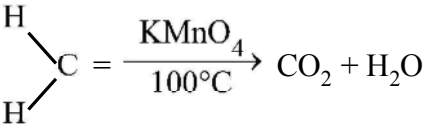
$[\text{Alkene} + \text{cold dil. } KMnO_4 \rightarrow \text{Diol}]$

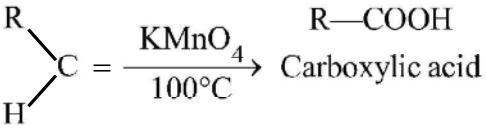
Baeyer's test for the presence of (C = C) bond

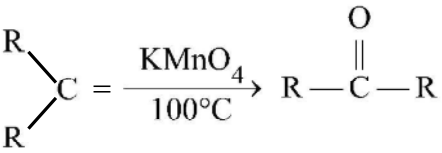
Compound + cold dil. alk. $KMnO_4$ ⟶ Purple colour decolourised

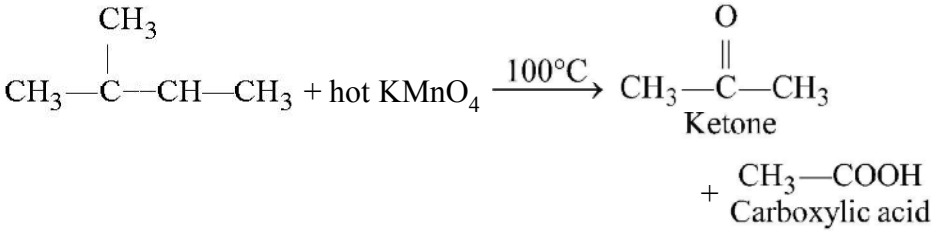
$\therefore$ Compound is alkene.

(ii) **Hot $KMnO_4$**

Case (1) : 

Case (2) : 

Case (3) : 

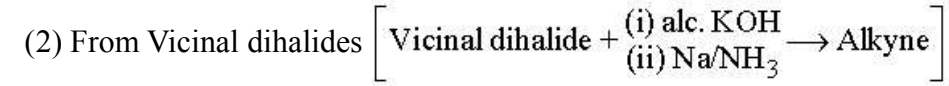


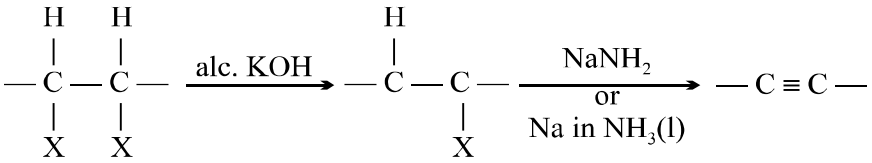
Alkynes

- **Preparation :**

(1) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + HC \equiv CH$

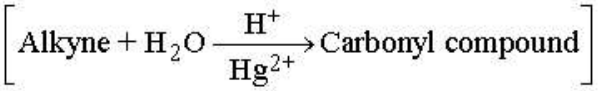
Calcium carbide Acetylene

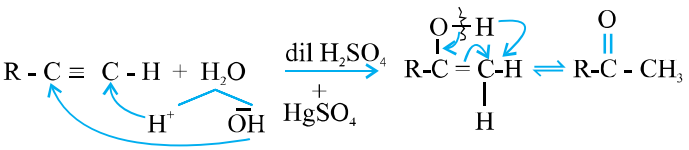
(2) From Vicinal dihalides 



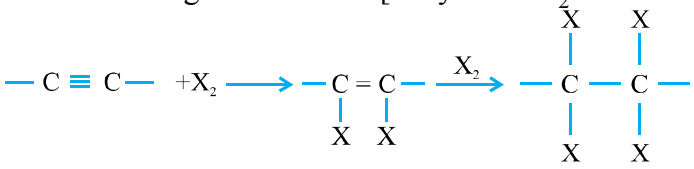
- **Chemical properties :**

(1) Hydration [Addition of water]

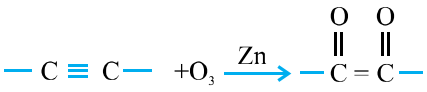




(2) Addition of Halogen molecule : [Alkyne + $2X_2$ ⟶ Tetra halides]



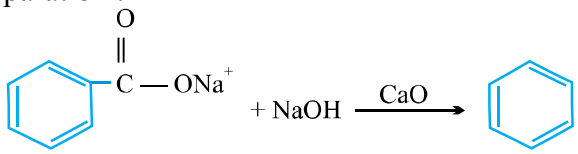
(3) Ozonolysis : [Alkyne +O_3 ⟶ Dicarbonyl compound]



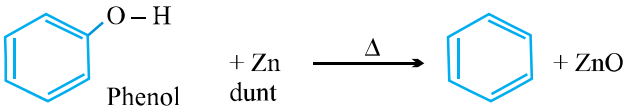
(4) $3HC \equiv CH \xrightarrow[\text{tube/873K}]{\text{Fe red hot}}$ 

Benzene

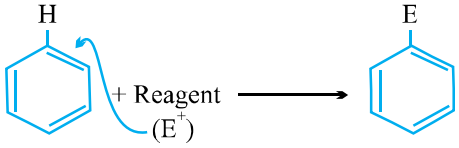
- Preparation :

(1) 

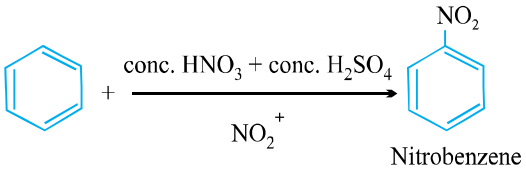
(2) $3HC \equiv CH \xrightarrow[873K]{\text{Fe red hot tube}}$ 

(3) 

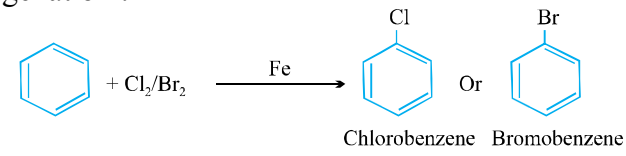
Chemical proprtics



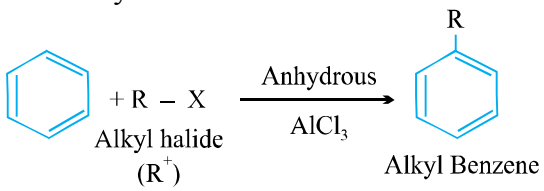
(1) Nitration :



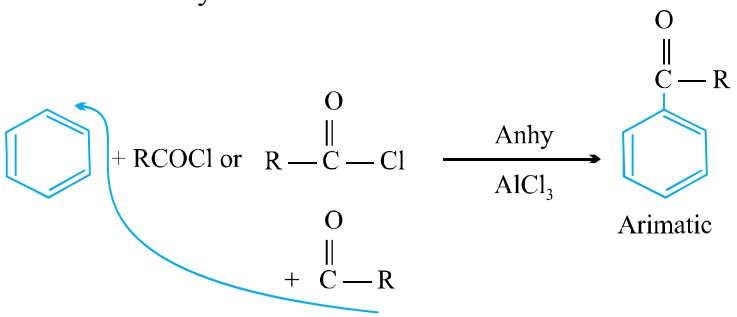
(2) Halogenation :



(3) Friedal-Craft Alkylation :



(4) Friedal-Craft Acylation :



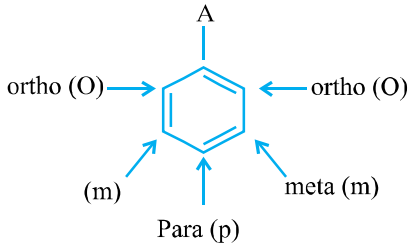
Huckel's Rule :

Conditions : (i) Compound most be planar.

(ii) Complete delocalisation of πe^-

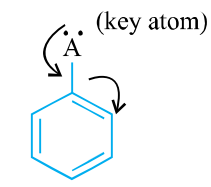
(iii) Presence of $(4n + 2)\ \pi e^-$.(n = 1, 2, 3, ...)

Derivatives of Benzenes :

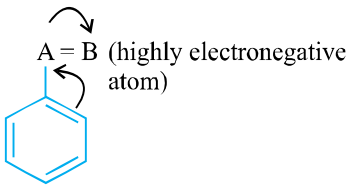


Ortho/Para directors : Group which direct the incoming electrophile to attach at ortho/para positions.

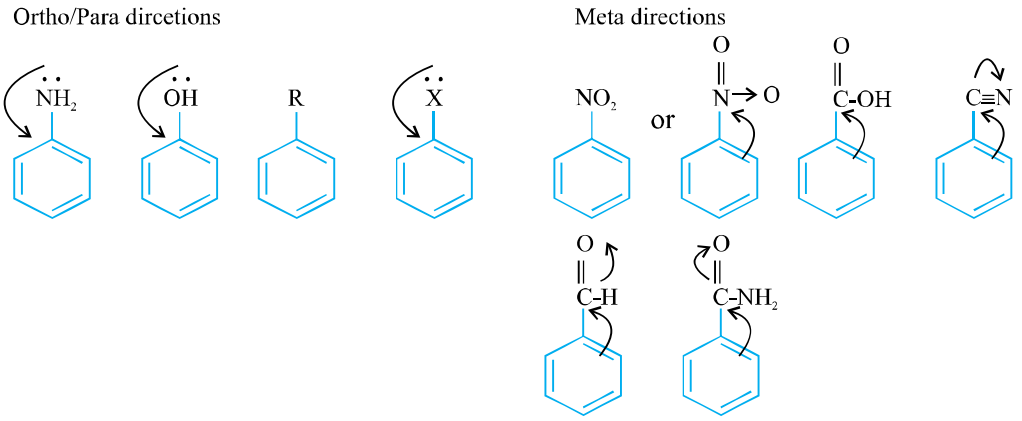
Meta directors : Groups which direct the incoming electrophile to attack at meta position.



Electron - releasing
Resonance effect
(+R)

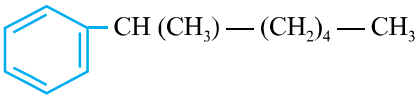
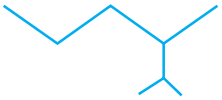


Electron withdrawing
Resonance effect
(–R)



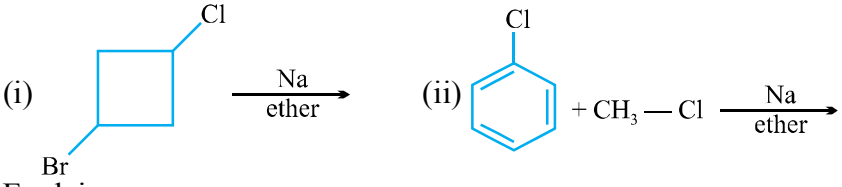
Hydrocarbons

1-Mark Questions

1. Give IUPAC name of 
2. Five the IUPAC name of 
3. Give the standard formula of 5-sec-butyl, 4-isopropyldecane.
4. Give the standard formula of 4-tert-butyl, 4-ethyl-2, 2, 5, 5-tetra methyl hexane.
5. Obtain isobutane from *n*-butane.
6. *n*-Hexane $\xrightarrow[V_2O_5]{773K,\ 10\text{-}20\ atm}$?

2-Mark Questions

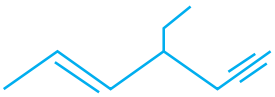
7. Out of 2-Methylpentane and 2, 3-Dimethylpentane which has greater boiling point and Why ?
8. Give the structure of alkyl halide which when treated with sodium metal in presence of ether gives $(CH_3)_2CH.CH(CH_3)_2$.
9. Complete :



10. Explain :
    (i) Staggered form of ethane is more stable than eclipsed form.
    (ii)Wurtz reaction is carried out in dry ether.

Alkenes

1-Mark Questions

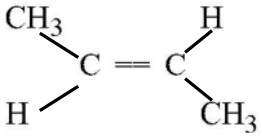
11. Give IUPAC name of 

12. Give hybridisation of central carbon in allene ($CH_2=C=CH_2$)

13. Name the effect which decide the stability of alkenes.

14. Complete the reaction : $CH_3—CH=CH_2 + HCl \xrightarrow[\text{Peroxide}]{} ?$

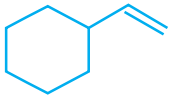
15. Which gas is produced during addition of HBr in alkenes is presence of peroxides ?

16. Name the reagent to convert $CH_3—C\equiv C—CH_3 \longrightarrow$ 

2-Mark Questions

17. Arrange the alkenes in decreasing order of stability.
$CH_3—CH = CH(CH_3)$, $CH_2 = CH_2$, $CH_3—CH = CH_2$

18. Complete the reaction $CH_2 = CH — \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH_2 + O_3 \xrightarrow[CH_3COOH]{Zn} ?$

19. Complete the reaction :
 + HBr ⟶ ?

20.  $+ O_3 \xrightarrow[CH_3COOH]{Zn} ?$

21. Name the alkene which will yield a mixture of cyclopentanone and propanal on treatment with O_3 followed by reduction with Zn.

22. An alkene on treatment with H—Br in presence of peroxide can generate two types of free radicals $CH_3—\underset{\displaystyle \cdot}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}}—CH_2—Br$ and $CH_3—\underset{\displaystyle Br}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}}—\dot{C}H_2$
Predict the finl product.

23. Explain :
(i) Melting point of *cis*-2-Butene is lower than that of trans-2-Butene.
(ii) Kharasch/peroxide effect is spontaneous with HBr only.

3 Mark Questions

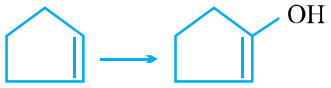
24. Complete the reactions :

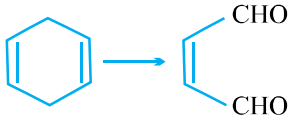
(i) $(CH_3)_2C = CH—CH_3 + \text{hot } KMnO_4 \longrightarrow$

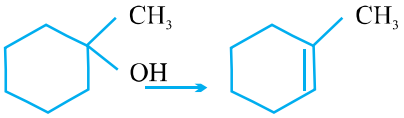
(ii) $(CH_3)_2C = CH.CH_3 + \text{cold dil. } KMnO_4 \longrightarrow$

(iii) $(CH_3)_2C = CH.CH_3 + HBr \xrightarrow{\text{Peroxide}}$

25. Indicate the reagents used to form the following products :

(i) 

(ii) 

(iii) 

26. (i) Convert: iso-propylbromide $\longrightarrow$ *n*-propyl bromide.

(ii) Give IUPAC name of Vinyl chloride.

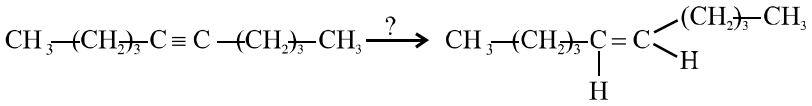
Alkynes

1 Mark Questions

27. Give IUPAC name of acetylene.

28. Which alkyne would you start with to prepare $CH_3—CH_2—CH_2—CO—CH_3$?

29. Name the reagent used in the following changes :

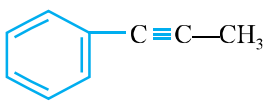


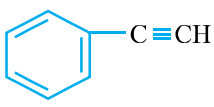
30. Give the alkyne which produce acetic acid and proponoic acid on treatment with alkaline $KMnO_4$ at 100°C.

2 Mark Questions

31. Convert : Acetylene → Propylene.

32. Convert : Ethylene → Acetylene.

33. Obtain : 

from 

34. Give the product when 1-methylcyclohexane reacts with :

(i) aq. acidic $KMnO_4$ (ii) O_3 followed by Zn/CH_3COOH.

3 Mark Questions

35. Pent-1-yne $\xrightarrow[\text{(ii) } CH_3—I]{\text{(i) } NaNH_2/NH_3}$ (A) $\xrightarrow[\text{Lindlar's Catalyst}]{H_2}$ (B) $\xrightarrow{Br_2}$ (C)

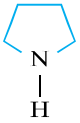
Identity A, B and C compounds and give their reactions.

Benzene

1 Mark Questions

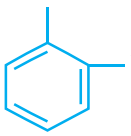
36. Who discovered benzene ?

37. Give reason whether  is aromatic or not.

38. Is pyrrole  an aromatic compound or not ? Give reason.

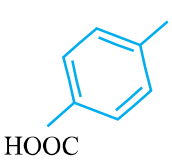
39.  $+ CH_3COCl \xrightarrow{\text{anhy. } AlCl_3} ?$

40. Give major product only



$+$ conc. HNO_3 $+$ conc. $H_2SO_4 \longrightarrow ?$

41. Give major product only



$+ Br_2 \xrightarrow{FeBr_3} ?$

2 Mark Questions

42. (i) Convert Acetylene $\longrightarrow$ Benzene

(ii)  $+ Cl_2 \xrightarrow{U.V.} ?$

43. Distinguish chemically butyne and but-2-yne.

44. (i) Planar, cyclic, conjugated compounds with $(4n + 2)$ πe^- are knows as ..... .

(ii) Planar, cyclic, conjugated compounds with $(4n)$ πe^- are knows as ..... .

3 Mark Questions

45. Convert: Ethylene $\longrightarrow$ Nitrobenzene.

46. Give chemical tests to distinguish the following :
(i) Pent-1-yne and pent-2-yne
(ii) Ethylene and Acetylene
(iii) Ethane and Ethylene

47. Complete the following reactions :
(i) $CH_3COONa + NaOH \longrightarrow$
(ii) *iso*-butyl bromide + alc. KOH $\longrightarrow$
(iii) *iso*-butyl alcohol + conc. $H_2SO_4 \xrightarrow{\Delta}$
(iv) $(CH_3)_2C = CH.CH_3 + HBr \xrightarrow[\text{Peroxide}]{}$
(v) $CH_3—\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2 + H_2O \xrightarrow{H^+}$
(vi) $(CH_3)_2C=CH_2$ + cold dil. $KMnO_4 \longrightarrow$
(vii) $(CH_3)_2C=CH.CH_3$ + hot $KMnO_4 \longrightarrow$
(viii) $(CH_3)_2C=CH.CH_3 + O_3 \xrightarrow[CH_3COOH]{Zn}$
(ix) $CH_3—\underset{\displaystyle Br}{\overset{\displaystyle |}{CH}}—\underset{\displaystyle Br}{\overset{\displaystyle |}{CH_3}}$ + 2 alc. KOH $\longrightarrow$
(x) $CaC_2 + H_2O \longrightarrow$
(xi) $CHCl_3 + Ag \longrightarrow$
(xii) $CH_3—C\equiv CH + H_2O \xrightarrow[Hg^{2+}]{H^+}$
(xiii) $CH_3—C\equiv CH_2CH_3 + O_3 \xrightarrow[H_2O]{Zn}$
(xiv) $CH_3C\equiv CH$ + alc. $KMnO_4 \xrightarrow{100°C}$
(xv) $C_6H_6 + H_2 \xrightarrow[473\ K]{Ni}$

48. Conversions :
(i) Ethane → Ethyne
(ii) Acetylene → But-2-yne
(iii) Propene → Propanol

(iv) Acetic acid → Methane

(v) Acetylene → Acetone (CH_3COCH_3)

(vi) Acetylene → Cyclohexane

49. A hydrocarbon (X) on treatment with ammonical $AgNO_3$ gave white precipitate. On treatment with water in dil. H_2SO_4 and $HgSO_4$, it gave CH_3—CHO. When (X) is treated with 1mol of $NaNH_2/NH_3$, along with *n*-propyl bromide, gave compound (Y), which on treatment with Lindlar's catalyst gave (Z) compound (Z) on treatment with O_3 along with Zn gave HCHO and butanol. Identify X, Y, Z and givel all the reactions.

50. An alkyl halide $C_5H_{11}Br$(A) reacts with alc. KOH to give on alkene (B) which reacts with Br_2 to give compound (C), which on dehydrobromination gives an alkyne (D). On treatment with sodium metal in liquid ammonia, one mole of (D) Give one mole of sodium salt of (D) and half mole of $H_2(g)$. Complete hydrogenation of (D) yields a straight chain alkane. Identify A, B, C and D. Give the reaction involved.

51. The sex attractant pheromme of codling moth has the molecular formula $C_{13}H_{24}O$. On catalytic reaction this compound gives 3-Ethyl-7-methyl-1-decanol having molecular formula $C_{13}H_{28}O$. On reduction ozonolysis the pheromme produces 2-pentane, 4-ketohexanal and 2-Hydroxyethanal. On the basis of these information, Write the structure of this pheromme.

52. 896 ml of a hydrocarbon (A) having 87.80% C and 12.19% H weights 3.28 g at STP. Hydrogenation of (A) gives 2-methylpentane. Also compound (A) on hydration in presence of H_2SO_4 and $HgSO_4$ gives Ketone (B) having molecular formula $C_6H_{12}O$. The ketone (B) gives a positive iodoform test. Find the structure of (A) give all reactions.

[**Hint :** (i) 1 mole of a compound at STP contains 22400 mL volume

(ii) Ketones having $CH_3-\overset{\overset{O}{\|}}{C}-$ structures gives positive iodoform test]

53. (a) Compound A{$C_{10}H_{18}O$} undergo reaction with H_2SO_4 at 250°C to yield a mixture of two alkenes {$C_{10}H_{16}$}. The major alkene product (B) gives only cyclopentanone after ozone treatment followed by reduction with Zn in CH_3COOH. Identify (A) and (B) give the reactions involved.

(b) Convert PhC≡CH ⟶ PhC≡C.CH_3

(c) Benzene does not give addition reactions under normal conditions.