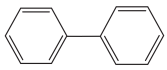
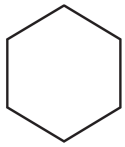
KD EDUCATION ACADEMY [9582701166] street no. 21 A-1 block Bengali colony sant nagar burari delhi -110084

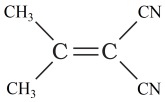
Time : 5 Hour | STD 11 Science Chemistry kd 90+ Ch-9 hydrocarbon | Total Marks : 270

* Choose The Right Answer From The Given Options.[1 Marks Each] [78]

1. In which of the following, all atoms are coplanar?

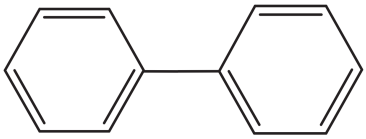
(A) 

(B) 

(C) 

(D) 

Ans. :

a. 

Explanation:

∵ All 'C' are sp^2 hybridised, all lie in one plane.

2. The bond order of individual carbon-carbon bonds in benzene is:

(A) One (B) Two

(C) Between one and two (D) One and two, alternately

Ans. :

c. Between one and two

Explanation:

Benzene is a resonance hybrid of two resonating structures. Bon dorder can be calculated as:

$$\text{Bond Order} = \frac{\text{Number of Resonating bonds}}{\text{Number of resonating structures}} = \frac{3}{2} = 1.5$$

The correct answer is between one and two.

3. Which of the following compounds will exhibit geometrical isomerism?

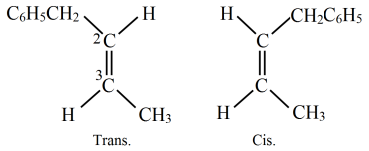
(A) 2-Phenyl-1-butene. (B) 1, 1-Diphenyl propane.

(C) 1-Phenyl-2-butene. (D) 3-phenyle butane.

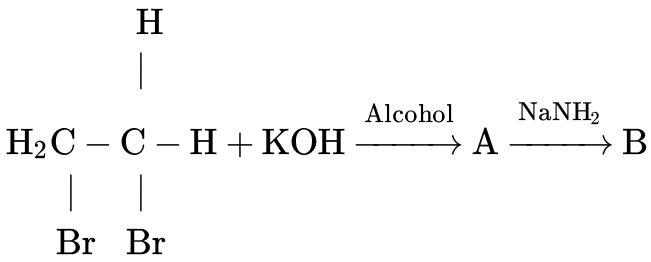
Ans. :

c. 1-Phenyl-2-butene.

Explanation:



4. What are A and B in following reaction?



	A	B
(a)	$H_2C = CH_2$	$CH \equiv CH$
(b)	$CH_2 = CHBr$	$CH \equiv CH$
(c)	$CH_2 = CHBr$	$CH_2 = CH_2$
(d)	$CH_2 = CH_2$	$CH \equiv CBr$

Ans. :

(b)	$CH_2 = CHBr$	$CH \equiv CH$

5. 2.84gms of methyl iodide was completely converted into CH_3MgI and the product was decomposed by the excess of ethanol. The volume of the gaseous hydrocarbon produced at NTP will be_____.

(A) 22.4lit. (B) 2240lit. (C) 0.448lit. (D) 224lit.

Ans. :

c. 0.448lit.

Explanation:

In this reaction, one mole of Grignard reagent reacts with one mole of alcohol to produce hydrocarbon.

$CH_3I \rightarrow CH_3MgI + C_2H_5OH \rightarrow CH_4 + C_2H_5OMgI$

Mass of methyl iodide = 2.84 gm (given)

No. of mole of methyl iodide = $\frac{2.84}{142}$ = 0.02

So hydrocarbon produced = 0.02 mole

So the volume of produced hydrocarbon = 0.448lit
(one mole produced 22.4lit).

6. The geometry of ethyne molecule is:

(A) Linear. (B) Trigonal planar.
(C) Tetrahedral. (D) Bent.

Ans. :

a. Linear.

7. IUPAC name of the first member of alkyne is _____.

(A) Ethene (B) Ethyne (C) Ethane (D) Methane

Ans. :

b. Ethyne

Explanation:

Alkynes are carbon compounds with general formula C_nH_{2n-2}

The first member of alkyne series is C_2H_2 (ethyne)

$H-C\equiv C-H$

Alkyne series: C_2H_2, C_3H_4, C_4H_6, C_5H_8.

8. An optically active hydrocarbon (X) on catalytic hydrogenation gives an optically inactive compound (Y), C_6H_{14}. The hydrocarbon (X) is-

(A) 3-methyl-1-pentene
(B) 3-methyl-2-pentene
(C) 2-ethyl-1-butene
(D) 3-methylcyclopentene

Ans. :

a. 3-methyl-1-pentene

Explanation:

The optically active hydrocarbon X is 3-methyl-1-pentene $CH_2=CH-CH(CH_3)CH_2CH_3$.

On catalytic hydrogenation, it forms, 3-methyl pentane $CH_3CH_2CH(CH_3)CH_2CH_3$, which is optically inactive.

9. Calcium heptane dioate on distillation produces:

(A) Cyclo hexanal
(B) Cyclohexene
(C) Cyclohexanone
(D) Cyclohexanoic acid

Ans. :

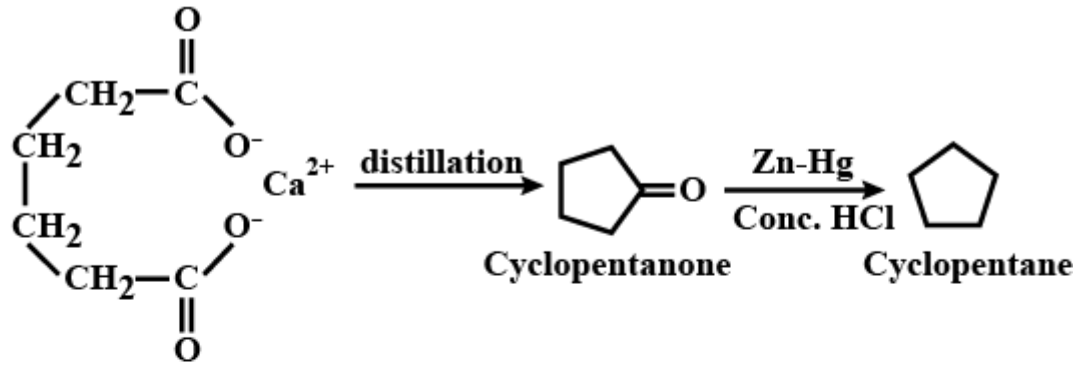
c. Cyclohexanone

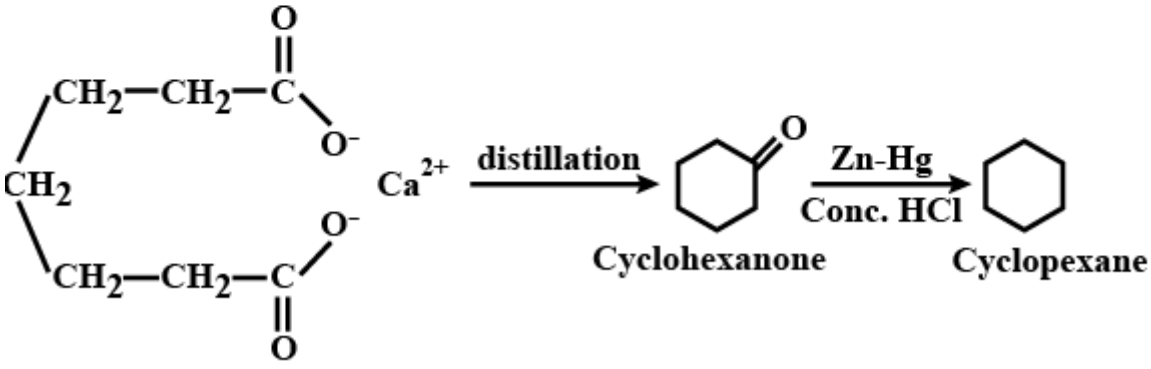
Explanation:

Calcium salts of saturated dicarboxylic acids on heating give corresponding cyclic ketones.

The Clemmenson reduction of cyclic ketones results in the formation of corresponding cycloakanes.

The reaction is best used for the synthesis of cyclopentane, cyclohexane, and cycloheptane.





10. Cycloalkanes are isomeric with:

(A) Alkanes (B) Alkenes (C) Alkynes (D) Arenes

Ans. :

b. Alkenes

11. The percentage of isomers formed during monobromination of 2,3−dimethyl butane at room temperature relative to 1, 2, 3 H atoms to chlorination is (1.0 : 3.8 : 5.0):

(A) 81% (B) 56% (C) 15% (D) 22%

Ans. :

d. 22%

Explanation:

A) is obtained from the reaction of 12 equivalent 1 H atoms.

(B) is obtained from the reaction of two equivalent 3 H atoms.

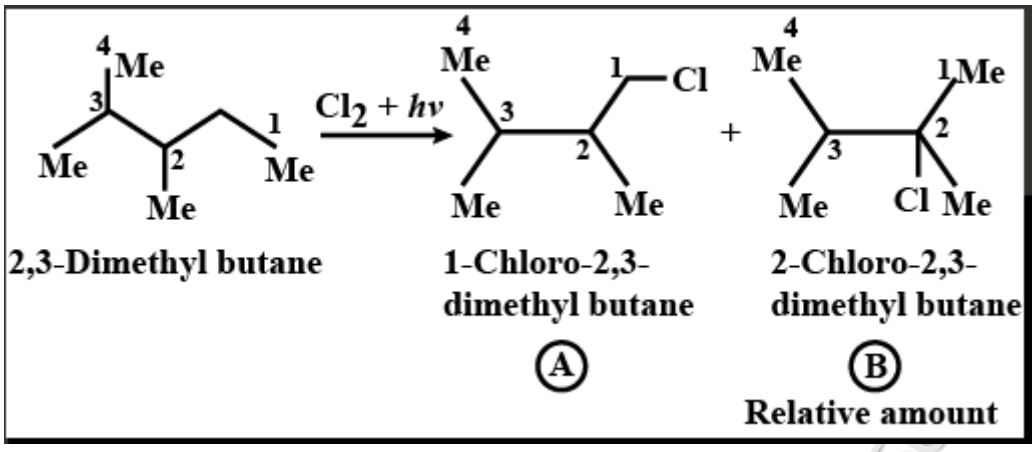
Percentage of (A) = $\frac{12\times100}{33}$ = 54.5%

Percentage of (B) = $\frac{10\times100}{22}$ = 45.5

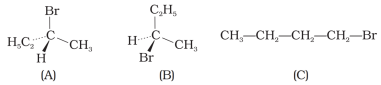
12 × 1 = 12.0

2 × 5 = 10.0

Total = 22.0



12. The addition of HBr to 1-butene gives a mixture of products A, B and C



The mixture consists of:

(A) A and B as major and C as minor products.

(B) B as major, A and C as minor products.

(C) B as minor, A and C as major products.

(D) A and B as minor and C as major products.

Ans. :

a. A and B as major and C as minor products.

Explanation:

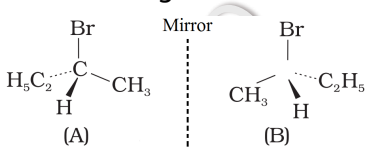
The alkene is unsymmetrical, hence will follow Markovnikov rule to give major product.

$$\underset{1-\text{Butene}}{CH_3-CH_2-CH=CH_2}+H-Br\rightarrow \underset{\text{I (major product)}}{CH_3-CH_2-CHBr-CH_3}+$$

$$C_2H_5-\overset{\overset{Br}{|}}{\underset{\underset{H}{|}}{C^*}}-CH_3 \qquad +\underset{\text{(C) (minor product)}}{CH_3-CH_2-CH_2-CH_2Br}$$

(I)

Since I contains a chiral carbon, it exists in two enantiomers (A and B) which are mirror image of each other.



13. How many chain isomers can be formed by butane?

(A) One (B) Three (C) Two (D) Four

Ans. :

c. Two

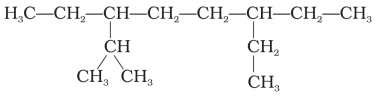
14. Which of the following is not a cumulated diene?

(A) Hexa−1, 2−diene
(B) Hexa−2, 3−diene
(C) Penta−2, 3−diene
(D) Penta−1, 3−diene

Ans. :

d. Penta−1, 3−diene

15. The correct IUPAC name of the following alkane is:

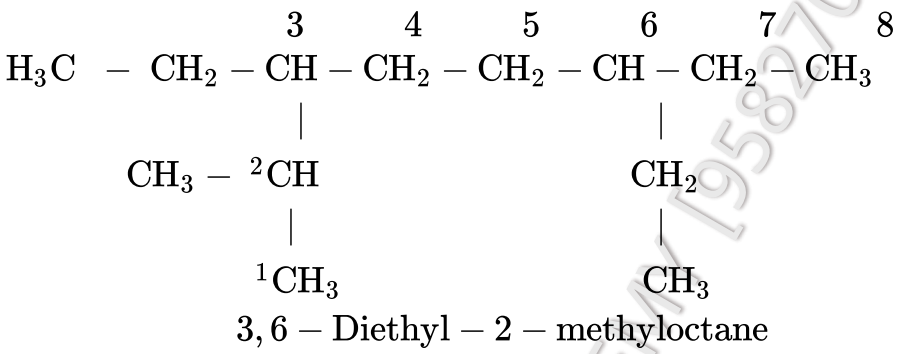


(A) 3, 6 – Diethyl – 2 – methyloctane.
(B) 5 – Isopropyl – 3 – ethyloctane.
(C) 3 – Ethyl – 5 – isopropyloctane.
(D) 3 – Isopropyl – 6 – ethyloctane.

Ans. :

a. 3, 6 – Diethyl – 2 – methyloctane.

Explanation:



16. A direct iodination of benzene is not possible because:
(A) Iodine is an oxidising agent.
(B) Resulting C_6H_5I is reduced to C_6H_6 by HI.
(C) HI is unstable.
(D) The ring gets deactivated.

Ans. :

b. Resulting C_6H_5I is reduced to C_6H_6 by HI.

Explanation:

The direct iodination reaction of benzene is,

$C_6H_6 + I_2 \rightleftharpoons C_6H_5I + HI$

This reaction is a reversible reaction. The product HI reacts with iodobenzene to get back benzene.

Hence, direct iodination of benzene is not possible because the product C_6H_5I is reduced by HI.

17. Which of the following exhibit geometrical isomerism?
(A) 2-methylpropene.
(B) But-1-ene.
(C) But-2-ene.
(D) 2, 3-dibromo-but-2-ene.

Ans. :

c. But-2-ene.

18. Examples of addition reactions include all but one of the following. Which is the odd one out?
(A) Reaction of HBr with but-2-ene.
(B) Combustion of propene.

(C) Reaction of Cl_2 with propene. (D) Polymerization of ethene.

Ans. :

b. Combustion of propene.

Explanation:

Combustion reaction involves the complete burning of a compound in the presence of excess of oxygen to give carbon dioxide and water.

Whereas addition reaction involves the addition of smaller molecules across the double bond to give the addition product.

19. $CH_3-C\equiv C$ MgBr can be prepared by the reaction of _____.

(A) $CH_3-C\equiv C-Br$ with $MgBr_2$ (B) $CH_3-C\equiv CH$ with MgB_2

(C) $CH_2-C\equiv CH$ with KBr and Mg metal (D) $CH_3-C\equiv CH$ with CH_3MgBr

Ans. :

d. $CH_3-C\equiv CH$ with CH_3MgBr

Explanation:

$CH_3-C\equiv C-H + CH_3MgBr \rightarrow CH_3-C\equiv CMgBr + CH_4$.

20. On heating sodium propionate with sodalime the hydrocarbon obtained is:

(A) Butane (B) Ethane (C) Propane (D) Ethene

Ans. :

b. Ethane

Explanation:

Sodium propionate reacts with soda lime (NaOH + CaO) to form ethane.

21. In an alkane if the value of n = 19, it is:

(A) Solid (B) Liquid

(C) Gaseous (D) None of the above

Ans. :

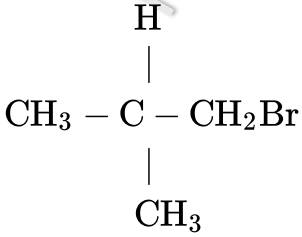
a. Solid

Explanation:

The homologous of alkanes larger than hexadecane are solids, solid alkanes are normally soft, with low melting points. These characteristics are due to strong repulsive forces generated between electrons on neighboring atoms, which are in close proximity in crystalline solids.

The strong repulsive forces counterbalance the weak van der Waals forces of attraction, alkanes are almost completely insoluble in water. If n = 19, then the alkane $C_{19}H_{40}$ is a solid.

22. Arrange the following carbanions in order of their decreasing stability.

A. 

B. CH_3-CH_2-Br

C. $CH_3-CH_2-CH_2-Br$

(A) $A > B > C$ (B) $C > B > A$ (C) $B > C > A$ (D) $A > C > B$

Ans. :

iv. $A > C > B$

Explanation:

$$CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle H}{\overset{|}{\underset{|}{C}}}} - CH_2Br > CH_3CH_2CH_2Br > CH_3CH_2Br$$

is the order of rate of β-elimination with alcoholic KOH.

$$CH_3 - \overset{\displaystyle H}{\overset{|}{\underset{|}{{}^{\beta}C}}} - {}^{\alpha}CH_2Br \qquad {}^{\beta}CH_3 - {}^{\alpha}CH_2 - Br$$

$$\underset{\displaystyle CH_3}{|} \qquad\qquad (B)$$

$(\text{has } 2\ \beta - \text{substituents}) \qquad (\text{has no } \beta - \text{substituent})$

$$CH_3 - {}^{\beta}CH_2 - {}^{\alpha}CH_2 - Br$$

$$(C)$$

$(\text{has1 } \beta - \text{substituent})$

More the number of β-substituents (alkyl groups), more stable alkene will be formed on β-elimination and more will be the reactivity. Thus, the decreasing order of the rate of β-elimination reaction with alcoholic KOH is: A > C > B.

23. Which of the following gives propyne on hydrolysis?

(A) Al_4C_3 (B) M_g2C_3 (C) B_4C (D) La_4C_3

Ans. :

b. M_g2C_3

Explanation:

Mg_2C_3 on hydrolysis gives propyne and $Mg(OH)_2$.

$Mg_2C_3 + 4H_2O \rightarrow 2Mg(OH)_2 + C_3H_4$.

24. What is the name of the alkene $H_2C{=}CH{-}CH{=}CH_2$?

(A) 1, 3-butadiene (B) 1, 3-butanediene

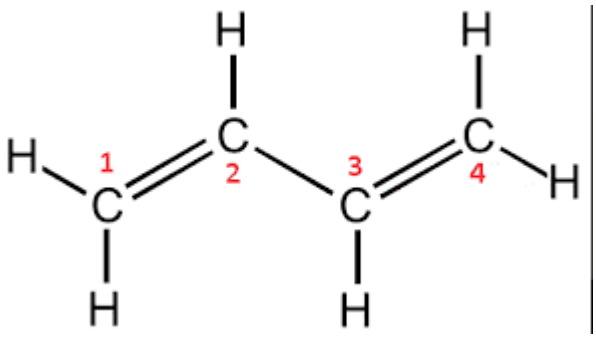
(C) 1, 3-dibutene (D) 1, 3-dibutadiene

Ans. :

a. 1, 3-butadiene

Explanation:

The name of the given compound is 1, 3-butadiene.



25. The compound formed as a result of oxidation of propyl benzene by hot alkaline $KMnO_4$ is:

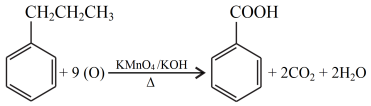
(A) Benzoic acid. (B) 2-phenyl ethanoic acid.

(C) 3-phenyl ethanoic acid. (D) Acetophenone.

Ans. :

a. Benzoic acid.

Explanation:



26. X compound reacts with Na to give $CH_3CH_2CH_2CH_3$. The compound X is:

(A) CH_3CH_2OH (B) CH_3CH_2-Cl

(C) CH_3-CH_3 (D) $CH_3-CH_2-CH_2-CH_2-OH$

Ans. :

b. CH_3CH_2-Cl

Explanation:

$CH_3CH_2Cl + 2Na + ClCH_2CH_3 \rightarrow CH_3-CH_2-CH_2CH_3 + 2NaCl$

This is Wurtz reaction.

27. The degree of unsaturation of the compound formed by the partial hydrogenation of phenol is:

(A) 3 (B) 4 (C) 2 (D) 1

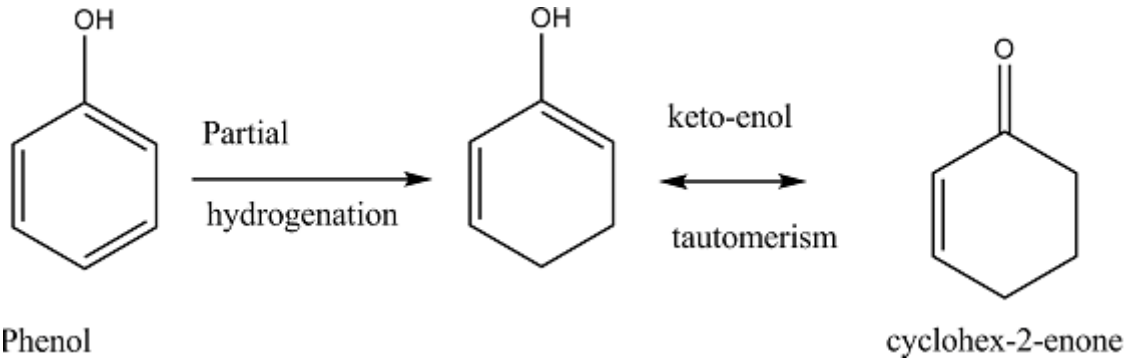
Ans. :

c. 2

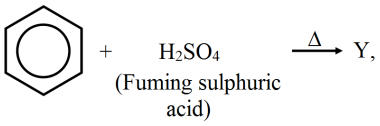
Explanation:

The degree of unsaturation of the compound formed by the partial hydrogenation of phenol is 2.

Phenol has 3 C=C double bonds. During the partial hydrogenation of phenol, one C=C double is hydrogenated and two C=C double bonds remain.



28. In the reaction,

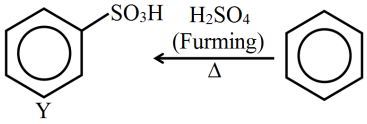


(A) $C_6H_5SO_3H$ (B) C_6H_5OH (C) $C_6H_5SO_2$ (D) C_6H_5CHO

Ans. :

a. $C_6H_5SO_3H$

Explanation:



29. Secondary butyl chloride will undergo alkaline hydrolysis in the polar solvent by the mechanism:

(A) S_N2 (B) S_N1

(C) S_N1 and S_N2 (D) None of the above

Ans. :

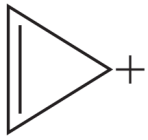
b. S_N1

Explanation:

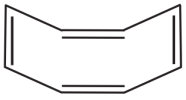
S_N1 mechanism is favored by polar solvents like water, in which the rate of the reaction only depends on the concentration of the alkyl halide.

30. Four structures are given in options (i) to (iv). Examine them and select the aromatic structures.

(A)



(B)



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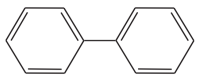
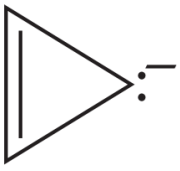
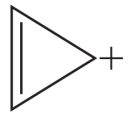
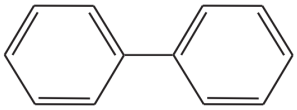


(D)



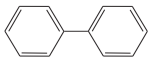
Ans. :

(a) 

(c) 

Explanation:

(a)  2 delocalized - electrons, (4n + 2) rule followed (where n = 0)

(c)  Both rings have 6 -electrons, (4n + 2) rule followed (where n = 1)

Cyclooctatetraene is non-planar and has 8π-electrons. It is not aromatic.
Cyclopropenyl anion is planar but has 4π-electrons. It is not aromatic.

31. Which of the following is Aromatic Hydrocarbon?

(A) C_2H_2 (B) C_3H_8 (C) C_5H_{12} (D) C_6H_6

Ans. :

d. C_6H_6

Explanation:

C_2H_2 is called acetylene. It is an aliphatic alkyne. So it is not aromatic.

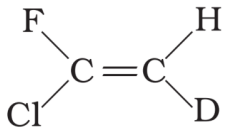
C_3H_8 is called propane. It is a simple alkane. So, it is not aromatic.

C_5H_{12} is called pentane. It is a simple alkane. So, It is also not aromatic.

C_6H_6 is a cyclic, planar, and has a complete conjugated system. Also, it has 6π electrons. Hence it follows Huckel's rule. Therefore, it is aromatic.

32. Which of the following will not show geometrical isomerism?

(A)



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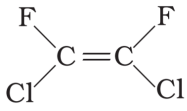
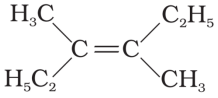


(C)



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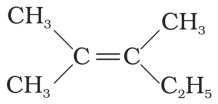
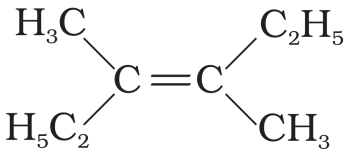


Ans. :

(d) 

Explanation:

Geometrical isomerism is shown by the alkenes in which double bonded carbons must have different atoms of groups. In structure (iv), double bonded carbons have 3 groups same and one is different.

33. Consider the nitration of benzene using conc. H_2SO_4 and conc. HNO_3. If large amount of $KHSO_4$ is added to mixture, the rate of nitration will be:

(A) Unchanged. (B) Doubled. (C) Faster. (D) Slower.

Ans. :

d. Slower.

Explanation:

$\because$ Less NO_2^+ will be formed. $HNO_3 + H_2SO_4 \rightleftharpoons NO_2^+ + HSO_4^- + H_2O$

Presence of $K^+HSO_4^-$ will shift the equilibrium backwards.

34. How many isomers are possible in C_4H_8?

(A) 3 (B) 2 (C) 4 (D) 5

Ans. :

d. 5

Explanation:

There are five constitutional isomers with the formula C_4H_8. They are:

But-1-ene

But-2-ene

2-Methylpropane

Cyclobutane

methylcyclopropane

35. Which of the following deactivates the benzene ring towards electrophilic substitution and is o/ p directing?

(A) $-Cl^{\ominus}$ (B) -OCH_3

(C) -CHO

(D) All of these.

Ans. :

a. $-Cl^{\ominus}$

36. The IUPAC name of $(CH_3)_3C-CH=CH_2$ is:

(A) 1, 1, 1-trimethyl-2-propene (B) 3, 3, 3-trimethyl-2-propene

(C) 2, 2-dimethyl -3-butene (D) 3, 3-Dimethyl-1-butene

Ans. :

d. 3, 3-Dimethyl-1-butene

Explanation:

The IUPAC name of $(CH_3)_3C-CH=CH_2$ is 3, 3-dimethyl-1-butene.

The parent hydrocarbon contains 4 C atoms and a C=C double bond.

Hence, it is a butene. Two methyl groups are present as substituents on third C atom. Prefix di indicates two methyl groups.

37. Ethylene is a/an:

(A) Saturated hydrocarbon (B) Alkene

(C) Paraffin (D) Aromatic compound

Ans. :

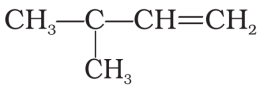
b. Alkene

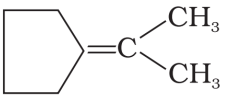
Explanation:

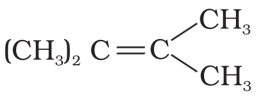
Ethylene is an alkene (unsaturated hydrocarbon) with the structure; $CH_2=CH_2$.

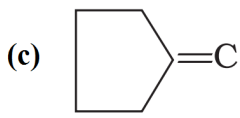
38. Which of the following alkenes on ozonolysis give a mixture of ketones only?

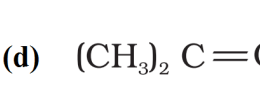
(a) $CH_3—CH=CH—CH_3$

(b) 

(c) 

(d) 

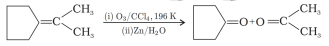
(c) 

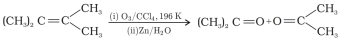
(d) 

Ans. :

Explanation:

Alkenes which have two substituents on each carbon atom of the double bond give a mixture of ketones on ozonolysis. Thus, options (c) and (d) give mixture of ketones.

(c) 

(d) 

On the other hand, alkenes (a) and (b) give a mixture of two aldehydes.

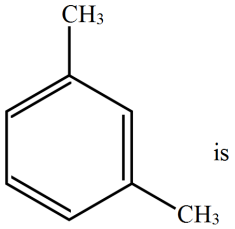
$$(a)\ CH_3CH=CH-CH_3 \xrightarrow[Zn/H_2O]{O_3/CCl_4,196K} CH_3CH=O+O=CHCH_3$$

(b) $CH_3 - CH - CH = CH_2 \xrightarrow[Zn/H_2O]{O_3/CCl_4,196K} CH_3 - CH - CH = O + O = CH_2$

$|$ $|$

CH_3 CH_3

39. The IUPAC name of



is

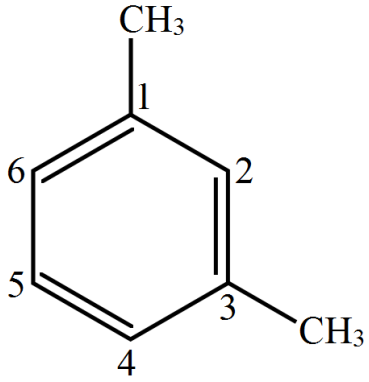
(A) Dimethylbenzene. (B) Methyltoluene.

(C) 1, 3-dimethylbenzene. (D) 1, 4-dimethylbenzene.

Ans. :

c. 1, 3-dimethylbenzene.

Explanation:



(1,3-dimethylbenzene)

40. Which one of the following compounds gives methane on treatment with water?

(A) Al_4C_3 (B) CaC_2 (C) VC (D) SiC

Ans. :

a. Al_4C_3

Explanation:

Al_4C_3 gives methane on treatment with water.

$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$.

41. Propene is allowed to react with B_2 D_6 and the product is treated with acetic acid. The final product obtained is:

(A) 1-deuteriopropane (B) 2-deuteriopropane

(C) 1-deuteriopropene (D) 2-deuteriopropene

Ans. :

b. 2-deuteriopropane

Explanation:

This is an example of hydroboration reaction (followed by hydrolysis) in which diborane is isotopically labeled.

A molecule of HD is added across the double bond of propene to form 2-deuteriopropane.

$$CH_2\,CHCH_3 \xrightarrow[CH_3COOH]{B_2D_6} CH_3 - CHDCH_3.$$

42. Which type of isomerism is shown by But-1-yne and cyclobutene?

(A) Ring chain isomerism
(B) Chain isomerism
(C) Position isomerism
(D) Metamerism

Ans. :

a. Ring chain isomerism

Explanation:

Ring chain isomerism is shown by But-1-yne and cyclobutene.

Alkynes are isomeric with cycloalkenes containing the same number of carbon atoms.

One compound is open chain and other is cyclic and both have same molecular formula that is C_4H_6.

Also, the both have different functional groups, so they are functional isomers.

All ring chain isomers are functional isomers but all functional isomers are not ring chain isomers.

43. Which of the following is properly matched?

(A) Kerosene - C_5-C_{10}
(B) Diesel oil - C_5-C_6
(C) Petrol - C_7-C_9
(D) All are correct

Ans. :

c. Petrol - C_7-C_9

Explanation:

The number of carbon atoms in Petrol is C_7-C_9.

44. When cyclohexane is poured on water, it floats because cyclohexane is:

(A) In boat form
(B) In chair form
(C) In crown form
(D) Less dense than water.

Ans. :

d. Less dense than water.

45. What happens when calcium carbide is treated with water?

(A) Ethane is formed.
(B) Methane and ethane are formed.
(C) Ethyne is formed.
(D) Ethene and ethyne are formed.

Ans. :

c. Ethyne is formed.

Explanation:

If we mix calcium carbide with water ethyne is released due to endothermic reaction between them. This is the industrial method of producing ethyne.

$Ca^{2+}[C\equiv C]^{2-} + 2H_2O \longrightarrow CH\equiv CH + Ca(OH)_2$

46. Compound A (molecular formula C_5H_{10}) gives only one monochlorinated product. Write the structure of compound A.

(A) 1-pentene
(B) 2-pentene
(C) 1-methyl cyclobutane
(D) Cyclopentane

Ans. :

d. Cyclopentane

Explanation:

Cyclopentane $\xrightarrow{Cl_2+hv}$ Cyclopentylchloride

Compound A has molecular formula C_5H_{10}.

The degree of unsaturation is 1. It should have either one double bond or should be a cyclic compound. If it has one double bond, then it will give many monochlorinated products.

However, it gives only one monochlorinated product. So, it is a cyclic compound. Thus, it should be cyclopentane.

47. For an electrophilic substitution reaction, the presence of a halogen atom in the benzene ring _____.

(A) Deactivates the ring by inductive effect.

(B) Deactivates the ring by resonance.

(C) Increases the charge density at ortho and para position relative to meta position by resonance.

(D) Directs the incoming electrophile to meta position by increasing the charge density relative to ortho and para position.

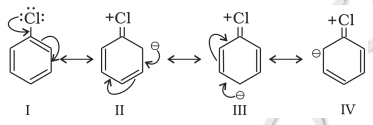
Ans. :

a. Deactivates the ring by inductive effect.

c. Increases the charge density at ortho and para position relative to meta position by resonance.

Explanation:

Halogen atom present on benzene ring shows +R effect and increases electron density on ortho and para position and direct electrophile on ortho and para positions. Halogen being more electronegative pulls the electron from benzene due to -I effect and decreases electron density but due to resonance the electron density on ortho and para positions is greater than meta position.



48. The C−C bond length of the following molecules is in the order:

(A) $CH_2 > C_2H_4 > C_6H_6 < C_2H_2$
(B) $C_2H_2 < C_2H_4 < C_6H_6 < C_2H_6$
(C) $C_2H_6 < C_2H_2 < C_6H_6 < C_2H_4$
(D) $C_2H_4 < C_2H_6 < C_2H_2 < C_6H_6$

Ans. :

b. $C_2H_2 < C_2H_4 < C_6H_6 < C_2H_6$

Explanation:

Bond length is related to bond order, when more electrons participate in bond formation the bond is shorter. By approximation, the bond lengths of two different atoms are the sum of the two individual covalent radii.

The bond length of carbon-carbon triple bond is shorter than carbon-carbon double bond and is shorter than resonance bonding in benzene and is shorter than carbon-carbon single bond.

Therefore, $C_2H_2 < C_2H_4 < C_6H_6 < C_2H_6$

49. Arrange the halogens F_2, Cl_2, Br_2, I_2, in order of their increasing reactivity with alkanes:

(A) $I_2 < Br_2 < Cl_2 < F_2$.
(B) $Br_2 < Cl_2 < F_2 < I_2$.
(C) $F_2 < Cl_2 < Br_2 < I_2$.
(D) $Br_2 < I_2 < Cl_2 < F_2$.

Ans. :

a. $I_2 < Br_2 < Cl_2 < F_2$.

Explanation:

Fluorine is highly electronegative element. Electronegativity of halogens decreases down the group. As the electronegativity of halogens decreases, reactivity with alkanes, decreases. Therefore, F_2 reacts vigorously and I_2 reacts too slow.

50. Which of the following organic materials damage DNA of our body?

(A) Tobacco.
(B) Coal.
(C) Petroleum.
(D) All of these.

Ans. :

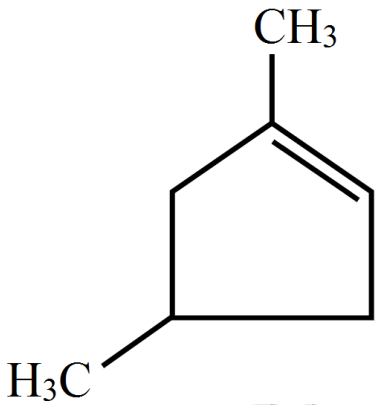
d. All of these.

Explanation:

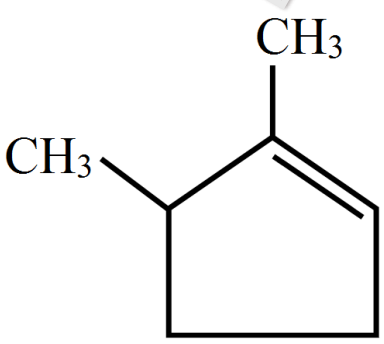
Tabacco, coal and petroleum damages DNA of our body and causes cancer.

51. Which compound would give 5-keto 2-methyl hexanal upon ozonolysis followed by reaction with $\frac{Zn}{H_2O}$?

(A)



(B)



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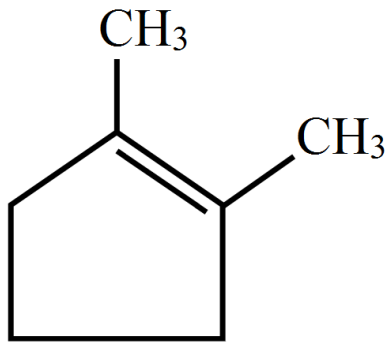

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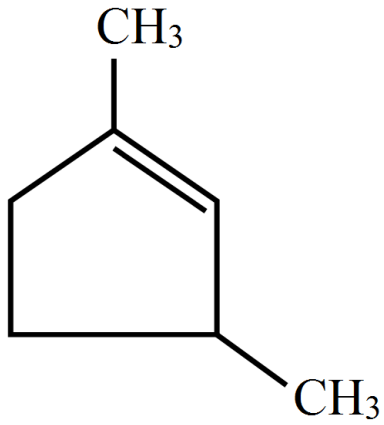
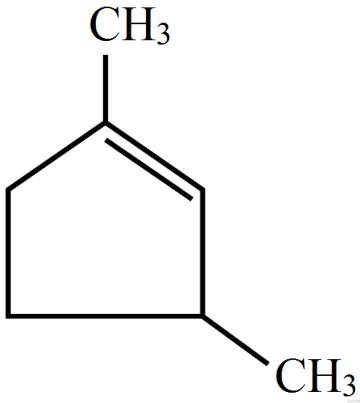
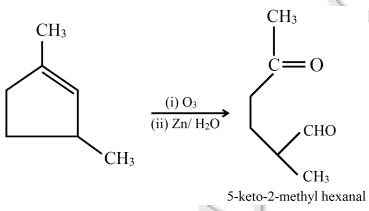


Ans. :

d.



Explanation:



52. Conformations of ethane in which hydrogen atoms attached to two carbon atoms are closest to each other are known as:

(A) Eclipsed. (B) Skew boat.

(C) Staggered. (D) Partially eclipsed.

Ans. :

a. Eclipsed.

Explanation:

Conformation in which hydrogen atoms attached to two carbons are as closed together as possible is called eclipsed conformation and the other in which hydrogen's are as far apart as possible is known as the staggered conformation. Any other intermediate conformation is called a skew conformation.

53. Nitration and chlorination of benzene are:

(A) Nucleophilic and electrophilic substitution respectively.

(B) Electrophilic and nucleophilic substitution respectively.

(C) Electrophilic substitution in both the reactions.

(D) Nucleophilic substitution in both the reactions.

Ans. :

c. Electrophilic substitution in both the reactions.

Explanation:

Since nitration and halogenation, both are carried out by the help of electrophile NO^{2+} & Cl^{+}.

Hence, both reactions are electrophilic substitution reactions.

54. Alkynes on reduction with sodium in liquid ammonia forms:

(A) Cis-alkene. (B) Alkane.

(C) Trans-alkene. (D) Both (a) and (c).

Ans. :

c. Trans-alkene.

55. The reaction of Toluene with Cl_2 in presence of $FeCl_3$ predominanly gives:

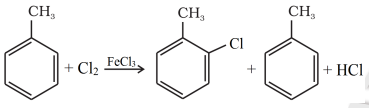
(A) Benzyle Chloride. (B) o- & p-chlorotoluene.

(C) m-Chlorotoluene. (D) Benzoyl chloride.

Ans. :

a. Benzyle Chloride.

Explanation:



56. Which content(s) of middle oil separate on cooling?

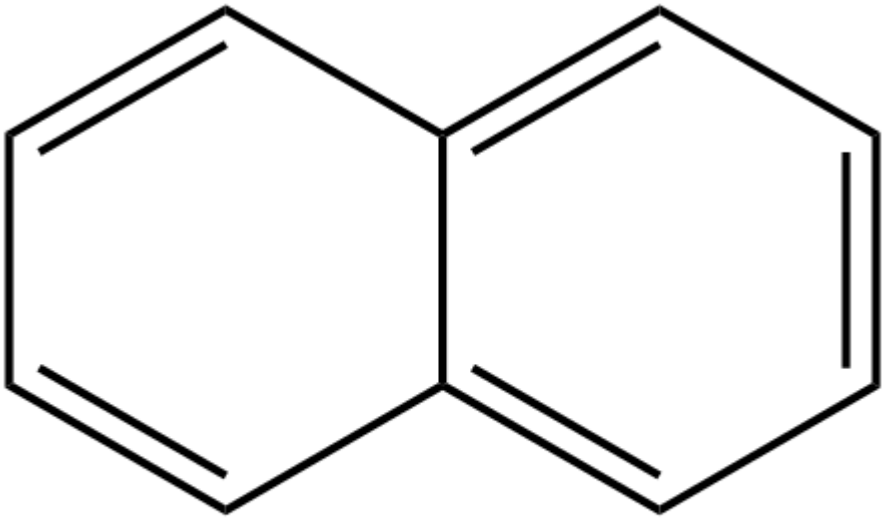
(A) Naphthalene (B) Phenol (C) Benzene (D) Pyridine

Ans. :

a. Naphthalene

Explanation:

The content of middle oil separate on cooling is naphthalene.



Naphthalene

57. The energy barrier to free rotation about carbon carbon bond of ethane is about:

(A) 30kJ mol^{-1} (B) 3kJ mol^{-1}

(C) 3kcal mol^{-1} (D) 40kJ mol^{-1}

Ans. :

c. 3kcal mol^{-1}

Explanation:

The staggered structure is the structure of lower energy than eclipsed structure.

The relative energy required for complete a rotation in ethane is called the energy barrier to rotation, and it is about 3kcal/mol.

That is, the eclipsed structure is 3 kcal higher in energy than the staggered structure.

58. 2-methyl propan-2-ol is obtained by the reaction of X with water in the presence of conc. H_2SO_4. The X is:

(A) 1-methylpropene. (B) 2, 2-dimethylhexane.

(C) 2-methylpropene. (D) 2-methylbutane.

Ans. :

c. 2-methylpropene.

59. Name the IUPAC nomenclature of $CH_3-CH_2-CH_2-CH=CH_2$:

(A) 1-Pentene (B) 2-Propene

(C) 3-Propene (D) None of these

Ans. :

a. 1-Pentene

Explanation:

Chain of five carbons with double bond on 1, 2 carbons, 1- pentene.

60. Which of the following can be used as the halide (electrophile provider) for Friedel crafts reaction:

(A) Chloro benzene. (B) Bromo benzene.

(C) Chloro ethane. (D) Isopropyl chloride.

Ans. :

d. Isopropyl chloride.

Explanation:

∵ Others have double bond character between

 which is deficient to break.

61. The hydrocarbon obtained by treating sodium ethanoate with soda lime is _____.

(A) Ethane (B) Methane (C) Propane (D) Butane

Ans. :

b. Methane

Explanation:

$CH_3COONa + NaOH \rightarrow CH_4 + Na_2CO_3$

CH_3COONa = Sodium ethanoate

NaOH = Soda lime

CH_4 = Methane

Na_2CO_3=Sodium carbonate

62. Ethylene is prepared by:

(A) Dehalogenation of chloroform.

(B) Pyrolysis of ethane at 450°C

(C) Dehydration of methanol with Al_2O_3/350°C

(D) Methyl chloride on reduction

Ans. :

b. Pyrolysis of ethane at 450°C

Explanation:

Decomposition of the compound by heat is called pyrolysis or thermal decomposition.

When Ethane is heated in absence of air at 450°C gives Ethylene and Hydrogen.

$CH_3-CH_3 \xrightarrow{450^\circ C} CH_2 = CH_2 + H_2$

When Alkanes are heated to high temperature in absence of air, the higher alkane molecules break up into smaller molecules of lower alkanes, alkanes, and hydrogen.

Remaining all reactions gives alkanes.

63. The highest boiling point is expected for:

(A) Isooctane (B) n-Octane

(C) 2, 2, 3, 3-Tetramethyl butane (D) n-Butane

Ans. :

b. n-Octane

Explanation:

Boiling point is characterized as the specific temperature at which the vapour pressure of the fluid is equivalent to the environmental pressure.

Among the given options

n-Octane is a straight-chain exacerbate that has a very large surface area. Along these lines, there are more van der Waals forces of attraction, bringing about high boiling points.

64. In the reaction, $\mathrm{CH_3-\underset{\displaystyle Br}{\underset{|}{CH_2}} \xrightarrow[\Delta]{\text{alc. KOH}} A,}$ A is:

(A) $CH_2=CH_2$ (B) CH_3CH_3

(C) $\mathrm{CH \equiv CH}$ (D) Both (a) and (b)

Ans. :

a. $CH_2=CH_2$

65. A single substitution of H atom in an alkane of molar mass by 72g/mole on chlorination produces only one product. The alkane is:

(A) n- pentane (B) 2- methyl butane

(C) 2, 2-dimethyl propane (D) n- butane

Ans. :

c. 2, 2-dimethyl propane

Explanation:

In 2,2-Dimethylpropane the central carbon atom is quaternary, meaning all four of its valencies are satisfied by Carbon atoms; which implies that there are no Hydrogen atoms which can be substituted by Chlorine(or halogen), and all the remaining 4 carbon atoms are identical, so substitution on any one of those will result in the same compound.

66. The discovery that chlorofluorocarbons initiate a radical -chain reaction that catalytically destroys ozone won the 1995Nobel prize in chemistry Given the initiation step below which of the following reactions is the most likely to serve as one of the propagation steps?

$CCl_2F_2 + hv \rightarrow {}^*CClF_2 + {}^*Cl$

(A) ${}^*Cl + {}^*Cl \rightarrow Cl_2$ (B) ${}^*Cl + O_3 \rightarrow {}^*OCl + O_2$

(C) ${}^*CClF_2 + {}^*Cl \rightarrow CCl_2F_2$ (D) $2{}^*CClF_2 + 2O_3 \rightarrow 2COF_2 + Cl_2 + 2O_2$

Ans. :

b. ${}^*Cl + O_3 \rightarrow {}^*OCl + O_2$

Explanation:

The ultraviolet light, as it hits the atmosphere, makes CFCs break up to form free radicals like this: $CCl_2F_2 \rightarrow *CClF_2 + Cl*$

Chlorine free radicals will then go on to react with the ozone in the stratosphere: $O_3 + Cl* \rightarrow ClO* + O_2$ (Propagation step)

The chlorine oxide molecule (ClO) is very reactive, and it then proceeds to react with ozone to make two oxygen molecules and a Cl* free radical: $ClO* + O_3 \rightarrow 2O_2 + Cl*$

That Cl* free radical will then go on and react with another ozone molecule, resulting in a chain reaction between the last two equations that theoretically never stops, due

to their unreactive nature and thus their inability to be easily removed from the atmosphere.

The chlorine atoms aren't used up, which means they are free to carry on breaking down the ozone.

67. Ethylbenzene reacts with Cl_2 in sunlight to give:

(A) 1-Chloro-1-phenylethane (B) 1-Chloro-2-phenylethane

(C) 4-Chloroethylbenzene (D) 3-Chloroethylbenzene

Ans. :

a. 1-Chloro-1-phenylethane

Explanation:

Reaction:

$$ph{-}CH_2CH_3 + Cl_2 \xrightarrow{\text{sunlight}} ph{-}CH(Cl){-}CH_3$$

This is a substitution reaction where chlorine replaces one hydrogen atom to form 1-chloro-1-phenylethane.

68. $CH_3CH = CH_2 + HBr$ gives:

(A) $CH_2 = CH - CH_2 - Br$ (B) $CH_3 - CH_2 - CH_2 - Br$ (C) $CH_3CH(Br) - CH_3$ (D) $CH_3 - CH_2 - CH_3$

Ans. :

a. $CH_3CH(Br) - CH_3$

Explanation:

This is an example of addition reaction.

The double bond is broken and hydrogen and bromine are added to the given compound.

Bromine will add up on secondary carbon. (Markovnikov's Rule)

$CH_3CH = CH_2 + HBr \rightarrow CH_3CH(Br) - CH_3$.

69. Which one of the following compound will give addition reaction?

(A) CH_4 (B) C_2H_6 (C) C_2H_4 (D) C_3H_8

Ans. :

c. C_2H_4

Explanation:

CH_4, C_2H_6 and C_3H_8 are saturated hydrocarbons.

Hence, they will give substitution reaction.

C_2H_4 on the other hand is an unsaturated hydrocarbon.

It will give addition reaction.

For example, catalytic hydrogenation of ethylene gives ethane. A molecule of hydrogen is added across C=C double bond.

$$C_2H_4 + H_2 \xrightarrow{Ni/Pt/Pd} C_2H_6$$

70. Arrange the following hydrogne halides in order of their decreasing reactivity with propene.

(A) HCl > HBr > HI (B) HBr > HI > HCl

(C) HI > HI > HCl (D) HCl > HI > HBr

Ans. :

c. HI > HI > HCl

71. Aromatic compounds containing benzene ring are termed as:

(A) Benzene.
(B) Benzenoids.
(C) Benzalene.
(D) All of these.

Ans. :

b. Benzenoids.

72. Which of the following reactions of methane is incomplete combustion:

(A) $2CH_4 + O_2 \xrightarrow{Cu/523K/100atm} 2CH_3OH$

(B) $CH_4 + O_2 \xrightarrow{Mo_2O_3} HCHO + H_2O$

(C) $CH_4 + O_2 \longrightarrow C(s) + 2H_2O(l)$

(D) $CH_4 + 2O_2 \longrightarrow CO_2(g) + 2H_2O(l)$

Ans. :

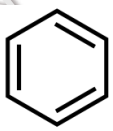
c. $CH_4 + O_2 \longrightarrow C(s) + 2H_2O(l)$

Explanation:

During incomplete combustion carbon black is formed. It takes place when there is insufficient supply of air or oxygen.

$CH_4 + O_2 \longrightarrow C(s) + 2H_2O(l)$

73.

$$CH_2 = CHBr \xrightarrow{NaNH_2} A \xrightarrow[\text{tube, 873K}]{\text{Red hot iron}}$$ 

Here, A refers to:

(A) $CH \equiv CH$
(B) $CH_3 - C \equiv CH$
(C) $CH_3 - CH_3$
(D) $CH \equiv C - NH_2$

Ans. :

a. $CH \equiv CH$

Explanation:

$$CH_2 = CHBr \xrightarrow{NaNH_2} \underset{A}{H - C \equiv CH} + NaBr + NH_3$$

$$A \xrightarrow{\text{Red hot iron tube, 873 K}} \text{Benzene}$$

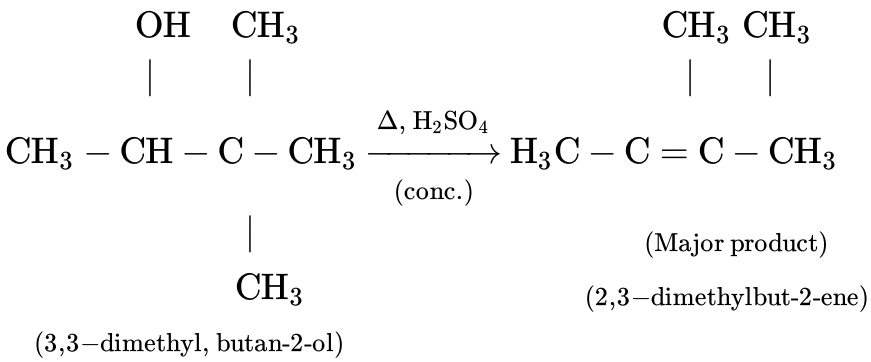
74. The major product formed when 3, 3-dimethyl butan-2-ol is heated with concentrated sulphuric acid is:

(A) 2, 3-dimethylbut-1-ene
(B) 2, 3-dimethylbut-2-ene
(C) 3, 3-dimethylbut-1-ene
(D) Cis and trans-isomers of 2, 3-dimethylbut-1-ene

Ans. :

b. 2, 3-dimethylbut-2-ene

Explanation:



75. The IUPAC name of given compound is: $CH_3-C\equiv C-C(CH_3)_2-CH_3$

(A) 4, 4-dimethyl-2-heptene-5-yne
(B) 4, 4-dimethyl-2-heptene-6-yne
(C) 4, 4-dimethyl-5-heptene-2-yne
(D) None of these

Ans. :

d. None of these

Explanation:

$CH_3-C\equiv C-C(CH_3)_2-CH_3$

IUPAC name: 4,4-dimethyl-pent-2-yne

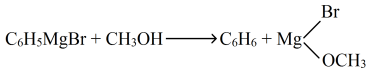
76. Phenyl magnesium bromide reacts with methanol to give:

(A) Benzene.
(B) Toluene.
(C) Phenol.
(D) Arisole.

Ans. :

a. Benzene.

Explanation:



77. Monochlorination of ethylbenzene ($PhCH_2CH_3$) with Cl_2 under heat produces _____.

(A) $PhCH_2CH_2Cl$
(B) $PhCHClCH_3$
(C) Both (a) and (b) in equal amounts
(D) None of (b) and less of (a)

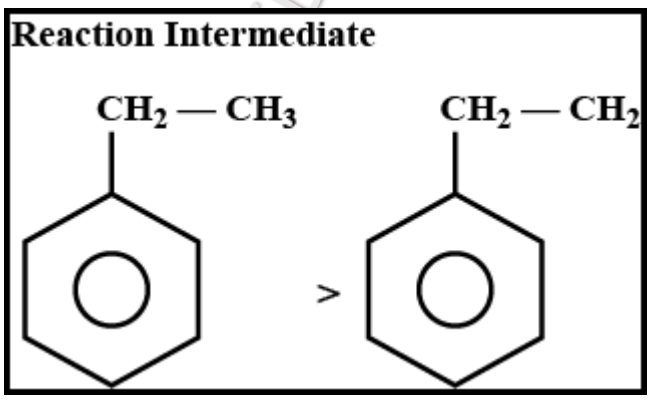
Ans. :

d. None of (b) and less of (a)

Explanation:

More stable due to resonance and hyper conjugate.

Hence none of (b) and less of (a) for free radial will go in resonance.



78. Among the following, which hydrocarbon is not produced by Wurtz reaction?

(A) Methane.
(B) Ethane.
(C) Propane.
(D) All given options can be prepared.

Ans. :

a. Methane.

Explanation:

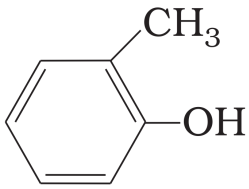
By Wurtz reaction, higher alkanes are prepared.

i.e., $\mathrm{R-Cl + 2Na + R-Cl \longrightarrow \underset{\text{Alkane}}{R-R} + 2NaCl}$

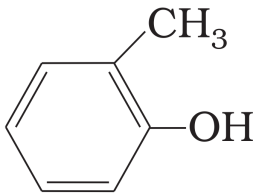
Thus, methane cannot be prepared by this reaction.

*** Answer The Following Questions In One Sentence.[1 Marks Each]** **[20]**

79. Write IUPAC names of the following compound:



Ans. :



IUPAC name: 2-Methyl phenol.

80. Write IUPAC names of the products obtained by the ozonolysis of the following compound:

Pent-2-ene.

Ans. : $\mathrm{CH_3 - CH_2 - HC = CH - CH_3 \xrightarrow{\text{ozonolysis}} \underset{\text{Propanal}}{CH_3 - CH_2 - CHO} + \underset{\text{Ethanal}}{CH_3CHO}}$

81. Write IUPAC names of the products obtained by the ozonolysis of the following compound:

3,4-Dimethylhept-3-ene.

Ans. :

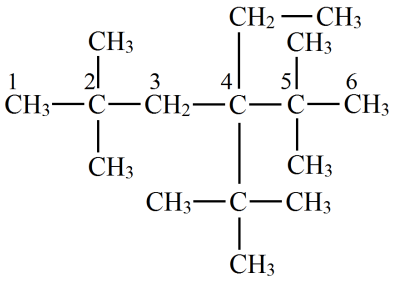
$$\mathrm{H_3C - H_2C - H_2C - \underset{\text{CH3}}{\underset{|}{C}} = \underset{\text{CH}_3}{\underset{|}{C}} - CH_2 - CH_3 \xrightarrow{\text{ozonolysis}} \underset{\text{Pentan-2-one}}{H_3C - CH_2 - CH_2 - \underset{\text{CH3}}{\underset{|}{C}} = O} + \underset{\text{Butan-2-one}}{CH_3 - CH_2 - \underset{\text{CH3}}{\underset{|}{C}} = O}}$$

82. Why is addition reaction of bromine to benzene difficult?

Ans. : Addition reaction of bromine to benzene is difficult due to delocalisation of $\pi-$electrons. It does not have pure double bonds and does not give test for unsaturation.

83. Give the structural formula of 4-tert, butyl-4-ethyl-2, 2, 5-tetra methyl hexane.

Ans. :

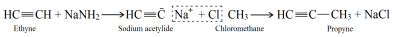


84. Bring out the following conversion ethane to ethene.

Ans. : $\underset{\text{Ethane}}{CH_3CH_3} \xrightarrow[-HI]{I_2/HNO_3} \underset{\text{Ethyl iodide}}{CH_3CH_2I} \xrightarrow{KOH(alc.)} \underset{\text{Ethene}}{CH_2 = CH_2}$

85. Convert ethyne to propyne.

Ans. :



86. Why eclipsed and staggered forms of ethane cannot be isolated at room temperature?

Ans. : It is because the difference in their energy is less. They can interchange into each other easily, therefore, their isolation (separation) is not possible.

87. Name the reagent used in the following changes

$$CH_3 - CH_2 - CH_2 - CH_2 - C \equiv C - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{?} CH_3 - CH_2 - CH_2 - CH_2 - \underset{|}{\overset{|}{C}} = \underset{|}{\overset{|}{C}} - CH_2 - CH_2 - CH_2 - CH_3$$

$$\text{H} \quad \text{H}$$

Ans. : H_2/ Pd-$BaSO_4$ is used. It is called Lindlar's catalyst. Syn addition takes place i.e., both hydrogen atom attack from same side.

88. In which of the following pair both angle strain and torsional strain is present?

a. Cyclopropane, Cyclobutane
b. Cyclopropane, Cyclohexane
c. Cyclobutane, Cyclohexane
d. Cyclohexane, Cyclopentane

Ans. :

a. Cyclopropane, Cyclobutane

Explanation:

3-Membered and 4-membered cycloalkane rings are the least stable containing angle strain(due to large deviation from tetrahedral angle) as well as torsional strain (due to electronic repulsions between the bonds), lying close to each other.

89. Arrange the three isomers of pentane in increasing order of their boiling points.

Ans. : 2, 2-Dimethylpropane < 2-Methylbutane < Pentane because surface area increases, van der Waal's forces of attraction increases, hence boiling point decreases.

90. Identify the structure of A and B;

$$CH_3 - CH_2COOH \xrightarrow{KOH} A \xrightarrow{\text{Kolbe's electrolysis}} B$$

$$CH_3 - CH_2COOH \xrightarrow{KOH} \underset{A}{CH_3CH_2COO^-K^+}$$

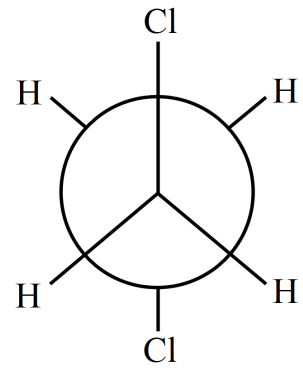
$$\xrightarrow{\text{Kolbe's electrolysis}} \underset{B}{CH_3CH_2CH_2CH_3}$$

Ans. : $A \rightarrow CH_3 - CH_2COO^- - K^+$;

$B \longrightarrow \underset{\text{Butane}}{CH_3 - CH_2 - CH_2 - CH_3}$

91. Draw the Newman's projection formula of the staggered form of 1, 2-dichloroethane.

Ans. :



Staggered form of 1, 2-dichloroethane

92. Convert methane to ethane.

Ans. : $\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow{\text{sunlight}} \underset{\text{Chloromethane}}{CH_3Cl} + \underset{\text{Sodium}}{2Na} + \underset{\text{Chloromethane}}{ClCH_3}$

$$\xrightarrow[\text{Ether}]{\text{Dry}} \underset{\text{Ethane}}{CH_3 - CH_3} + 2NaCl$$

93. Write an equation of the reaction of propyne with water in the presence of H_2SO_4 and $HgSO_4$. Show the intermediate.

Ans. : $CH_3 - C \equiv CH + H_2O \xrightarrow{HgSO_4/H_2SO_4}$

$$\left[\underset{\text{(Enol) unstable}}{\underset{\displaystyle OH}{\overset{\displaystyle |}{CH - C = CH_2}}}\right] \xrightarrow{\text{Tautomerism}} \underset{\text{Acetone}}{\underset{\displaystyle O}{\overset{\displaystyle ||}{CH_3 - C - CH_3}}}$$

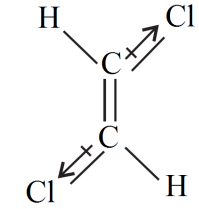
(a ketone stable)

The Markownikoff's addition of H_2O gives an unstable enol form that rearranges to the more stable ketone.

94. Why is dipole moment of trans-1, 2-dichloroethene zero?

Ans. :

It is because individual dipoles are equal and opposite such that net dipole moment is zero.



trans-1, 2-Dichloroethene

95. Convert 1-bromopropane to 2-bromopropane.

Ans. : $CH_3CH_2CH_2Br \xrightarrow{KOH(alc)} \underset{\text{Propene}}{CH_3 - CH = CH_2}$

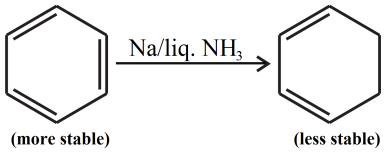
$\underset{1-\text{bromopropane}}{}$

$$\xrightarrow[\text{Markownikoff addition}]{HBr} CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3$$

$2-\text{bromopropane}$

96. Why do alkenes prefer to undergo electrophilic addition reaction while arenes prefer electrophilic substitution reactions? Explain.

Ans. : Alkenes and arenes both are unsaturated and electron rich. Olefins or alkenes undergo addition reaction to give more stable saturated product; in this reaction hybridization changes from sp^2 to sp^3. Arenes are stabilised by resonance w delocalization of π-electrons. On addition reaction to the double bond of arene, we get a product which is not resonance stabilised. Thus, arenes prefer to undergo substitution reaction while alkenes prefer to undergo addition reaction.



(more stable) (less stable)

$$\underset{(\text{less stable})}{CH_2 = CH_2} + H_2 \xrightarrow{Ni/573K} \underset{(\text{more stable})}{CH_3 - CH_3}$$

97. Alkynes on reduction with sodium in liquid ammonia form trans alkenes. Will the butene thus formed on reduction of 2-butyne show the geometrical isomerism?

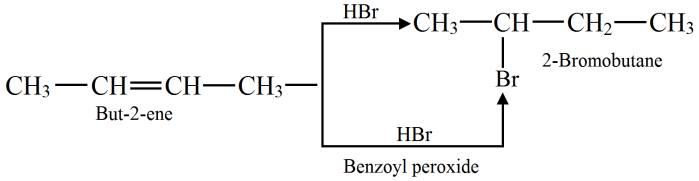
Ans. :

$$H_3C - C \equiv C - CH_3 + H_2 \xrightarrow{Na/liq.NH_3} \underset{\text{trans-But-2-ene}}{\overset{H_3C}{\underset{H}{}}\!\!>\!C=C\!<\!\overset{H}{\underset{CH_3}{}}}$$

Thus, but-2-ene is capable of showing geometrical isomerism.

98. Give the structure of the alkene (C_4H_8) which adds on HBr in the presence and in absence of peroxide to give the same product, C_4H_9Br.

Ans. :

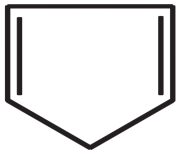


But-2-ene is symmetric alkene, therefore, it gives 2-Bromobutane in presence as well as in absence of peroxide.

*** Given Section consists of questions of 2 marks each.** **[28]**

99. Explain why the following system are not aromatic?

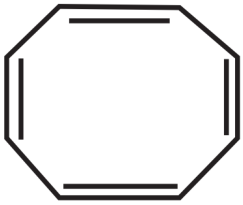
Ans. :



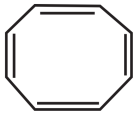
sp^3-carbon

Due to the presence of a sp^3-carbon, the system is not planar. Further,it contains only four n-electrons, therefore, the system is not aromatic because it does not contain planar cyclic cloud having (4n + 2) n-electrons.

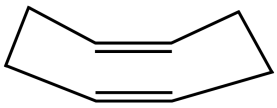
100. Explain why the following system are not aromatic?



Ans. :



Planar

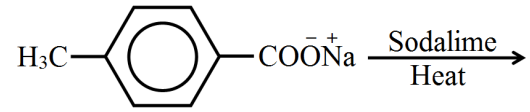


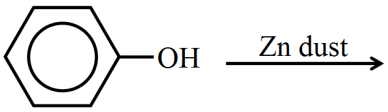
Tub shaped

Cyclo-octatetraene is not planar but is tub shaped. It is, therefore, a non-planar system having 8 n-electrons.

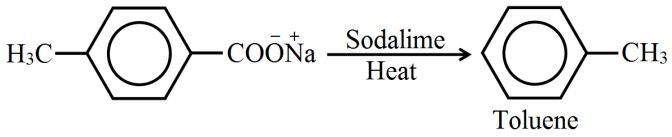
Therefore, the molecule is not aromatic since it does not contain a planar cyclic cloud having (4n + 2) n-electrons.

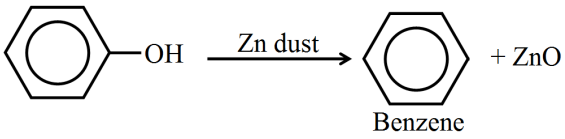
101. Complete the following:

(i) 

(ii) 

Ans. :

(i) 

(ii) 

102. An alkyl bromide (X) react with sodium metal dissolved in anhydrous ether to form 4, 5-diethyl octane. Identify 'X'.

Ans. : $2CH_3-CH_2-CH_2-\underset{\underset{Cl}{|}}{CH}-CH_2-CH_3+2Na \xrightarrow[Ether]{Anhydrous}$

3−chloro hexane

$\overset{1}{CH_3}-\overset{2}{CH_2}-\overset{3}{CH_2}-\overset{4}{CH}(C_2H_5)-\overset{5}{CH}(C_2H_5)-\overset{6}{CH_2}-\overset{7}{CH_2}-\overset{8}{CH_3}$

4, 5−Diethyl octane

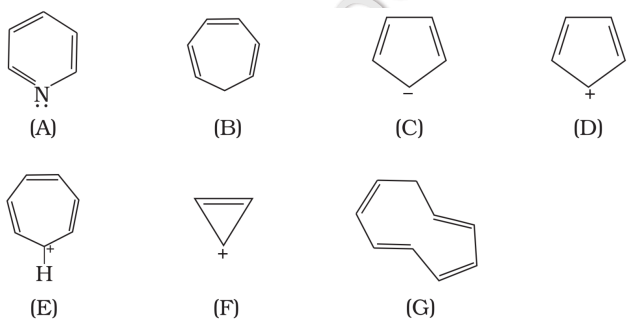
103. The ring systems having following characteristics are aromatic.

i. Planar ring containing conjugated π bonds.

ii. Complete delocalisation of the $\pi-$electrons in ring system i.e. each atom in the ring has unhybridised p-orbital, and

iii. Presence of $(4n + 2)\pi-$electrons in the ring where n is an integer (n = 0, 1, 2, ...) [Huckel rule].

Using this information classify the following compounds as aromatic/ nonaromatic.



Ans. : A = Planar ring, all atoms of the ring sp^2 hybridised, has six delocalised π-electrons, follows Huckel rule. It is aromatic.

B = Has six π-electrons, but the delocalisation stops at sp^3 hybridised CH_2- carbon. Hence, not aromatic.

C = Six delocalised π-electrons (4π electrons +2 unshared electrons on negatively charged carbon) in a planar ring, follows Huckel's rule. It is aromatic.

D = Has only four delocalised π-electrons. It is non aromatic.

E = Six delocalised π-electrons follows Huckel's rule. π-electrons are in sp^2 hybridised orbitals, conjugation all over the ring because of positively charged carbon. The ring is planar hence is aromatic.

F = Follows Huckel's rule, has 2π electrons i.e. (4n + 2) π-electrons where (n = 0), delocalised π-electrons. It is aromatic.

G = 8π electrons, does not follow Huckel's rule i.e., (4n + 2) π-electrons rule. It is not aromatic.

104. Complete the following reactions:

i. $(CH_3)_2C = CH - CH_3 \xrightarrow[\text{heat}]{KMnO_4/KOH}$

ii. $(CH_3)_2C = CH - CH_3 \xrightarrow{\text{cold } KMnO_4/KOH}$

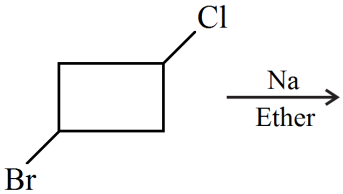
Ans. :

i.
$$(CH_3) - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH - CH_3 \xrightarrow[\text{heat}]{KMnO_4/KOH} CH_3 - \underset{\displaystyle O}{\overset{\displaystyle ||}{C}} - CH_3 + CH_3COOH$$

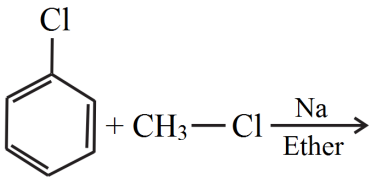
ii.
$$(CH_3) - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} = CH - CH_3 \xrightarrow{\text{cold } KMnO_4/KOH} CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - \underset{\displaystyle OH}{\overset{\displaystyle |}{CH}} - \underset{\displaystyle OH}{\overset{\displaystyle |}{CH_3}}$$

105. Complete:

i.

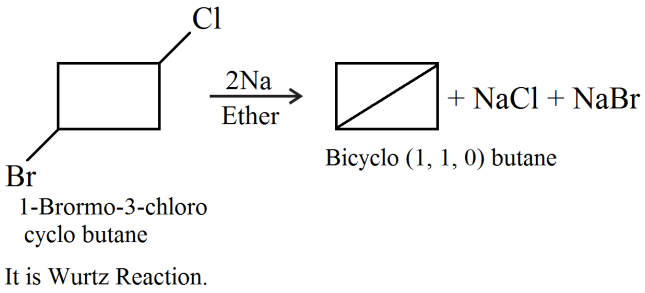


ii.



Ans. :

i.

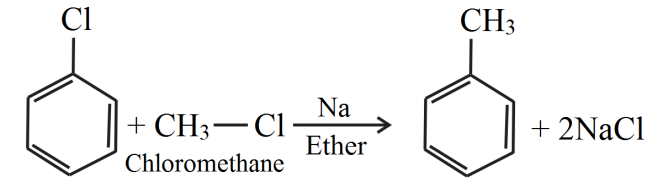


Bicyclo (1, 1, 0) butane

1-Brormo-3-chloro cyclo butane

It is Wurtz Reaction.

ii.

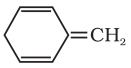


Chlobenzene

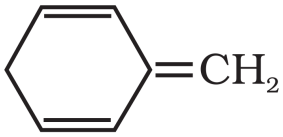
Toluene

It is Wurtz-Fittig Reaction.

106. Explain why the following systems are not aromatic?



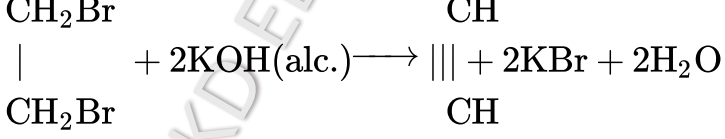
Ans. :



Due to the presence of a sp3-hybridized carbon, the system is not planar. It does contain six n-electrons but the system is not fully conjugated since all the six n-electrons do not form a single cyclic electron cloud which surrounds all the atoms of the ring. Therefore, it is not an aromatic compound.

107. What happens when 1, 2-Dibromo ethane reacts with excess of alc. KOH?

Ans. :



108. Complete the following reactions.

i. Iso-propyl bromide $\xrightarrow[\text{Heat}]{\text{Alc. KOH}} A \xrightarrow[\text{Peroxide}]{\text{HBr}} B$

ii. n-propyl alcohol $\xrightarrow[443K]{\text{Conc. } H_2SO_4} A \xrightarrow[\text{Heat}]{O_2, Ag} B$

Ans. :

i. $CH_3CHCH_3 \xrightarrow[\text{Heat}]{\text{Alc. KOH}} CH_3CH=CH_2$

CH_3CHCH_3 (Br) — Iso-propyl bromide

$CH_3CH=CH_2$ (A) — Propene

$\xrightarrow[\text{Peroxide}]{\text{HBr}} CH_3CH_2CH_2Br$

(B) — 1−bromopropane

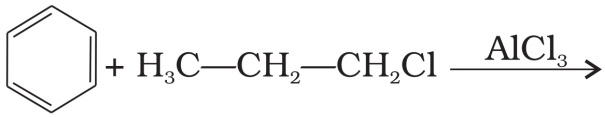
ii.

$CH_3CH_2CH_2OH \xrightarrow[443\ K]{\text{Conc. } H_2SO_4} CH_3CH=CH_2$

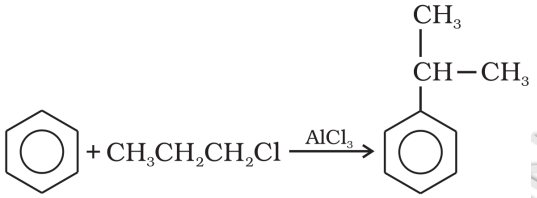
n-propyl alcohol — (A) Propene

$\xrightarrow[\text{Heat}]{O_2,\ Ag}$ CH_3CH-CH_2 (O) (B) Propylene oxide

109. What will be the product obtained as a result of the following reaction and why?

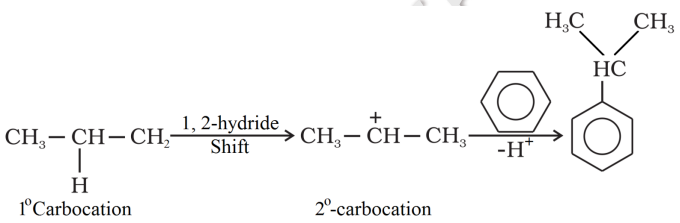


Ans. :



Isoproyl benzene

Propyl chloride forms $CH_3-CH_2-CH_2^+$ with anhydrous $AlCl_3$ which is less stable. This rearranges to a more stable carbocation as:



1°Carbocation — 2°-carbocation

110. What happens when:

i. Bromoethane is treated with zinc and hydrochloric acid?

ii. Hydrogen is passed into 2-bromopropane in the presence of palladium?

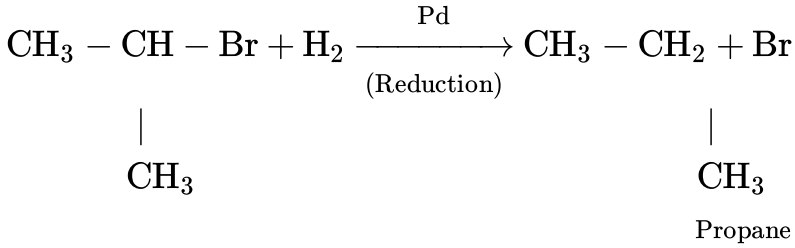
Ans. :

i. Ethane is formed.

$CH_3CH_2-Br + 2[H] \xrightarrow[\text{(Reduction)}]{Zn/HCl} CH_3CH_3 + HBr$

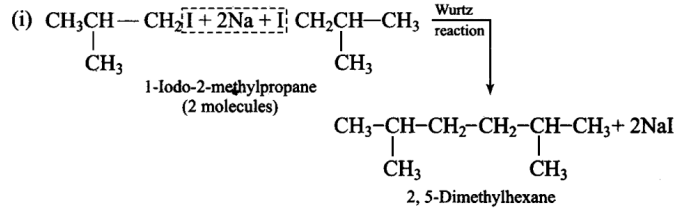
Bromoethane

ii. Propane is obtained.



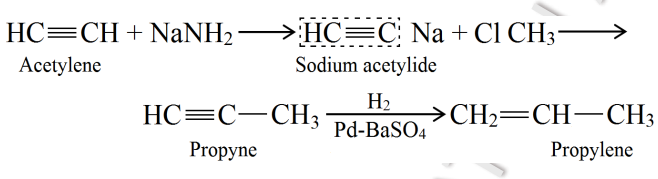
111. Write the structures and names of products obtained in the reactions of sodium with a mixture of 1-iodo-2-methylpropane and 2-iodopropane.

Ans. :



112. Convert Acetylene to Propylene.

Ans. :



*** Given Section consists of questions of 3 marks each.** **[66]**

113. 2 Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+.

Toluene, p-H_3C-C_6H_4-NO_2 , p-O_2N-C_6H_4-NO_2.

Ans. : Electrophiles are reagents that participate in a reaction by accepting an electron pair in order to bond to nucleophiles.

The higher the electron density on a benzene ring, the more reactive is the compound towards an electrophile, E^+ (Electrophilic reaction).

While CH_3- is an electron donating group, NO_2- group is electron withdrawing. Hence, toluene will have the maximum electron density and is most easily attacked by E^+.

NO_2- is an electron withdrawing group. Hence, when the number of NO_2- substituents is greater, the order is as follows:

Toluene > p-CH_3-C_6H_4-NO_2, p-O_2 N-C_6H_4-NO_2.

114. For the following compound, write structural formulas and IUPAC names for all possible isomers having the number of double or triple bond as indicated:
C_5H_8 (one triple bond).

Ans. : $H\overset{1}{C}\equiv\overset{2}{C}-\overset{3}{C}H_2-\overset{4}{C}H_2-\overset{5}{C}H_3$

(I)

$H_3\overset{1}{C}-\overset{2}{C}\equiv\overset{3}{C}-\overset{4}{C}H_2-\overset{5}{C}H_3$

(II)

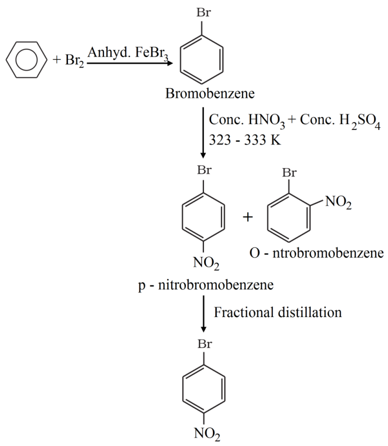
$H_3\overset{4}{C}-\overset{3}{C}H(CH_3)-\overset{2}{C}\equiv\overset{1}{C}H$

(III)

The IUPAC name of
Compound (I) is pent-1-yne,
Compound (II) is pent-2-yne, and
Compound (III) is 3-Methylbut-1-1-yne.

115. How will you convert benzene into:
p-nitrobromobenzene.

Ans. : Benzene can be converted into p-nitrobromobenzene as:



p-nitrobromobenzene

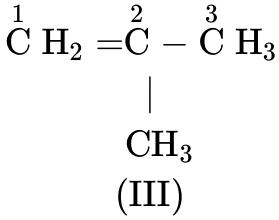
116. For the following compound, write structural formulas and IUPAC names for all possible isomers having the number of double or triple bond as indicated:
C_4H_8 (one double bond).

Ans. : $H_2\overset{1}{C}=\overset{2}{C}H-\overset{3}{C}H_2-\overset{4}{C}H_3$

(I)

$\overset{1}{C}H_3-\overset{2}{C}H=\overset{3}{C}H-\overset{4}{C}H_3$

(II)



(III)

The IUPAC name of

Compound (I) is But-1-ene.

Compound (II) is But-2-ene.

Compound (III) is 2-Methylprop-1-ene.

117. Suggest the name of a Lewis acid other than anhydrous aluminium chloride which can be used during ethylation of benzene.

Ans. : The ethylation reaction of benzene involves the addition of an ethyl group on the benzene ring. Such a reaction is called a Friedel-Craft alkylation reaction. This reaction takes place in the presence of a Lewis acid.

Any Lewis acid like anhydrous $FeCl_3$, $SnCl_4$, BF_3 etc. can be used during the ethylation of benzene.

118. 2 Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+.

Chlorobenzene, 2,4-dinitrochlorobenzene, p-nitrochlorobenzene.

Ans. : Electrophiles are reagents that participate in a reaction by accepting an electron pair in order to bond to nucleophiles.

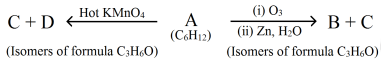
The higher the electron density on a benzene ring, the more reactive is the compound towards an electrophile, E^+ (Electrophilic reaction).

The presence of an electron withdrawing group (i.e., NO_2^- and Cl^-) deactivates the aromatic ring by decreasing the electron density.

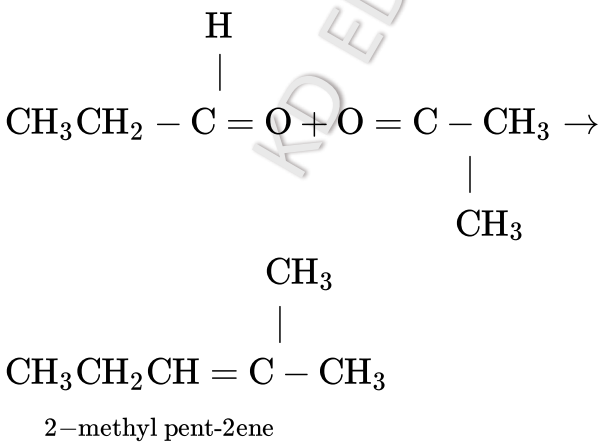
Since NO_2^- group is more electron withdrawing (due to resonance effect) than the Cl^- group (due to inductive effect), the decreasing order of reactivity is as follows:

Chlorobenzene > p-nitrochlorobenzene > 2,4-dinitrochlorobenzene.

119. Give the structures of A and B.



Ans. : (B) and (C) are CH_3CH_2CHO (propanal) and CH_3COCH_3 (propanone). Hence, A is



2−methyl pent-2ene

$$\underset{\text{(B)}}{CH_3CH_2CHO} + \underset{\text{(C)}}{CH_3COCH_3} \xleftarrow{\text{Ozonolysis}} \underset{\text{(A)}}{CH_3CH_2CH = \overset{\overset{CH_3}{|}}{C} - CH_3}$$

$$\underset{\text{(A)}}{CH_3CH_2CH = \overset{\overset{CH_3}{|}}{C} - CH_3} \xrightarrow{\text{Hot } KMnO_4}$$

$$\underset{\text{(D)}}{CH_3CH_2COOH} + \underset{\text{(C)}}{CH_3 - \overset{\overset{CH_3}{|}}{C} = O}$$

120. Complete the following reactions:

i. $CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}} ?$

ii. $CH_3 - Cl + Na \xrightarrow{\text{Dry ether}} ?$

iii. $CH_3 - \underset{\underset{Cl}{|}}{CH} - CH_2 - CH_3 \xrightarrow[\Delta]{\text{alc. KOH}}$

Ans. :

i. $CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}} CH_3 - CH_2 - CH_2Br$

ii. $CH_3 - Cl + Na \xrightarrow{\text{Dry ether}} CH_3 - CH_3 + 2NaCl$

iii. $CH_3 - \underset{\underset{Cl}{|}}{CH} - CH_2 - CH_3 \xrightarrow[\Delta]{\text{alc. KOH}} CH_3 - CH = CH - CH_3 + KCl + H_2O$

121. Complete the reactions:

i. $CH_3CH_2CH_3 + HNO_3 \xrightarrow{\text{Vapour phase}}$

ii. $CH_4 + O_2 \xrightarrow[723-773K]{\text{Copper tube}}$

iii. $C_2H_5\ \overset{-}{C}OO\overset{+}{N}a + NaOH \xrightarrow{CaO}$

Ans. :

i. $CH_3CH_2CH_3 + HNO_3 \xrightarrow{\text{Vapour phase}} CH_3CH_2NO_2 + CH_3CH_2CH_2NO_2 + CH_3NO_2 + H_2O$

Nitroethane Nitropropane Nitromethane

ii. $CH_4 + O_2 \xrightarrow[723-773K]{\text{Copper tube}} 2CH_3OH$

iii. $C_2H_5COONa + NaOH \xrightarrow[\text{CaO}]{\text{Methanol}} C_2H_6 + Na_2CO_3$

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

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

Ans. : $HC \equiv C - CH_2 - CH_3 \xrightarrow[\text{(i) } CH_3-I]{\text{(i) } NaNH_2/NH_3}$

$CH_3 - C \equiv C - CH_2 - CH_2 - CH_3 \xrightarrow[H_2]{\text{Lindlar's catalyst}}$

'A'

$CH_3 - CH = CH - CH_2 - CH_2 - CH_3 \xrightarrow{Br_2}$

'B'

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

'C'

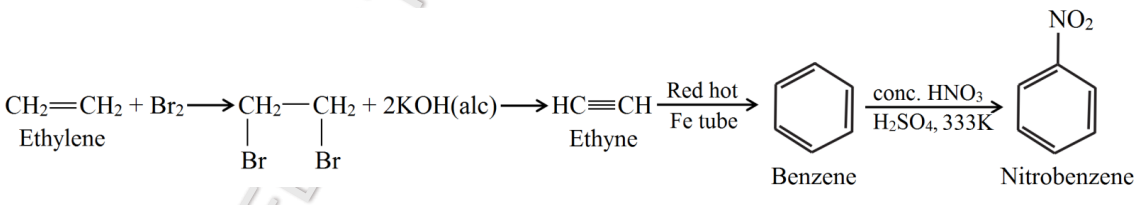
123. Convert:

i. Ethylene to Nitrobenzene.

ii. Write short note on Markovnikov's Rule.

Ans. :

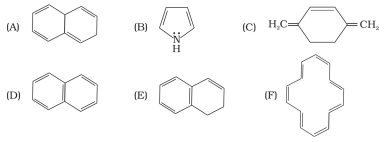
i.



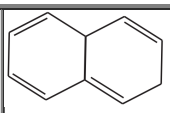
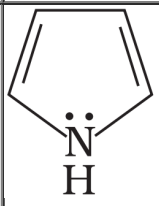
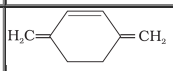
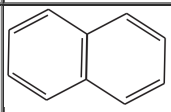
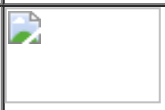
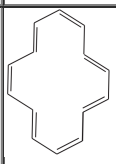
ii. **Markovnikov's Rule:** When a polar compound is a unsymmetrical alkene or alkyne, negative part goes to least substituted carbon e.g.,

$CH_3 - CH = CH_2 + HCl \rightarrow CH_3 - \underset{|}{\underset{Cl}{CH}} - CH_3$

124. Which of the following compounds are aromatic according to Huckel's rule?



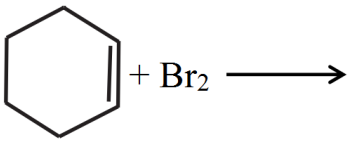
Ans. :

(A)		The compound has 8π electrons. It is non aromatic.
(B)		This compound has delocalised 6π electrons, follows Huckel rule. It is aromatic.
(C)		In this compound 6π electrons are not present in the ring hence nonaromatic.
(D)		It is aromatic obeying Huckel's rule. It has 10 delocalised π-electrons.
(E)		It has 8π-electrons, out of which 6π-electrons are delocalised. Follows Huckel rule. It is aromatic.
(F)		In this compound 14π electrons are in conjugation and in the planar ring. It is also aromatic, It follows Huckel's rule.

125. For the following reactions, complete and Identify the type of reactions:

i. $CH_3 - CH_2 - CH_2Br + KOH(alc.) \longrightarrow$

ii. $CH_3 - \underset{\displaystyle Br}{\underset{|}{CH}} - CH_3 + KOH(aq) \longrightarrow$

iii. 

Ans. :

i. $CH_3CH_2CH_2Br + KOH(alc.) \longrightarrow$

$CH_3 - CH = CH_2 + KBr + H_2O$

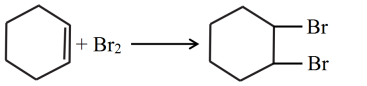
Nucleophilic Elimination is taking place.

ii. $CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3 + KOH(aq) \longrightarrow CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3 + KBr$

2−Propanol

Nucleophilic substitution reaction is taking place.

iii.



1,2-Dibromo cyclohexane

Addition reaction is taking place.

126. An alkyl halide (X) of formula $C_3H_{13}Cl$ on treatment with alcoholic KOH or potassium tert-butoxide gives two isomeric alkenes Yand Z(C_6H_{12}). Both alkenes on hydrogenation give 2, 3-dimethylbutane. Predict the structure of X, Y and Z.

Ans. :

$$CH_3 - \underset{\underset{Cl}{|}}{\overset{\overset{CH_3}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3 + KOH \xrightarrow[(alc.)]{Heat}$$

(X)

$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} = \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3 + CH_2 = \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - C - CH_3$$

2,3-dimethyl but-2-ene

2,3−dimethyl-1-butene

(Z)

127. Give the reactions involved in the preparation of propane from the following:

i. $CH_3 - CH = CH_2$

ii. $CH_3 - CH_2 - CH_2Cl$

iii. $CH_3CH_2CH_2COO^-Na^+$

Ans. :

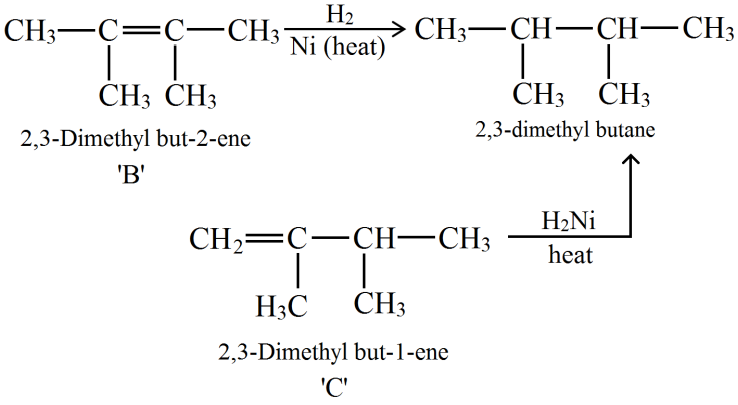
i. $\underset{\text{Propene}}{CH_3 - CH = CH_2} + H_2 \xrightarrow{Pd/pt/Ni} \underset{\text{Propane}}{CH_3 - CH_2 - CH_3}$

ii. $CH_3 - CH_2 - CH_2 - Cl + 2[H] \xrightarrow{Zn/HCl} CH_3CH_2CH_3 + HCl$

iii. $CH_3 - CH_2 - CH_2 - COO^-Na^+ + NaOH(CaO) \xrightarrow{heat} CH_3 - CH_2 - CH_3 + Na_2CO_3$

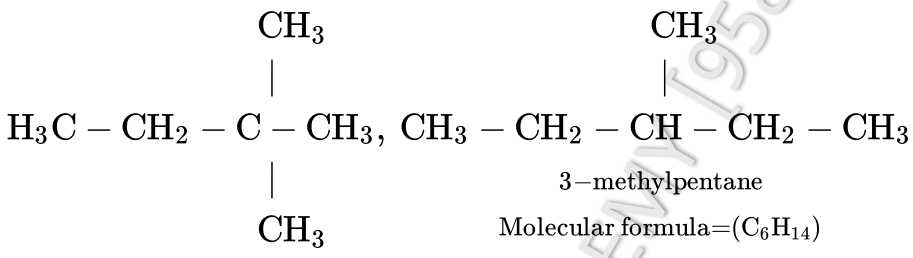
128. An alkyl halide 'A' of formula $C_6H_{13}Cl$ on treatment with alcoholic KOH gives two isomeric alkenes 'B' and 'C' with molecular formula C_6H_{12}. Both alkenes on hydrogenation give 2, 3-dimethyl butane. Predict the structure of 'A', 'B' and 'C'.

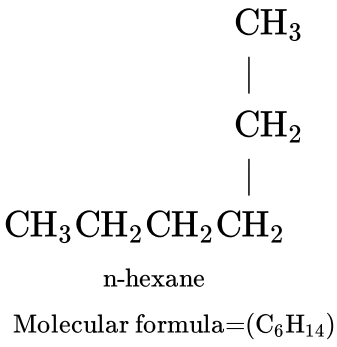
Ans. :



129. Arrange 2, 2-dimethylbutane, 3-methylpentane and n-hexane in increasing order of their boiling point.

Ans. :



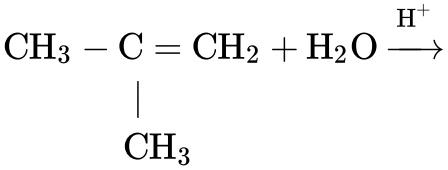


The three given compounds are isomers if molecular formula C_6H_{14}, n-hexane has the longest chain and therefore has the highest boiling point. 2, 2-dimethylbutane is the most spherical and has the smallest surface area. In this case the van der Waal's force will be weakest and so it has the lowest boiling point.

Thus, the increasing order of boiling point of the three isomers in as follows.

2, 2-dimethylbutane < 3-methylpentane < n-hexane.

130.
a. Name a compound that will be required to obtain butane using Kolbe's electrolytic method.
b. Why does benzene show electrophilic substitution easily?
c. Complete the following:



Ans. :

a. CH_3CH_2COONa (sodium propanoate), on electrolysis will give butane.

b. It is because benzene has 6π electrons, therefore, it attracts electrophile and undergo electrophilic substitution reactions.

c. $$CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2 + H_2O \xrightarrow{H^+}$$

$2-$Methyl propene

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

$2-$Methyl propan-2-ol

131. Write chemical reactions of:

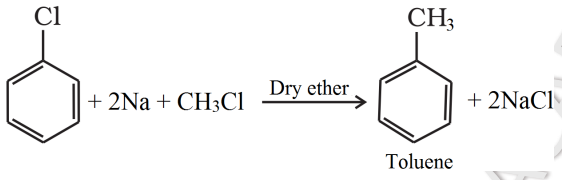
i. Wurtz-Fittig reaction.

ii. Kolbe's electrolytic method.

iii. B-Elimination reaction.

Ans. :

i. **Wurtz-Fittig reaction:**



Toluene

ii. **Kolbe's electrolytic method:**

$$CH_3COONa(aq) \xrightarrow{\text{electrolysis}} CH_3COO^- + Na^+$$

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

At cathode: $2H^+ + 2e^- \longrightarrow H_2(g)$

At anode: $$2CH_3COO^- - 2e^- \longrightarrow \underset{\underset{CH_3}{|}}{CH_3} + 2CO_2$$

iii. $\beta-$ **Elimination reaction:**

$$CH_3 - \overset{\beta}{CH_2} - \overset{\alpha}{\underset{\underset{Cl}{|}}{CH}} - CH_2 - CH_3 + KOH(alc.) \longrightarrow$$

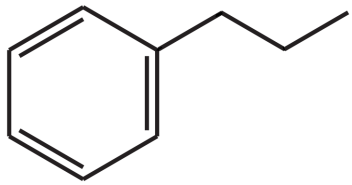
$3-$Chloropentane

$$CH_3 - CH = CH - CH_2 - CH_3 + KCl + H_2O$$

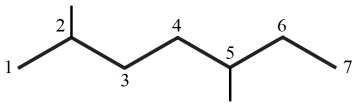
Pent-2-ene

132. Write IUPAC names of the following:

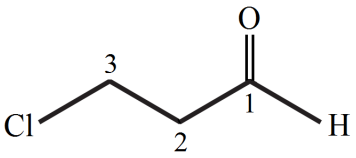
a.



b.



c.



Ans. :

a. Propyl benzene.
b. 2, 5-Dimethyl heptanes.
c. 3-Chloropropanal.

133. An alkane has a molecular mass of 72. Give all the possible structural isomers along with their IUPAC names.

Ans. : The general formula of alkanes is C_nH_{2n+2} $\Rightarrow$ 12 × n + 1 × (2n + 2) = 72 or 12n + 2n + 2 = 72 or n = 5

Thus, the molecular formula of the alkane is C_5H_{12}.

i. $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$

n-hexane

ii. $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_2 - CH_3$

2−methylpentane

iii. $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_3$

3−methylpentane

iv. $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$

2, 3−dimethylbutane

v. $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}} - CH_2 - CH_3$

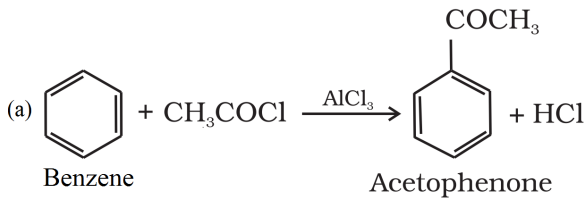
2, 2−dimethylbutane

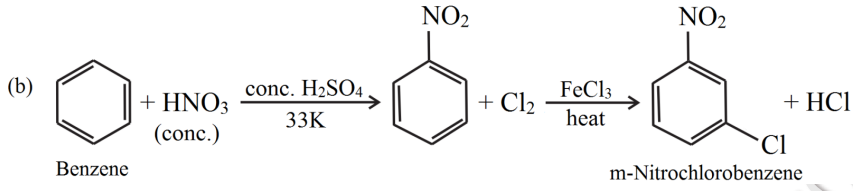
134. i. How will you convert benzene into:

a. Acetophenone?
b. m-nitrochlorobenzene?

ii. Write the structures of products obtained by ozonolysis of pent-2-ene.

Ans. :





ii. $CH_3 - CH = CH - CH_2 - CH_3 \xrightarrow[\text{(i) } Zn/H_2O]{\text{(i) } O_3}$

$$CH_3 - \overset{\overset{O}{\|}}{C} - H + CH_3CH_2CHO$$

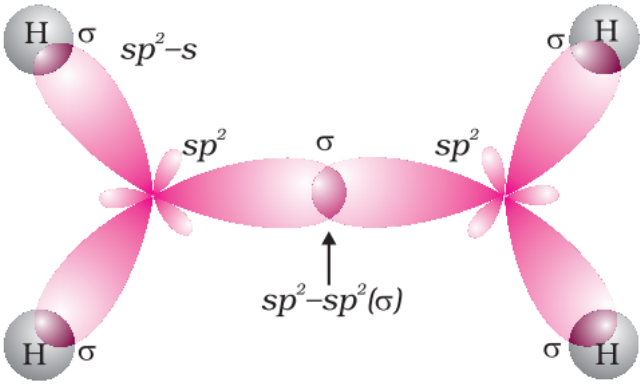
Ethanal Propanal

* Case study based questions [8]

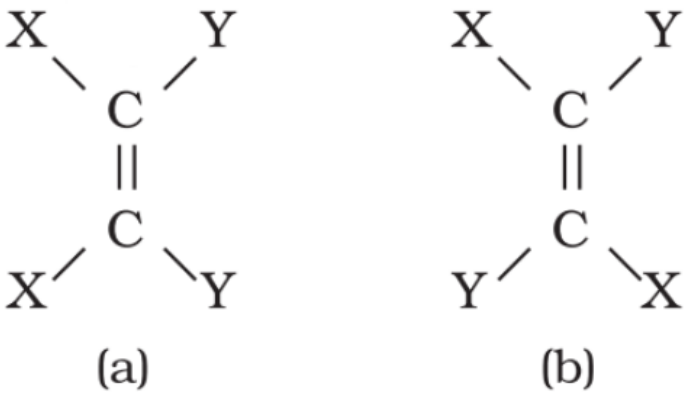
135. Read the passage given below and answer the following questions from 1 to 5.

Alkenes are unsaturated hydrocarbons containing at least one double bond. What should be the general formula of alkenes? If there is one double bond between two carbon atoms in alkenes, they must possess two hydrogen atoms less than alkanes. Hence, general formula for alkenes is C_nH_{2n}. Alkenes are also known as olefins (oil forming) since the first member, ethylene or ethene (C_2H_4) was found to form an oily liquid on reaction with chlorine.

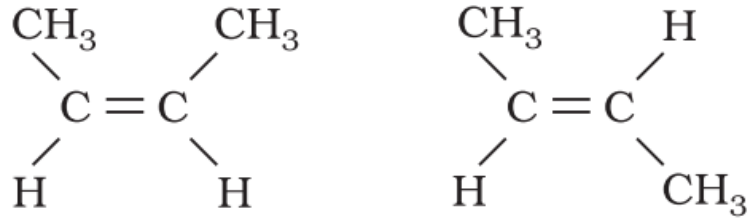
Structure of Double Bond Carbon-carbon double bond in alkenes consists of one strong sigma (σ) bond (bond enthalpy about 397 kJ $mol^{-1)}$ due to head-on overlapping of sp^2 hybridised orbitals and one weak pi π bond (bond enthalpy about 284 kJ mol^{-1}) obtained by lateral or sideways overlapping of the two 2p orbitals of the two carbon atoms. The double bond is shorter in bond length (134 pm) than the C–C single bond (154 pm). You have already read that the pi (π) bond is a weaker bond due to poor sideways overlapping between the two 2p orbitals. Thus, the presence of the pi (π)bond makes alkenes behave as sources of loosely held mobile electrons. Therefore, alkenes are easily attacked by reagents or compounds which are in search of electrons. Such reagents are called electrophilic reagents. The presence of weaker(π)-bond makes alkenes unstable molecules in comparison to alkanes and thus, alkenes can be changed into single bond compounds by combining with the electrophilic reagents. Strength of the double bond (bond enthalpy, 681 kJ mol^{-1}) is greater than that of a carbon-carbon single bond in ethane (bond enthalpy, 348 kJ mol^{-1}). Orbital diagrams of ethene molecule are shown in Figure.



Geometrical isomerism: Doubly bonded Carbon atoms have to satisfy the remaining two Valences by joining with two atoms or groups. If the two atoms or groups attached to each Carbon atom are different, they can be Represented by YX C = C XY like structure. YX C = C XY can be represented in space in the Following two ways:



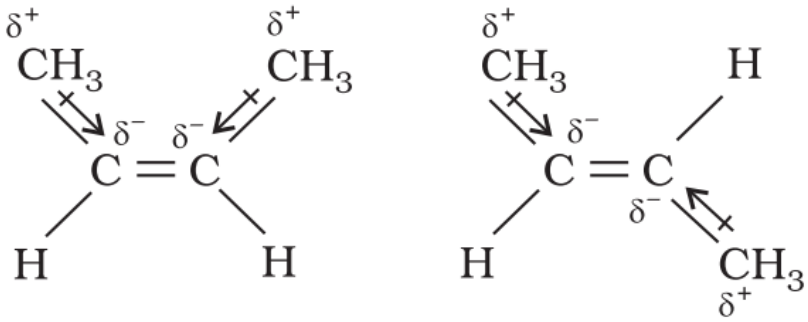
In (a), the two identical atoms i.e., both the X or both the Y lie on the same side of the Double bond but in (b) the two X or two Y lie Across the double bond or on the opposite Sides of the double bond. This results in Different geometry of (a) and (b) i.e. disposition Of atoms or groups in space in the two Arrangements is different. Therefore, they are Stereoisomers. They would have the same Geometry if atoms or groups around C = C bond Can be rotated but rotation around C = C bond Is not free. It is restricted. For understanding This concept, take two pieces of strong Cardboards and join them with the help of two Nails. Hold one cardboard in your one hand And try to rotate the other. Can you really rotate The other cardboard ? The answer is no. The Rotation is restricted. This illustrates that the Restricted rotation of atoms or groups around The doubly bonded carbon atoms gives rise to Different geometries of such compounds. The Stereoisomers of this type are called Geometrical isomers. The isomer of the type (a), in which two identical atoms or groups lie On the same side of the double bond is called Cis isomer and the other isomer of the type (b), in which identical atoms or groups lie on The opposite sides of the double bond is called Trans isomer. Thus cis and trans isomers Have the same structure but have different Configuration (arrangement of atoms or groups In space). Due to different arrangement of Atoms or groups in space, these isomers differ In their properties like melting point, boiling Point, dipole moment, solubility etc. Geometrical or cis-trans isomers of but-2-ene Are represented below:



cis-But-2-ene
(b.p. 277 K)

trans-But-2-ene
(b.p. 274 K)

Cis form of alkene is found to be more polar Than the trans form. For example, dipole Moment of cis - but - 2-ene is 0.33 Debye, Whereas, dipole moment of the trans form Is almost zero or it can be said that trans - but - 2 -ene is non-polar. This can be understood by drawing geometries of the two forms as given below from which it is clear that in the trans - but - 2 -ene, the two methyl groups are in opposite directions, Therefore, dipole moments of C - CH_3 bonds cancel, thus making the trans form non-polar.



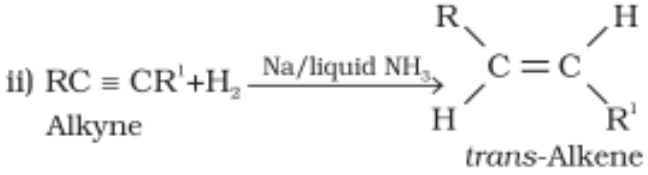
cis-But-2-ene
(μ = 0.33D)

trans-But-2-ene
(μ = 0)

In the case of solids, it is observed that the trans isomer has higher melting point than the cis form. Geometrical or cis-trans isomerism is also shown by alkenes of the types XYC = CXZ and XYC = CZW

Preparation – From alkynes: Alkynes on partial reduction with calculated amount of dihydrogen in the presence of palladised charcoal partially deactivated with poisons like sulphur

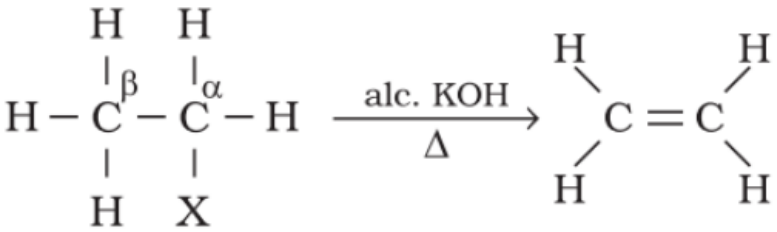
compounds or quinoline give alkenes. Partially deactivated palladised charcoal is known as Lindlar's catalyst. Alkenes thus obtained are having cis geometry. However, alkynes on reduction with sodium in liquid ammonia form trans alkenes.



iii) $CH \equiv CH + H_2 \xrightarrow{Pd/C} CH_2 = CH_2$ (13.32)
Ethyne Ethene

iv) $CH_3 - C \equiv CH + H_2 \xrightarrow{Pd/C} CH_3 - CH = CH_2$
Propyne Propene

From alkyl halides: Alkyl halides (R-X) on heating with alcoholic potash (potassium hydroxide dissolved in alcohol, say, ethanol) eliminate one molecule of halogen acid to form alkenes. This reaction is known as dehydrohalogenation i.e., removal of halogen acid. This is example of $\beta-$elimination reaction, since hydrogen atom is eliminated from the β carbon atom (carbon atom next to the carbon to which halogen is attached).



Nature of halogen atom and the alkyl group determine rate of the reaction. It is observed that for halogens, the rate is: iodine > bromine > chlorine, while for alkyl groups it is: tert > secondary > primary.

Physical properties Alkenes as a class resemble alkanes in physical properties, except in types of isomerism and difference in polar nature. The first three members are gases, the next fourteen are liquids and the higher ones are solids. Ethene is a colourless gas with a faint sweet smell. All other alkenes are colourless and odourless, insoluble in water but fairly soluble in non- polar solvents like benzene, petroleum ether. They show a regular increase in boiling point with increase in size i.e., every $-CH_2$ group added increases boiling point by 20–30 K. Like alkanes, straight chain alkenes have higher boiling point than isomeric branched chain compounds.

i. The first three members of alkenes are …?
   a. Gases
   b. Liquids

c. Solids
d. None of above

ii. General formula for alkenes is ....?
a. C_nH_{2n+1}
b. C_nH_{2n}
c. C_nH_{2n-1}
d. C_nH_{2n+2}

iii. The colour of ethene gas is ...?
a. Red
b. White
c. Pale Green
d. None of above

iv. The bond length of carbon carbon double bond is ... pm ?
a. 154
b. 143
c. 134
d. 120

v. Alkenes are also knows as ...?
a. Olefines
b. Paraffines
c. Oleofines
d. Paracetofines

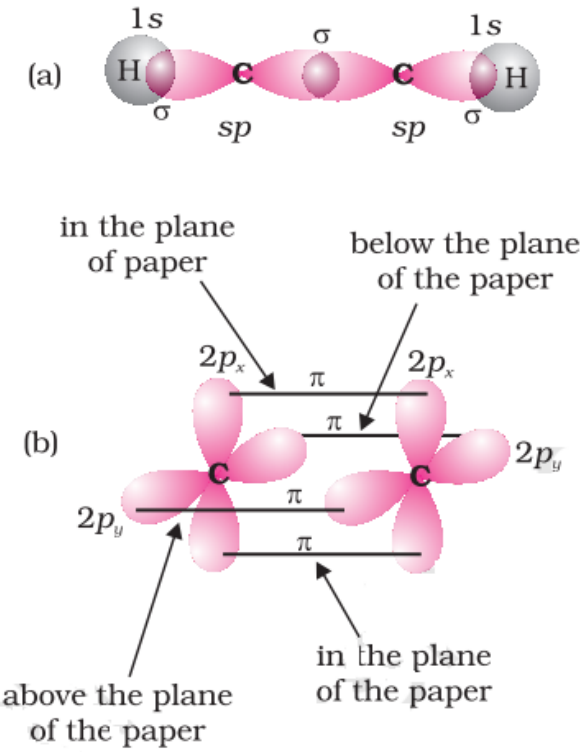
Ans. :

i. (a) Gases
ii. (b) C_nH_{2n}
iii. (d) None of above
iv. (c) 134
v. (a) Olefines

136. Read the passage given below and answer the following questions from 1 to 5.

Alkynes– Like alkenes, alkynes are also unsaturated hydrocarbons. They contain at least one triple bond between two carbon atoms. The number of hydrogen atoms is still less in alkynes as compared to alkenes or alkanes. Their general formula is C_nH_{2n-2}. The first stable member of alkyne series is ethyne which is popularly known as acetylene. Acetylene is used for arc welding purposes in the form of oxyacetylene flame obtained by mixing acetylene with oxygen gas. Alkynes are starting materials for a large number of organic compounds. Hence, it is interesting to study this class of organic compounds.

Structure of Triple Bond Ethyne is the simplest molecule of alkyne series. Structure of ethyne is shown in Figure. Each carbon atom of ethyne has two sp hybridised orbitals. Carbon-carbon sigma (σ) bond is obtained by the head-on overlapping of the two sp hybridised orbitals of the two carbon atoms. The remaining sp hybridised orbital of each carbon atom undergoes overlapping along the internuclear axis with the 1s orbital of each of the two hydrogen atoms forming two C-H sigma bonds. H-C-C bond angle is of 180°.



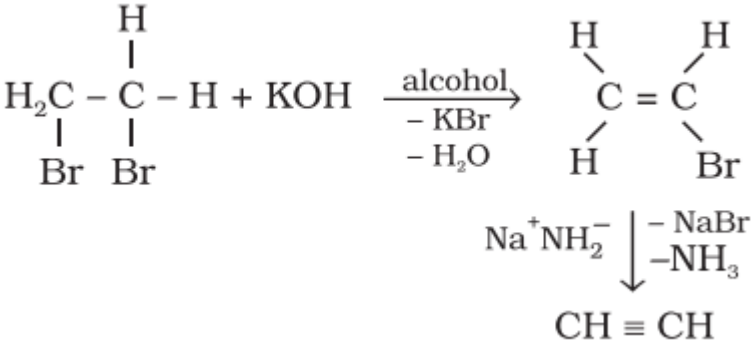
Each carbon has two unhybridised p orbitals which are perpendicular to each other as well as to the plane of the C - C sigma bond. The 2p orbitals of one carbon atom are parallel to the 2p orbitals of the other carbon atom, which undergo lateral or sideways overlapping to form two pi (π) bonds between two carbon atoms. Thus ethyne molecule consists of one C – C σ bond, two C – H σ bonds and two C – C π bonds. The strength of C ≡ C bond (bond enthalpy 823 kJ mol^{-1}) is more than those of C = C bond (bond enthalpy 681 kJ mol^{-1}) and C – C bond (bond enthalpy 348 kJ $mol^{-1)}$. The C ≡ C bond length is shorter (120 pm) than those of C = C (133 pm) and C – C (154 pm). Electron cloud between two carbon atoms is cylindrically symmetrical about the internuclear axis. Thus, ethyne is a linear molecule.

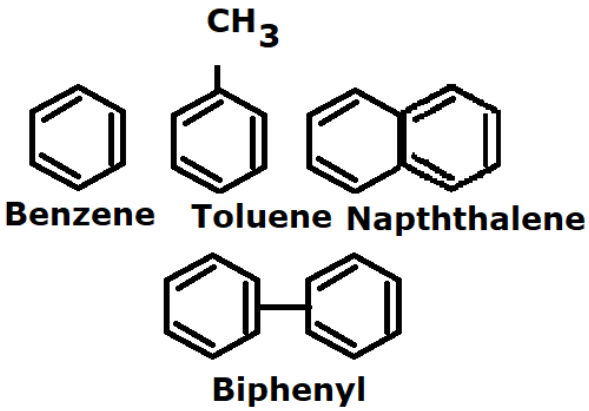
Preparation – From calcium carbide: On industrial scale, ethyne is prepared by treating calcium carbide with water. Calcium carbide is prepared by heating quick lime with coke. Quick lime can be obtained by heating limestone as shown in the following reactions:

$$CaO + 3C \longrightarrow \underset{\text{Calcium carbide}}{CaC_2} + CO$$

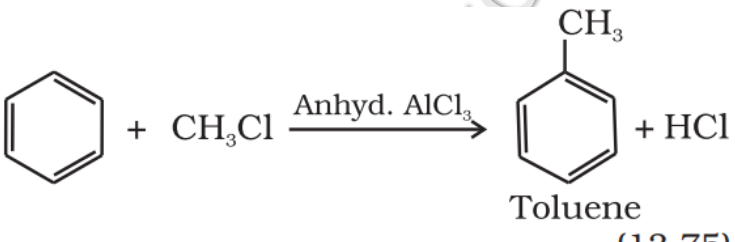
$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

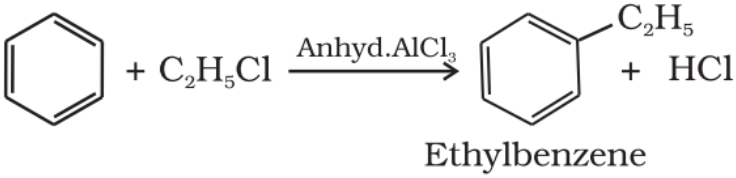
From vicinal dihalides: Vicinal dihalides on treatment with alcoholic potassium hydroxide undergo dehydrohalogenation. One molecule of hydrogen halide is eliminated to form alkenyl halide which on treatment with sodamide gives alkyne.





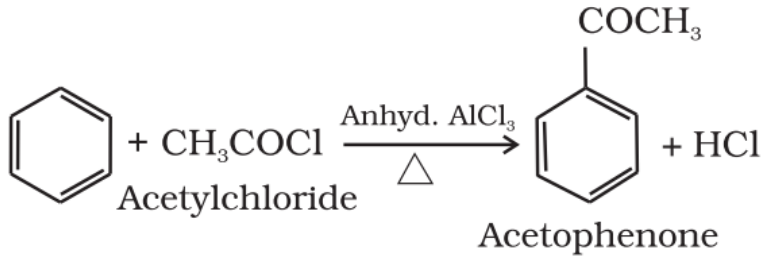
Aromatic hydrocarbon- These hydrocarbons are also known as ‘arenes’. Since most of them possess pleasant odour, the class of compounds was named as ‘aromatic compounds’. Most of such compounds were found to contain benzene ring. Benzene ring is highly unsaturated but in a majority of reactions of aromatic compounds, the unsaturation of benzene ring is retained. However, there are examples of aromatic hydrocarbons which do not contain a benzene ring but instead contain other highly unsaturated ring. Aromatic compounds containing benzene ring are known as benzenoids and those not containing a benzene ring are known as non-benzenoids. Some examples of arenes are given below:



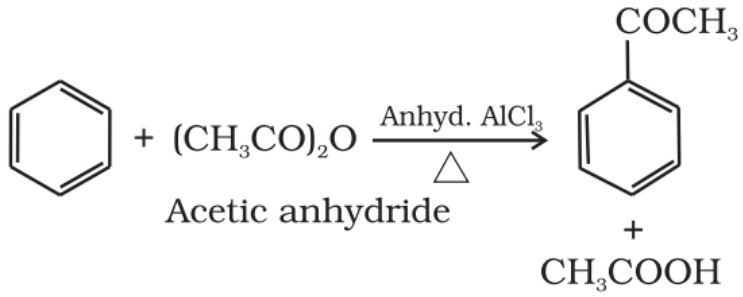


Friedel-Crafts alkylation reaction: When benzene is treated with an alkyl halide in the presence of anhydrous aluminium chloride, alkylbenene is formed.

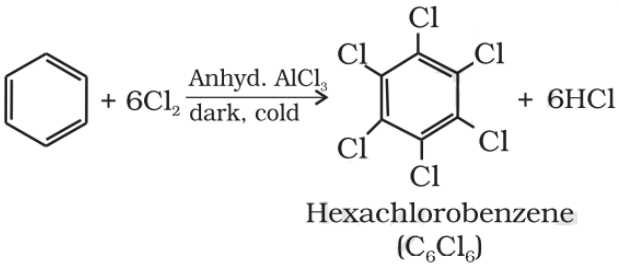
Friedel-Crafts acylation reaction: The reaction of benzene with an acyl halide or acid anhydride in the presence of Lewis acids ($AlCl_3$) yields acyl benzene.



(13.77)



If excess of electrophilic reagent is used, further substitution reaction may take place in which other hydrogen atoms of benzene ring may also be successively replaced by the electrophile. For example, benzene on treatment with excess of chlorine in the presence of anhydrous $AlCl_3$ can be chlorinated to hexachlorobenzene (C_6Cl_6)



i. The general formula of Alkynes is …?
   a. C_nH_{2n-2}
   b. C_nH_{2n-2}
   c. C_nH_{2n-2}
   d. C_nH_{2n-2}

ii. Calcium carbide is prepared by heating quick lime with …?
   a. Backing soda
   b. Coke
   c. Carbide
   d. Salt

iii. Vicinal dihalides on treatment with alcoholic potassium hydroxide undergo …?
   a. Dehydrogenation.
   b. Hydrohalogenation.
   c. Dehydrohalogenation
   d. Dehalogenation.

iv. The bond enthalpy of C ≡ C is …?
   a. 523 kJ mol
   b. 623 kJ mol
   c. 723 kJ mol
   d. 823 kJ mol

v. The C ≡ C bond length is …?

a. 1200 pm
b. 620 pm
c. 240 pm
d. 120 pm

Ans. :

i. (a) C_nH_{2n-2}
ii. (b)Coke
iii. (c) Dehydrohalogenation.
iv. (d) 823 kJ mol
v. (d) 120 pm

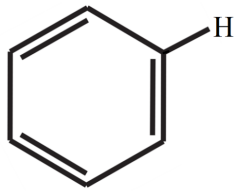
*** Given Section consists of questions of 5 marks each.** **[70]**

137. 8 Arrange benzene, n-hexane and ethyne in decreasing order of acidic behaviour. Also give reason for this behaviour.

Ans. :

Acidic character of a species is defined on the basis of ease with which it can lose its H-atoms.

The hybridization state of carbon in the given compound is:



Benzene
sp_2

$CH_3—(CH_2)_4—CH_3$
Hexane
sp_3

$H—C\equiv C—H$
Ethyne
sp

As the s-character increases, the electronegativity of carbon increases and the electrons of C-H bond pair lie closer to the carbon atom. As a result, partial positive charge of H-atom increases and H^+ ions are set free.

The s-character increases in the order:

$sp^3 < sp^2 < sp$

Hence, the decreasing order of acidic behaviour is Ethyne > Benzene > Hexane.

138. What are the necessary conditions for any system to be aromatic?

Ans. : The necessary and sufficient condition for any system to be aromatic is given by Huckel's rule. As per Huckel's rule, any system is said to be aromatic if it satisfies the following 3 conditions:

1. Contains (4n + 2)71 electrons, where n is any positive integer or 0,
2. Shows complete delocalisation of π electrons and
3. The molecule must be planar.

139. Write chemical equations for combustion reaction of the following hydrocarbons:

i. Butane.
ii. Pentene.
iii. Hexyne.
iv. Toluene.

Ans. : Upon combutions any hydrocarbon produces CO_2 and H_2O for the givren hydrocarbons the reaction may be represented as:

i. Butane: $C_4H_{10} + \frac{13}{2}O_2 \xrightarrow{\Delta} 4CO_2 + 5H_2O$

ii. Pentene: $C_5H_{10} + \frac{15}{2}O_2 \xrightarrow{\Delta} 5CO_2 + 5H_2O$

iii. Hexyne: $C_6H_{10} + \frac{17}{2}O_2 \xrightarrow{\Delta} 6CO_2 + 5H_2O$

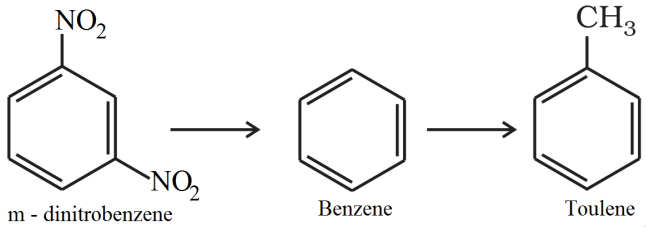
iv. Toluene: $C_7H_8 + 9O_2 \xrightarrow{\Delta} 7CO_2 + 4H_2O$

140. Out of benzene, m-dinitrobenzene and toluene which will undergo nitration most easily and why?

Ans. :

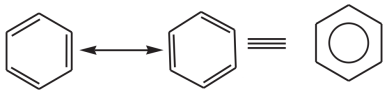
The ease of nitration depends on the presence of electron density on the compound to form nitrates. Nitration reactions are examples of electrophilic substitution reactions where an electron-rich species is attacked by a nitronium ion (NO_2-).

Now, CH_3- group is electron donating and NO_2- is electron withdrawing. Therefore, toluene will have the maximum electron density among the three compounds followed by benzene. On the other hand, m-Dinitrobenzene will have the least electron density. Hence, it will undergo nitration with difficulty. Hence, the increasing order of nitration is as follows:

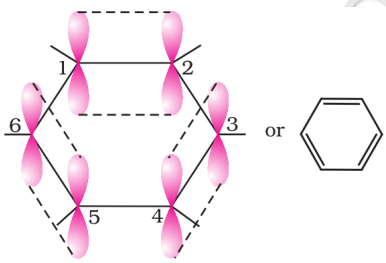


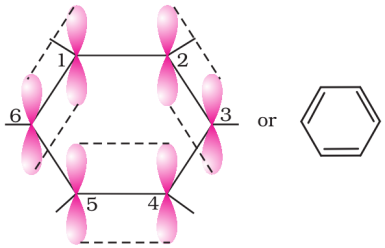
141. Why is benzene extra ordinarily stable though it contains three double bonds?

Ans. : Benzene is a hybrid of resonating structures given as:



All six carbon atoms in benzene are sp^2 hybridized. The two sp^2 hybrid orbitals of each carbon atom overlap with the sp^2 hybrid orbitals of adjacent carbon atoms to form six sigma bonds in the hexagonal plane. The remaining sp^2 hybrid orbital on each carbon atom overlaps with the s-orbital of hydrogen to form six sigma C-H bonds. The remaining unhybridized p-orbital of carbon atoms has the possibility of forming three π bonds by the lateral overlap of C_1-C_2, C_3-C_4, C_5-C_6, or C_2-C_3, C_4-C_5, C_6-C_1.



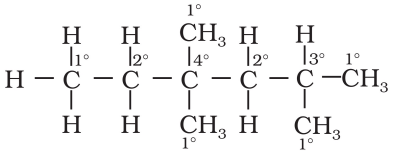


or

The six $\pi's$ are delocalized and can move freely about the six carbon nuclei. Even after the presence of three double bonds, these delocalized $\pi-$ electrons stabilize benzene.

142. 4 In the alkane $H_3C\text{-}CH_2\text{-}C(CH_3)_2\text{-}CH_2\text{-}CH(CH_3)_2$, identify 1°,2°,3° carbon atoms and give the number of H atoms bonded to each one of these.

Ans. :



1° carbon atoms are those which are bonded to only one carbon atom, i.e., they have only one carbon atom as their neighbor. The given structure has five 1° carbon atoms and fifteen hydrogen atoms are attached to it.

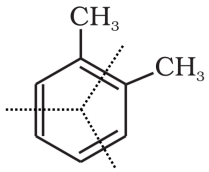
2° carbon atoms are those which are bonded to two carbon atoms, i.e., they have two carbon atoms as their neighbors. The given structure has two 2° carbon atoms and four hydrogen atoms are attached to it.

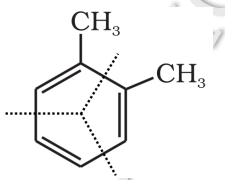
3° carbon atoms are those which are bonded to three carbon atoms, i.e., they have three carbon atoms as their neighbors. The given structure has one 3° carbon atom and only one hydrogen atom is attached to it.

143. Write down the products of ozonolysis of 1,2-dimethylbenzene (o-xylene). How does the result support Kekulé structure for benzene?

Ans. :

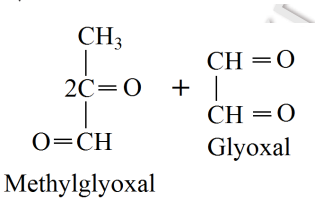
o-xylene has two resonance structures:





(i)

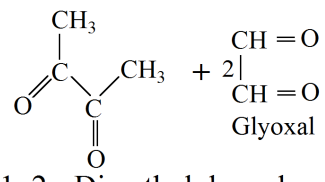
(i) O_3, CH_2Cl_2, 196 K
(ii) Zn/H_2O



Methylglyoxal

(ii)

(i) O_3, CH_2Cl_2, 196 K
(ii) Zn/H_2O



1, 2 - Dimethylglyoxal

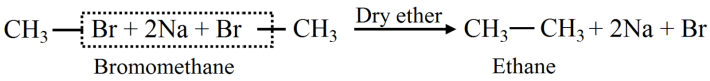
All three products, i.e., methyl glyoxal, 1,2-dimethylglyoxal, and glyoxal are obtained from two Kekule structures. Since all three products cannot be obtained from any one of the two

structures, this proves that o-xylene is a resonance hybrid of two Kekule structures (I and II).

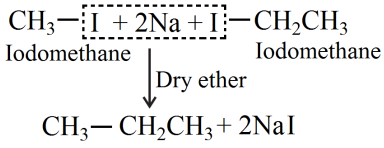
144. Why is Wurtz reaction not preferred for the preparation of alkanes containing odd number of carbon atoms? Illustrate your answer by taking one example.

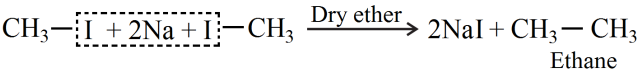
Ans. :

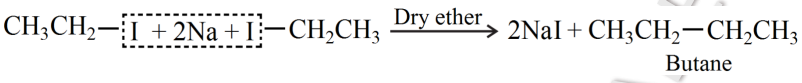
Wurtz reaction is limited for the synthesis of symmetrical alkanes (alkanes with an even number of carbon atoms) In the reaction, two similar alkyl halides are taken as reactants and an alkane, containing double the number of carbon atoms, are formed. Example:



Wurtz reaction cannot be used for the preparation of unsymmetrical alkanes because if two dissimilar alkyl halides are taken as the reactants, then a mixture of alkanes is obtained as the products. Since the reaction involves free radical species, a side reaction also occurs to produce an alkene. For example, the reaction of bromomethane and iodoethane gives a mixture of alkanes.







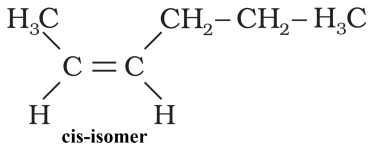
The boiling points of alkanes (obtained in the mixture) are very close. Hence, it becomes difficult to separate them.

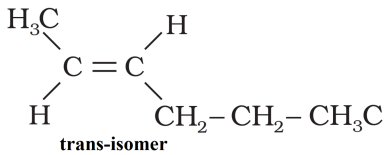
145. Draw the cis and trans structures of hex-2-ene. Which isomer will have higher b.p. and why?

Ans. : Hex-2-ene is represented as:

$$CH_3 - CH = CH - CH_2 - CH_2 - CH_3$$

Geometrical isomers of hex-2-ene are:





The dipole moment of cis-compound is a sum of the dipole moments of C-CH_3 and C-$CH_2CH_2CH_3$ bonds acting in the same direction.

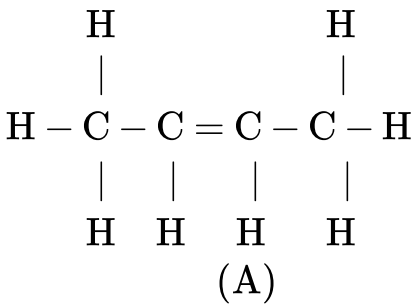
The dipole moment of trans-compound is the resultant of the dipole moments of C-CH_3 and C-$CH_2CH_2CH_3$ bonds acting in opposite directions.

Hence, cis-isomer is more polar than trans-isomer. The higher the polarity, the greater is the intermolecular dipole-dipole interaction and the higher will be the boiling point. Hence,

cis-isomer will have a higher boiling point than trans-isomer.

146. 6 An alkene 'A' contains three C-C, eight C–H σ bonds and one C–C π bond. 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. Write IUPAC name of 'A'.

Ans. : As per the given information, 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 u. The formation of two moles of an aldehyde indicates the presence of identical structural units on both sides of the double bond containing carbon atoms. Hence, the structure of 'A' can be represented as: XC = CX There are eight C–H σ bonds. Hence, there are 8 hydrogen atoms in 'A'. Also, there are three C–C bonds. Hence, there are four carbon atoms present in the structure of 'A'. Combining the inferences, the structure of 'A' can be represented as:



(A)

'A' has 3 C–C bonds, 8 C–H σ bonds, and one C–C π bond. Hence, the IUPAC name of 'A' is But-2-ene. Ozonolysis of 'A' takes place as: https://api.studentbro.in/web/HaqQhKV4.png" style="height:30%; width:30%"> The final product is ethanal with molecular mass = [2 × 12] + (4 × 1) + (1 × 16)] = 44 u.

147. How do you account for the formation of ethane during chlorination of methane?

Ans. : Chlorination of methane proceeds via a free radical chain mechanism. The whole reaction takes place in the given three steps.

Step 1: Initiation:

The reaction begins with the homolytic cleavage of Cl - Cl bond as:

$$\underset{}{\mathrm{Cl-Cl}} \xrightarrow{\mathrm{hv}} \underset{\text{Chlorine free radicals}}{\dot{\mathrm{C}}\mathrm{l} + \dot{\mathrm{C}}}$$

Step 2: Propagation:

In the second step, chlorine free radicals attack methane molecules and break down the C–H bond to generate methyl radicals as:

$$\underset{\text{Methane}}{\mathrm{CH_4}} + \dot{\mathrm{C}}\mathrm{l} \xrightarrow{\mathrm{hv}} \dot{\mathrm{C}}\mathrm{H_3} + \mathrm{H-Cl}$$

These methyl radicals react with other chlorine free radicals to form methyl chloride along with the liberation of a chlorine free radical.

$$\dot{\mathrm{C}}\mathrm{H_3} + \mathrm{Cl-Cl} \rightarrow \underset{\text{Methyl chloride}}{\mathrm{CH_3-Cl}} + \dot{\mathrm{C}}\mathrm{l}$$

Hence, methyl free radicals and chlorine free radicals set up a chain reaction. While HCl and CH_3Cl are the major products formed, other higher halogenated compounds are also formed as:

$$\mathrm{CH_3Cl} + \dot{\mathrm{C}}\mathrm{l} \longrightarrow \dot{\mathrm{C}}\mathrm{H_2Cl} + \mathrm{HCl}$$

$$\dot{\mathrm{C}}\mathrm{H_2Cl} + \mathrm{Cl-Cl} \longrightarrow \mathrm{CH_2Cl_2} + \dot{\mathrm{C}}\mathrm{l}$$

Step 3: Termination:

Formation of ethane is a result of the termination of chain reactions taking place as a result of the consumption of reactants as:

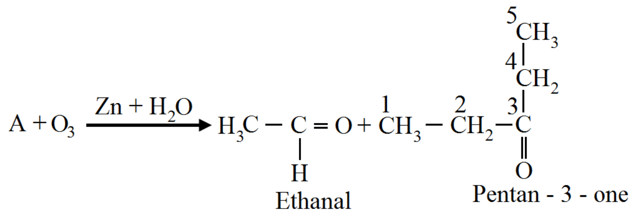
$$\dot{Cl} + \dot{Cl} \longrightarrow Cl - Cl$$

$$H_3\dot{C} + \dot{C}H_3 \longrightarrow H_3C - CH_3$$
$$\text{(Ethane)}$$

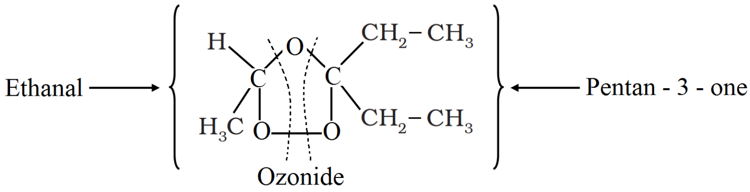
Hence, by this process, ethane is obtained as a by-product of chlorination of methane.

148. An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write structure and IUPAC name of 'A'.

Ans. :



During ozonolysis, an ozonide having a cyclic structure is formed as an intermediate which undergoes cleavage to give the final products. Ethanal and pentan-3-one are obtained from the intermediate ozonide. Hence, the expected structure of the ozonide is:



This ozonide is formed as an addition of ozone to 'A'. The desired structure of 'A' can be obtained by the removal of ozone from the ozonide. Hence, the structural formula of 'A' is:

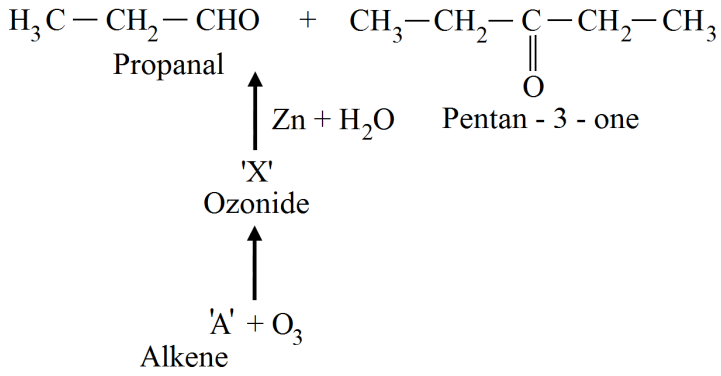
$$H_3\overset{1}{C} - \overset{2}{C}H = \overset{3}{C}(CH_2 - CH_3) - \overset{4}{C}H_2 - \overset{5}{C}H_3$$

The IUPAC name of 'A' is 3-Ethylpent-2-ene.

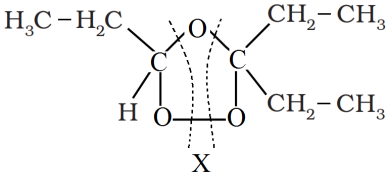
149. Propanal and pentan-3-one are the ozonolysis products of an alkene? What is the structural formula of the alkene?

Ans. :

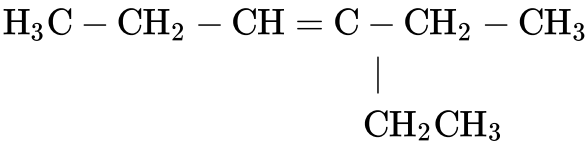
As per the given information, propanal and pentan-3-one are the ozonolysis products of an alkene. Let the given alkene be 'A'. Writing the reverse of the ozonolysis reaction, we get:



The products are obtained on the cleavage of ozonide 'X'. Hence, 'X' contains both products in the cyclic form. The possible structure of ozonide can be represented as:



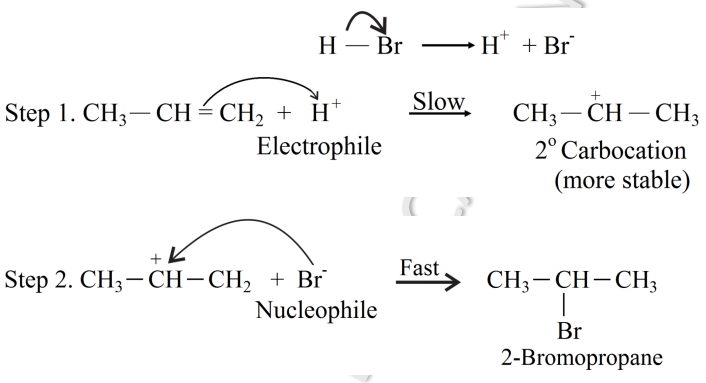
Now, 'X' is an addition product of alkene 'A' with ozone. Therefore, the possible structure of alkene 'A' is:



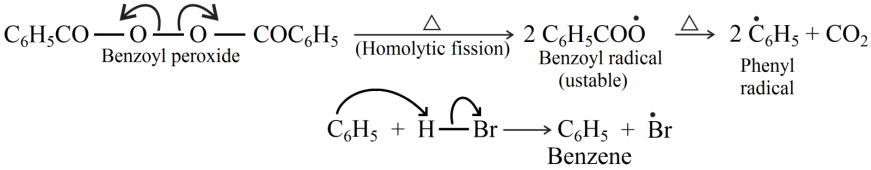
150. Addition of HBr to propene yields 2-bromopropane, while in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. Explain and give mechanism.

Ans. :

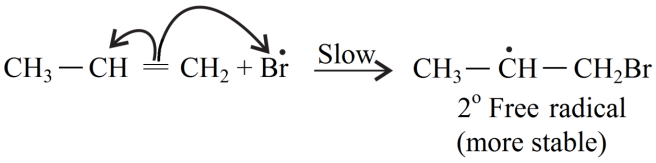
Addition of HBr to propene is an ionic electrophilic addition reaction in which the electrophile, i.e., H^+ first adds to give a more stable 2° carbocation. In the 2nd step, the carbocation is rapidly attacked by the nucleophile Br ion to give 2-bromopropane.

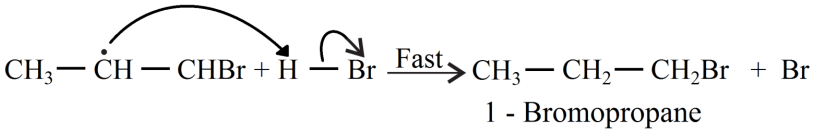


In presence of benzoyl peroxide, the reaction is still electrophilic but the electrophile here is a Br free radical which is obtained by the action of benzoyl peroxide on HBr.



In the first step, Br radical adds to propene in such a way so as to generate the more stable 2° free radical. In the second step, the free radical thus obtained rapidly abstracts a hydrogen atom from HBr to give 1-bromopropane.





From the above discussion, it is evident that although both reactions are electrophilic addition reactions but it is due to different order of addition of H and Br atoms which gives different products.

----- one minute can't change your life but utilisation of every minute definitely change your life -----