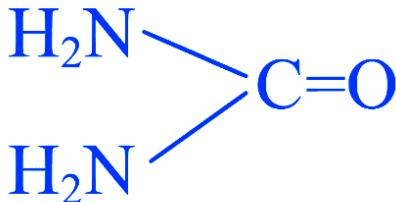
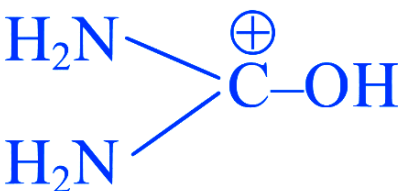
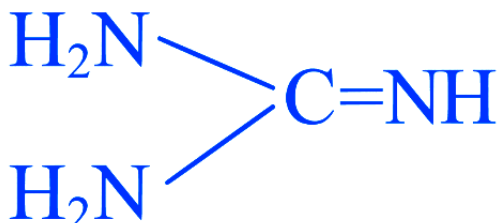
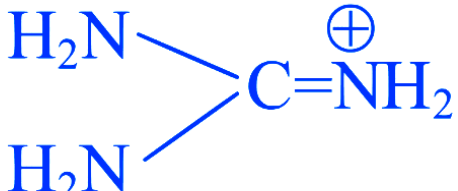


21 Some Basic Principles of Organic Chemistry

Question: Which amongst the following compounds/species is least basic?

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- A 
- B 
- C 
- D 

Answer: B

Question: Which amongst the following compounds will show geometrical isomerism?

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A Pent-1-ene

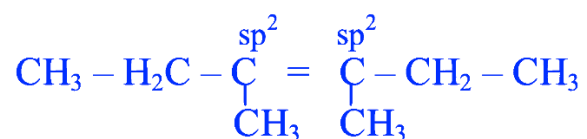
B 2, 3-Dimethylbut-2-ene

C 2-Methylprop-1-ene

D 3, 4-Dimethylhex-3-ene

Answer: D

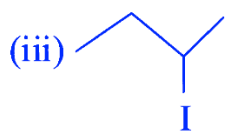
Explanation



Question:

The correct order for the rate of α , β -dehydrohalogenation for the following compounds is _____.

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A (i) < (ii) < (iii)

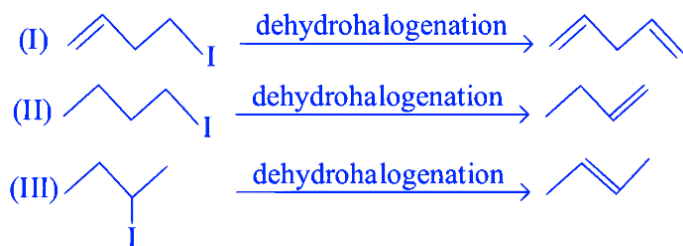
B (ii) < (i) < (iii)

C (iii) < (ii) < (i)

D (ii) < (iii) < (i)

Answer: D

Explanation



Rate of Dehydrohalogenation : II < III < I

Question: Given below are two statements:

Statement I: In an organic compound, when inductive and electromeric effects operate in opposite directions, the inductive effect predominates.

Statement II: Hyperconjugation is observed in o-xylene.

In the light of the above statements, choose the correct answer from the options given below:

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☐ A Statement-I is true but Statement-II is false.

☐ B Statement-I is false but Statement-II is true.

☐ C Both Statement-I and Statement-II are true.

☐ D Both Statement-I and Statement-II are false.

Answer: B

Question:

The number of σ bonds, π bonds and lone pair of electrons in pyridine, respectively are:

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☐ A 12, 3, 0

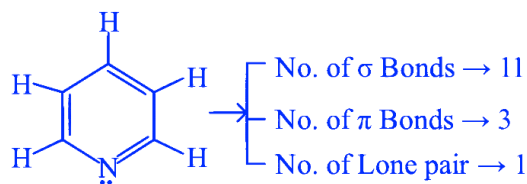
☐ B 11, 3, 1

☐ C 12, 2, 1

☐ D 11, 2, 0

Answer: B

Explanation



Question: In Lassaigne's extract of an organic compound, both nitrogen and Sulphur are present, which gives blood red colour with Fe^{3+} due to the formation of-

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A NaSCN

B $[\text{Fe}(\text{CN})_5\text{NOS}]^{4-}$

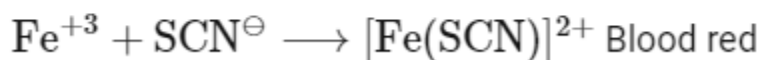
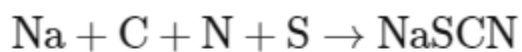
C $[\text{Fe}(\text{SCN})]^{2+}$

D $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 \cdot x\text{H}_2\text{O}$

Answer: C

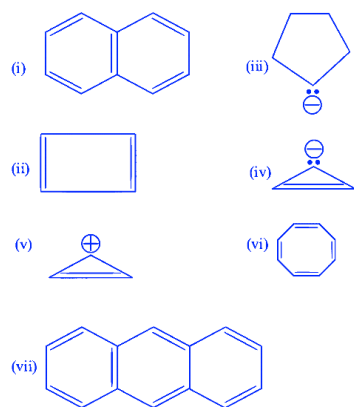
Explanation

Sol. In case nitrogen and Sulphur both are present in an organic compound, sodium thiocyanate is formed, it give blood red colour and no Prussian blue since there are no free cyanide Ions



Question: Consider the following compounds/species:

NEET 2023



The number of compounds species which obey Hucker's rule is _____.

A 6

B 2

C 5

D 4

Answer: D

Explanation

Huckle's rule = $(4n + 2)\pi$ electrons

Comp (i), (ii), (v), (vii) obey Huckle's rule

2022

MCQ (Single Correct Answer)

Q.1. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Chlorine is an electron withdrawing group but it is ortho, para directing in electrophilic aromatic substitution.

Reason (R) : Inductive effect of chlorine destabilises the intermediate carbocation formed during the electrophilic substitution, however due to the more pronounced resonance effect, the halogen stabilises the carbocation at ortho and para positions.

In the light of the above statements, choose the most appropriate answer from the options given below :

- ☐ A (A) is not correct but (R) is correct
- ☐ B Both (A) and (R) are correct and (R) is the correct explanation of (A)
- ☐ C Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- ☐ D (A) is correct but (R) is not correct

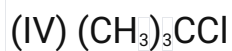
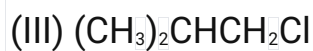
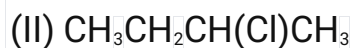
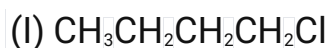
NEET 2022 Phase 2

Ans. (D)

Explanation

Cl has pronounced $-I$ effect than $+R$ effect due to large size difference between carbon and chlorine, also due to high electronegativity of chlorine.

Q.2. Predict the order of reactivity of the following four isomers towards S_N2 reaction.



A (IV) > (II) > (III) > (I)

B (IV) > (III) > (II) > (I)

C (I) > (II) > (III) > (IV)

D (I) > (III) > (II) > (IV)

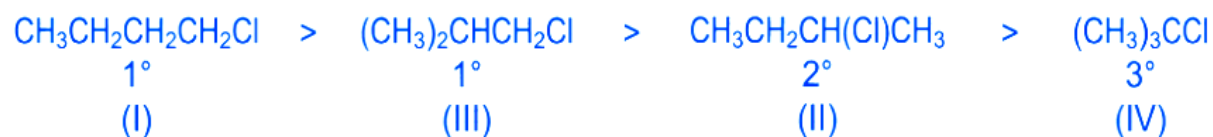
NEET 2022 Phase 2

Ans. (D)

Explanation

· Lesser the steric hinderance on halide carbon, more will be the reactivity of alkyl halide towards $\text{S}_{\text{N}}2$ reaction.

· So correct order towards $\text{S}_{\text{N}}2$ reactivity is :



Q.3. What is the hybridization shown by C_1 and C_2 carbons, respectively in the given compound?



A sp^3 and sp^3

B sp^2 and sp^3

C sp^2 and sp^2

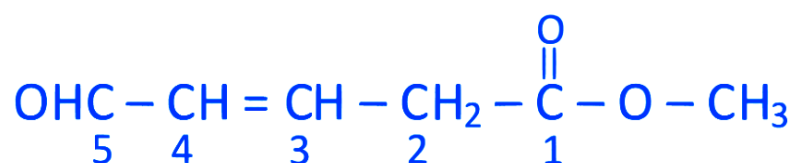
D sp^3 and sp^2

NEET 2022 Phase 2

Ans. (B)

Explanation

$-\text{COOCH}_3$ has higher priority than $-\text{C}=\text{C}-$ and $-\text{CHO}$ in IUPAC nomenclature.

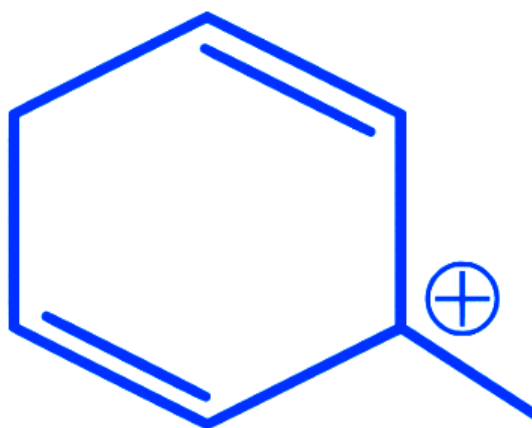


$\text{C}_1 = sp^2$

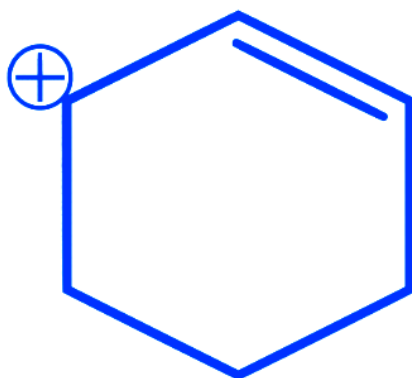
$\text{C}_2 = sp^3$

Q.4. Which of the following is the most stable carbocation?

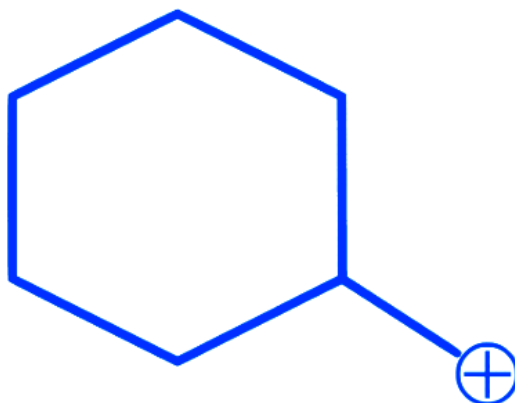
A



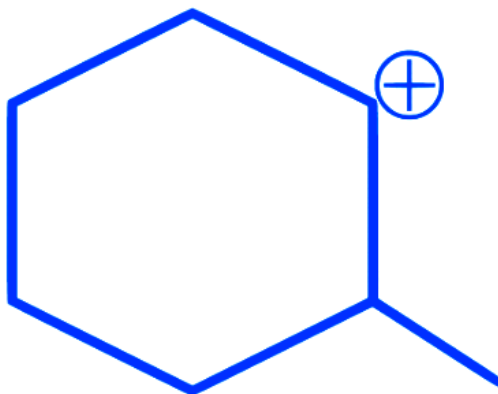
B



C



D



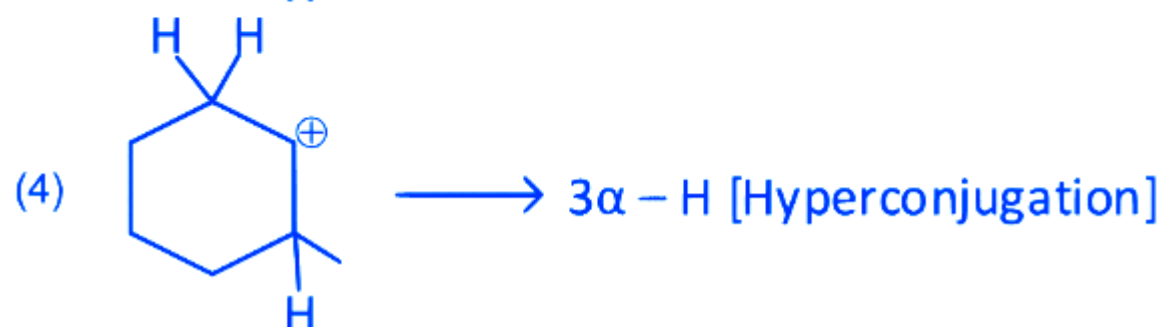
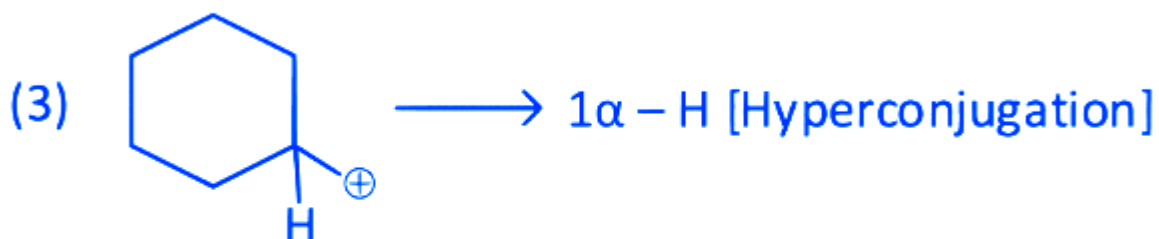
NEET 2022 Phase 2

Ans. (A)

Explanation

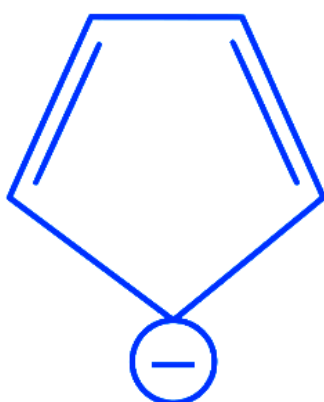


Due to cross-conjugation and $3\alpha - \text{H}$ [Hyperconjugation], (1) is most stable.

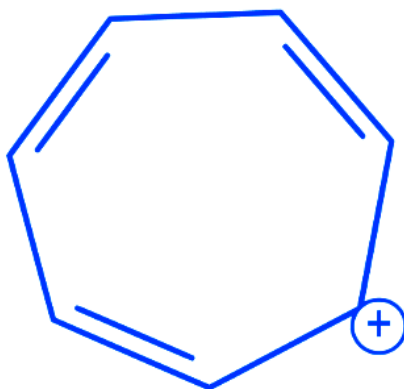


Q.5. Which compound amongst the following is not an aromatic compound?

A



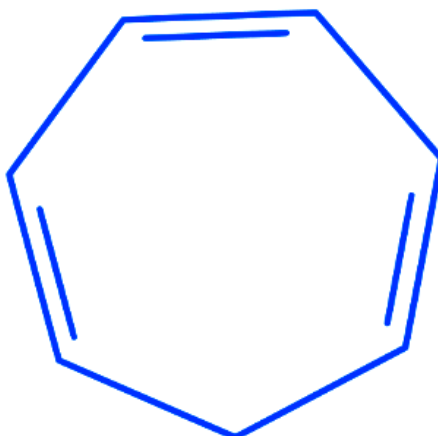
B



C



D

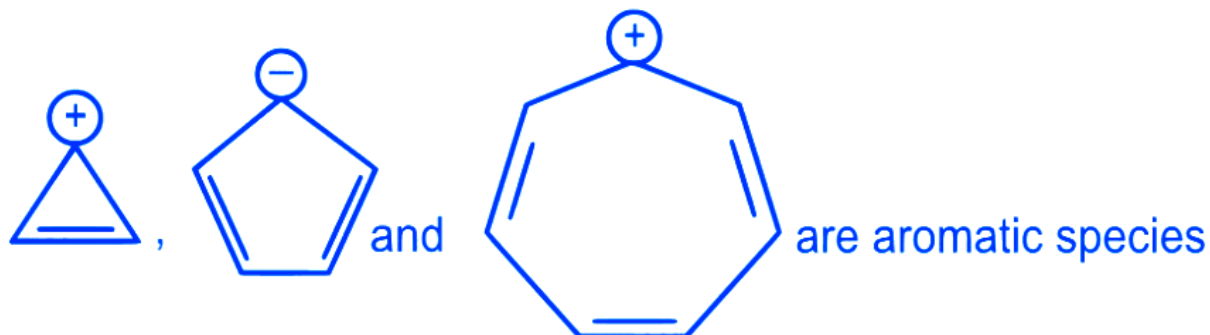


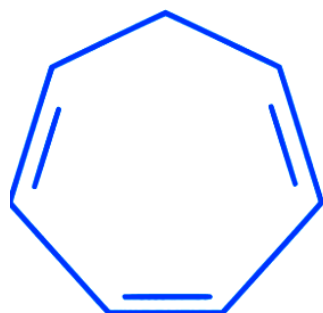
NEET 2022 Phase 1

Ans. (D)

Explanation

Planar, cyclic, conjugated species containing $(4n + 2)\pi$ electrons will be aromatic in nature (n is an integer)





is not an aromatic compound

Q.6. The incorrect statement regarding chirality is

- A** S_N1 reaction yields 1 : 1 mixture of both enantiomers
- B** The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration
- C** Enantiomers are superimposable mirror images on each other
- D** A racemic mixture shows zero optical rotation

NEET 2022 Phase 1

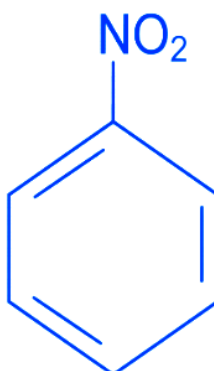
Ans. (C)

Explanation

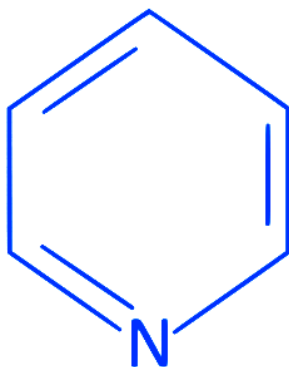
The stereoisomers related to each other as non-superimposable mirror image are called enantiomers.

Q.7. The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?

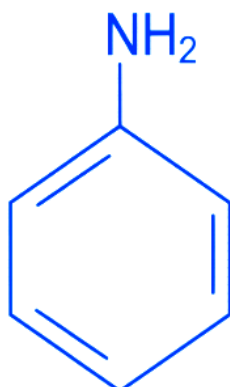
A



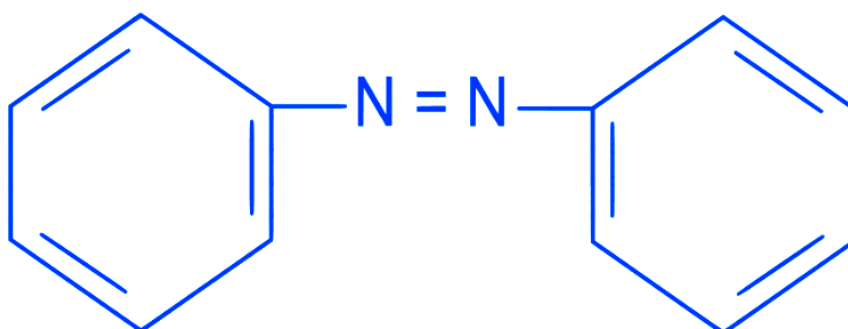
B



C



D



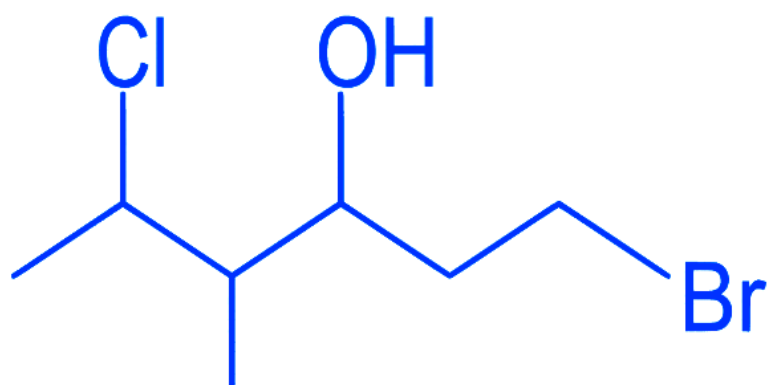
NEET 2022 Phase 1

Ans. (C)

Explanation

Kjeldahl method is not applicable to compounds containing nitrogen in nitro group, azo groups and nitrogen present in the ring (e.g., pyridine) as nitrogen of these compounds does not change to ammonium sulphate under these conditions.

Q.8. The correct IUPAC name of the following compound is



A 1-bromo-5-chloro-4-methylhexan-3-ol

B 6-bromo-2-chloro-4-methylhexan-4-ol

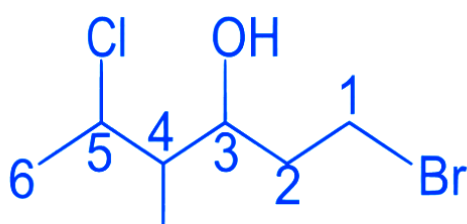
C 1-bromo-4-methyl-5-chlorohexan-3-ol

D 6-bromo-4-methyl-2-chlorohexan-4-ol

NEET 2022 Phase 1

Ans. (A)

Explanation



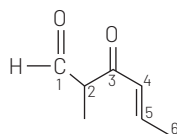
1-bromo-5-chloro-4-methylhexan-3-ol

TOPIC 1 Nomenclature

01 The IUPAC name of the compound
[NEET 2017]

- (a) 3-keto-2-methylhex-4-enal
(b) 5-formylhex-2-en-3-one
(c) 5-methyl-4-oxohex-2-en-5-al
(d) 3-keto-2-methylhex-5-enal

Ans. (a)



– CHO group gets higher priority over >C=O and >C=C< group in numbering of principal carbon chain.
IUPAC name =
3-keto-2-methylhex-4-enal.

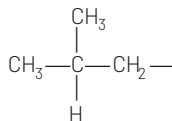
02 The structure of isobutyl group in an organic compound is [NEET 2013]

- (a)
(b)
(c)
(d)

Ans. (a)

'Iso' mean's one Me group is present in side chain. Hence, the structure of

iso-butyl group in an organic compound is



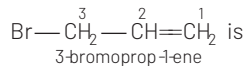
('yl' suffix is used to represent one –H less than the parent hydrocarbon.)

03 Which nomenclature is not according to IUPAC system?
[CBSE AIPMT 2012]

- (a) $\text{Br}-\text{CH}_2-\text{CH}=\text{CH}_2$
1-bromo prop 2-ene
(b)
4-bromo-2, 4-dimethylhexane
(c)
2-methyl-3-phenylpentane
(d) $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{COOH}$
5-oxohexanoic acid

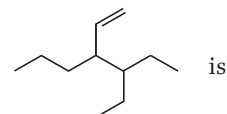
Ans. (a)

In IUPAC system of nomenclature, preference is given to multiple bond than halogen substituent, so the correct name of



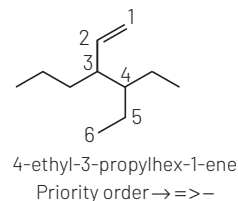
Priority is given to double bond than halogen.

04 The correct IUPAC name of the compound
[CBSE AIPMT 2011]



- (a) 3-ethyl-4-ethenylheptane
(b) 3-ethyl-4-propylhex-5-ene
(c) 3-(1-ethyl propyl) hex-1-ene
(d) 4-ethyl-3-propylhex-1-ene

Ans. (d)

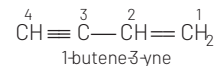


05 The IUPAC name of the compound having the formula $\text{CH}\equiv\text{C}-\text{CH}=\text{CH}_2$ is
[CBSE AIPMT 2009]

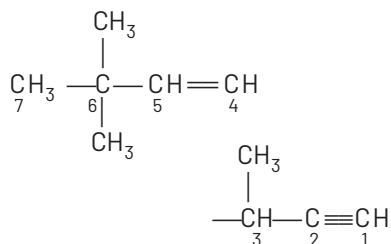
- (a) 3-butene-1-yne
(b) 1-butyne-3-ene
(c) but-1-yne-3-ene
(d) 1-butene-3-yne

Ans. (d)

In IUPAC nomenclature, double bond is given more preference than triple bond.



06 The state of hybridisation of C_2 , C_3 , C_5 and C_6 of the hydrocarbon,



is in the following sequence

[CBSE AIPMT 2009]

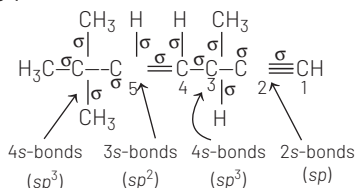
- (a) sp, sp^3, sp^2 and sp^3
 (b) sp^3, sp^2, sp^2 and sp
 (c) sp, sp^2, sp^2 and sp^3
 (d) sp, sp^2, sp^3 and sp^2

Ans. (a)

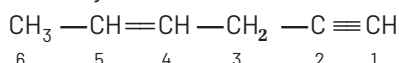
If number of σ bonds = 2; hybridisation is sp .

If number of σ bonds = 3; hybridisation is sp^2 ,

If number of σ bonds = 4; hybridisation is sp^3 .



07 In the hydrocarbon

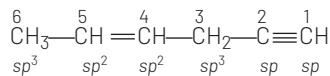


the state of hybridisation of carbons 1, 3 and 5 are in the following sequence

[CBSE AIPMT 2008]

- (a) sp^2, sp, sp^3 (b) sp, sp^3, sp^2
 (c) sp, sp^2, sp^3 (d) sp^3, sp^2, sp

Ans. (b)



Thus, the hybridisation of C^1, C^3 and C^5 are sp, sp^3, sp^2 respectively.

08 The correct order regarding the electronegativity of hybrid orbitals of carbon is [CBSE AIPMT 2006]

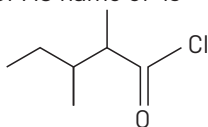
- (a) $sp > sp^2 < sp^3$ (b) $sp > sp^2 > sp^3$
 (c) $sp < sp^2 > sp^3$ (d) $sp < sp^2 < sp^3$

Ans. (b)

The correct order regarding the electronegativity of hybrid orbitals of carbon is $sp > sp^2 > sp^3$ because in sp, sp^2 and sp^3 hybrid orbitals, s-orbital character is 50%, 33.3% and 25%

respectively. Due to higher s-character electron attracting tendency, i.e. electronegativity increases.

09 The IUPAC name of is

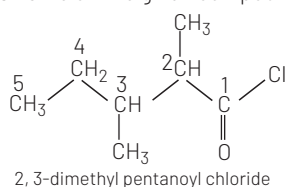


[CBSE AIPMT 2006]

- (a) 3, 4-dimethylpentanoyl chloride
 (b) 1-chloro-1-oxo-2, 3-dimethylpentane
 (c) 2-ethyl-3-methylbutanoyl chloride
 (d) 2, 3-dimethyl pentanoyl chloride

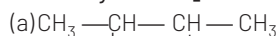
Ans. (d)

IUPAC name of the given compound is

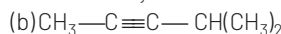


2, 3-dimethyl pentanoyl chloride

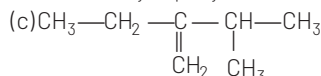
10 Names of some compounds are given. Which one is not correct in IUPAC system? [CBSE AIPMT 2005]



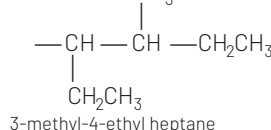
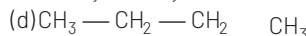
3-methyl 2-butanol



4-methyl-2-pentyne

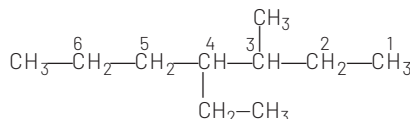


2-ethyl-3-methylbut-1-ene



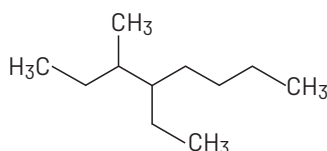
3-methyl-4-ethyl heptane

Ans. (d)



Correct IUPAC name is 4-ethyl-3-methyl heptane.

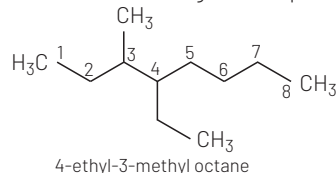
11 Name of the compound given below [CBSE AIPMT 2003]



- (a) 2, 3-diethylheptane
 (b) 5-ethyl-6-methyloctane
 (c) 4-ethyl-3-methyloctane
 (d) 3-methyl-4-ethyloctane

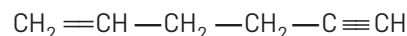
Ans. (c)

The IUPAC name of the given compound is



4-ethyl-3-methyl octane

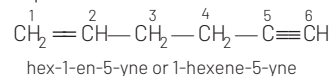
12 IUPAC name of the following is [CBSE AIPMT 2002]



- (a) 1, 5-hexenyne (b) 1-hexene-5-yne
 (c) 1-hexyne-5-ene (d) 1, 5-hexynene

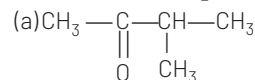
Ans. (b)

The double bond gets more priority over triple bond. So, the IUPAC name of compound is

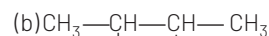


hex-1-en-5-yne or 1-hexene-5-yne

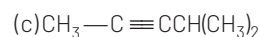
13 The incorrect IUPAC name is [CBSE AIPMT 2001]



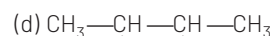
2-methyl-3-butanone



2, 3-dimethyl pentane

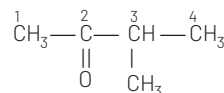


4-methyl-2-pentyne



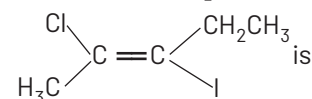
2-bromo-3-chloro butane

Ans. (a)



Correct name is 3-methyl-2-butanone.

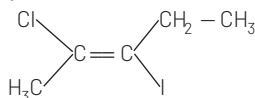
14 IUPAC name of the compound [CBSE AIPMT 1998]



- (a) trans-3-iodo-4-chloro-3-pentene
 (b) cis-2-chloro-3-iodo-2-pentene

- (c) *trans*-2-chloro-3-iodo-2-pentene
(d) *cis*-3-iodo-4-chloro-3-pentene

Ans. (c)



In this compound groups preferential order is

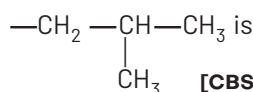
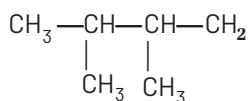
—Cl > —CH₃ and —I > —CH₂—CH₃

Hence, more preferential order containing groups are attached at opposite sides. So, it is *E* (*trans*)-isomer.

Thus, its name is

trans-2-chloro-3-iodo-2-pentene.

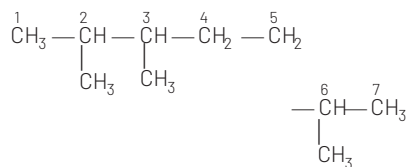
15 The IUPAC name of



[CBSE AIPMT 1996]

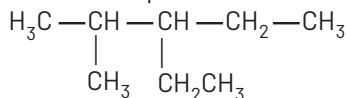
- (a) 1,3-isopropyl-3-methyl propane
(b) 2,3,6-trimethyl heptane
(c) 2,5,6-trimethyl heptane
(d) 2,6,3-trimethyl heptane

Ans. (b)



Its IUPAC name is 2, 3, 6-trimethyl heptane.

16 For the compound

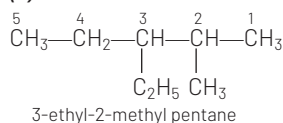


which of the following IUPAC names is correct?

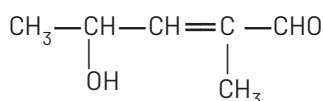
[CBSE AIPMT 1994]

- (a) 2-methyl-3-ethyl pentane
(b) 3-ethyl-2-methyl pentane
(c) 2-ethyl-3-methyl pentane
(d) 3-methyl-2-ethyl pentane

Ans. (b)



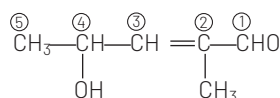
17 The IUPAC name of



[CBSE AIPMT 1992]

- (a) 4-hydroxy-1-methyl pentanal
(b) 4-hydroxy-2-methyl pent-2-en-1-al
(c) 2-hydroxy-4-methyl pent-3-en-5-al
(d) 2-hydroxy-3-methyl pent-2-en-5-al

Ans. (b)



4-hydroxy -2-methyl pent -2-en-1-al

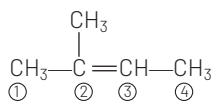
18 2-methyl-2-butene will be

represented as **[CBSE AIPMT 1992]**

- (a) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{CH} - \text{CH}_2\text{CH}_3 \end{array}$
(b) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} = \text{CH} - \text{CH}_3 \end{array}$
(c) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{CH}_2 - \text{C} = \text{CH}_2 \end{array}$
(d) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{CH} - \text{CH} = \text{CH}_2 \end{array}$

Ans. (b)

The structure of 2-methyl-2-butene is



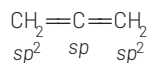
19 Which of the following possesses a *sp*-carbon in its structure?

[CBSE AIPMT 1989]

- (a) CH₂=CCl—CH=CH₂
(b) CCl₂=CCl₂
(c) CH₂=C=CH₂
(d) CH₂=CH—CH=CH₂

Ans. (c)

In structure CH₂=C=CH₂, the middle carbon is attached with two π -bonds, so it have *sp* hybridisation.



Also, called allenes.

TOPIC 2 Isomerism

20 Identify the compound that will react with Hinsberg's reagent to give a solid which dissolves in alkali.

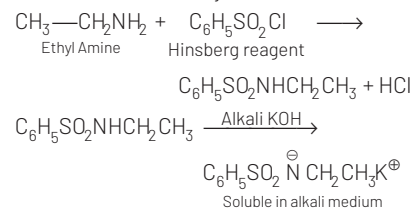
[NEET 2021]

- (a) $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}_3 - \text{CH}_2 - \text{N} \text{O}_2 \end{array}$
(b) $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}_3 - \text{CH}_2 - \text{N} \text{H} - \text{CH}_3 \end{array}$
(c) $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}_3 - \text{CH}_2 - \text{N} \text{H}_2 \end{array}$
(d) $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}_3 - \text{CH}_2 - \text{N} \text{CH}_2\text{CH}_3 \end{array}$

Ans. (c)

Hinsberg test is used to test the amine compounds. Only 1° and 2° amines give product after reacting with Hinsberg reagent (benzene sulphonyl chloride). 3° amines do not react.

The product formed can be distinguished by dissolving in alkali. If it dissolves, then amine is 1° otherwise the reactant is secondary amine.



21 With respect to the conformers of ethane, which of the following statements is true?

- (a) Bond angle remains same but bond length changes **[NEET 2017]**
(b) Bond angle changes but bond length remains same
(c) Both bond angle and bond length change
(d) Both bond angles and bond length remain same

Ans. (d)

Isomers which are possible by rotation about single bonds without cleavage of any bond are called conformers. In ethane, an infinite number of conformations are possible. There are two extreme forms, the staggered conformation, which is the most stable

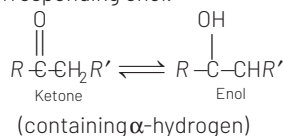
and the eclipsed conformation which is least stable. Among the conformers of ethane, bond angle and bond length remains same while their energy, stability and dihedral angle are different.

- 22** The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is [NEET 2016, Phase I]

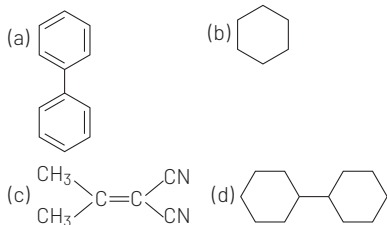
- a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration
- a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation
- a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism
- a carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol

Ans. (c)

In keto-enol tautomerism, a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol.

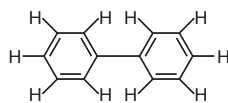


- 23** In which of the following molecules, all atoms are coplanar? [NEET 2016, Phase II]



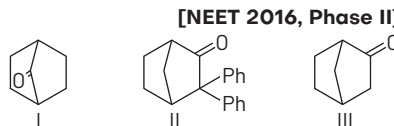
Ans. (a)

The molecule in which all the carbon atoms are sp^2 -hybridised will be coplanar. Thus, in option (a) i.e.



all carbons are sp^2 -hybridised.

- 24** Which among the given molecules can exhibit tautomerism? [NEET 2016, Phase II]

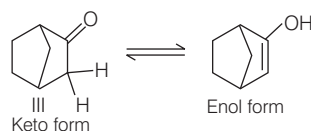


- III Only
- Both I and III
- Both I and II
- Both II and III

Ans. (a)

In tautomerism, α -hydrogen must be present in the molecule. Thus, molecule II will not show tautomerism. As at bridge, double bond is highly unstable. Thus, molecule I will also not show tautomerism.

For III molecule,

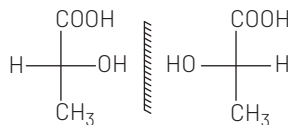


So only, III molecule will show tautomerism. Thus, correct option is (a).

- 25** Two possible stereo-structures of $\text{CH}_3\text{CHOH}\cdot\text{COOH}$, which are optically active, are called [CBSE AIPMT 2015]

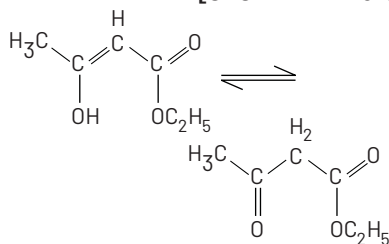
- diastereomers
- atropisomers
- enantiomers
- mesomers

Ans. (c)



Both are enantiomers.

- 26** The enolic form of ethyl acetoacetate as below has [CBSE AIPMT 2015]

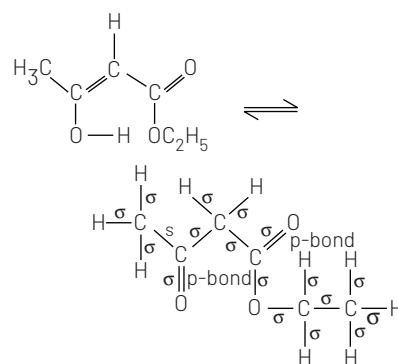


- 18 sigma bonds and 2 pi-bonds
- 16 sigma bonds and 1 pi-bond
- 9 sigma bonds and 2 pi-bonds
- 9 sigma bonds and 1 pi-bond

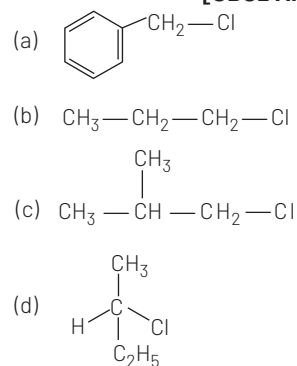
Ans. (a)

The enolic form of ethyl acetoacetate has 16 single bonds i.e. 16 σ -bonds and 2 double bonds i.e. 2 σ -bonds and 2 π -bonds.

Hence, the given structure has 18 σ -bonds and 2 π -bonds.



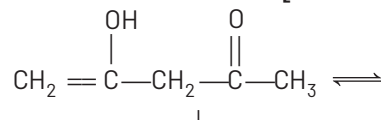
- 27** Which of the following compounds will undergoes racemisation when solution of KOH hydrolysis? [CBSE AIPMT 2014]

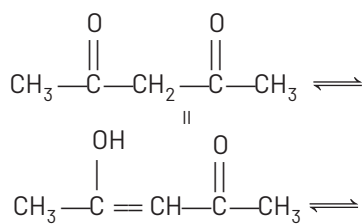


Ans. (c)

Option (c) is most probable answer. Out of compound (c) or (d), the (d) results in formation of racemic product due to chirality. Compound (c) although not chiral but can form racemic product. After removal of Cl^- gives a carbocation which in turn undergo racemisation after rearrangement.

- 28** The order of stability of the following tautomeric compound is [NEET 2013]

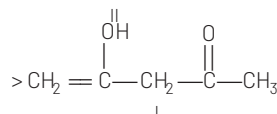
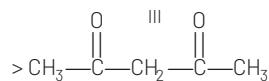
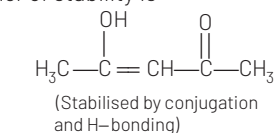




- (a) I > II > III (b) III > II > I
(c) II > I > III (d) II > III > I

Ans. (b)

The enols of β -dicarbonyl compounds are more stable because of conjugation and intramolecular H-bonding. Thus, the order of stability is



Less stable as (=) bond is not in conjugation with carbonyl group

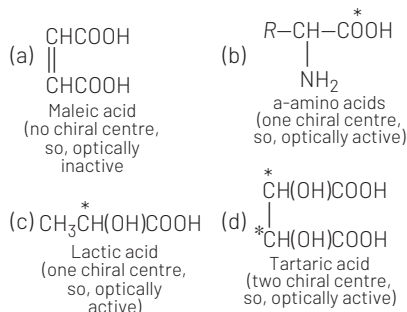
29 Which of the following acid does not exhibit optical isomerism?

[CBSE AIPMT 2012]

- (a) Maleic acid (b) α -amino acid
(c) Lactic acid (d) Tartaric acid

Ans. (a)

Only those compounds exhibit optical isomerism, which have chiral centre and/or absence of symmetrical elements. (Chiral carbon is the carbon in which all the four valencies are satisfied by four different groups.)



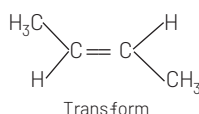
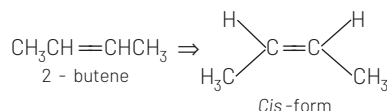
Thus, maleic acid does not exhibit optical isomerism.

NOTE If $R = \text{H}$, the α -amino acid is achiral.

30 Which of the following compounds will exhibit *cis-trans* (geometrical) isomerism? [CBSE AIPMT 2009]

- (a) 2-butene (b) Butanol
(c) 2-butyne (d) 2-butenol

Ans. (a)



$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \Rightarrow$ no geometrical isomers
Butanol

$\text{CH}_3\text{C}\equiv\text{CCH}_3 \Rightarrow$ no geometrical isomers

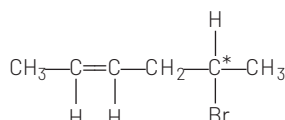
$\text{CH}_3\text{CH}_2\text{C}(\text{OH})=\text{CH}_2 \Rightarrow$ no geometrical isomers.

31 How many stereoisomers does this molecule have? [CBSE AIPMT 2008]



- (a) 4 (b) 6
(c) 8 (d) 2

Ans. (a)



C^* = asymmetric carbon

Number of optical isomers = 2^n

where, n = number of asymmetric carbon atoms = $2^1 = 2$

Number of geometrical isomers = 2^n

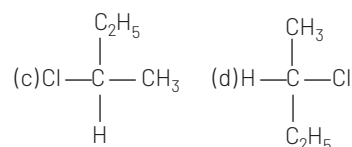
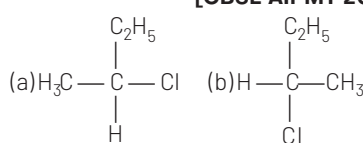
where, n = number of double bonds = $2^1 = 2$

Hence, total number of stereoisomers =

Total optical isomers + Total geometrical isomers

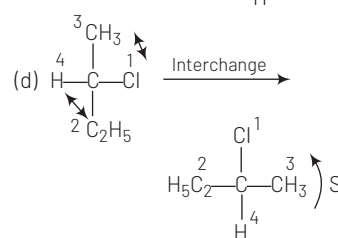
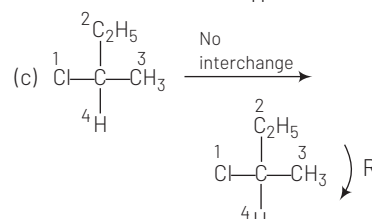
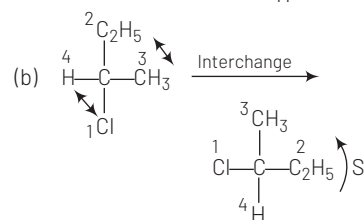
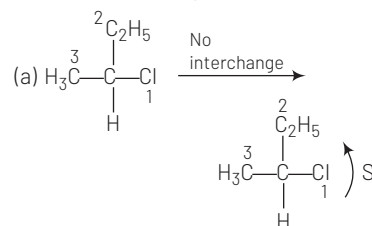
$$= 2 + 2 = 4$$

32 $\text{CH}_3-\text{CHCl}-\text{CH}_2-\text{CH}_3$ has a chiral centre. Which one of the following represents its R-configuration? [CBSE AIPMT 2007]



Ans. (c)

$\text{CH}_3-\text{CHCl}-\text{CH}_2-\text{CH}_3$, Priority order is $-\text{Cl} > -\text{C}_2\text{H}_5 > -\text{CH}_3 > -\text{H}$



33 If there is no rotation of plane polarised light by a compound in a specific solvent, though to be chiral, it may mean that

[CBSE AIPMT 2007]

- (a) the compound is certainly a chiral
(b) the compound is certainly meso
(c) there is no compound in the solvent
(d) the compound may be a racemic mixture

Ans. (b)

The compounds in which asymmetric carbon atom is present, are called optically active, they rotate the plane polarised light but the compounds which

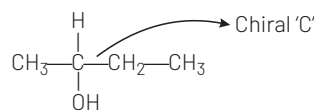
do not show optical activity inspite of the presence of chiral carbon atoms are called *meso*-compounds. The absence of optical activity in these compounds is due to the presence of plane of symmetry in the molecule.

34 Which of the following is not chiral?
[CBSE AIPMT 2006]

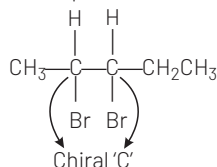
- (a) 2-butanol
(b) 2, 3-dibromo pentane
(c) 3-bromo pentane
(d) 2-hydroxy propanoic acid

Ans. (c)

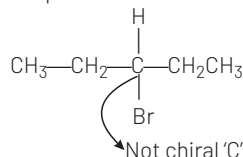
(a) 2-butanol



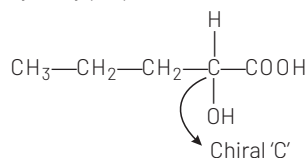
(b) 2,3-dibromo pentane



(c) 3-bromo pentane

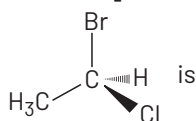


(d) 2-hydroxy propanoic acid



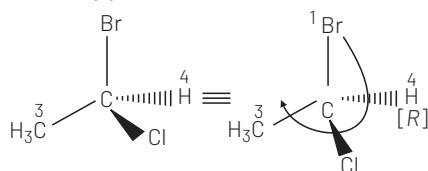
Hence, 3-bromopentane is not a chiral molecule due to absence of chiral C-atom.

35 The chirality of the compound
[CBSE AIPMT 2005]



- (a) R (b) S (c) Z (d) E

Ans. (a)



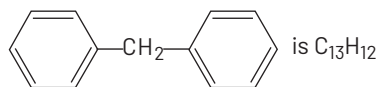
36 Which one of the following pairs represents stereoisomerism?
[CBSE AIPMT 2005]

- (a) Chain isomerism and rotational isomerism
(b) Structural isomerism and geometrical isomerism
(c) Linkage isomerism and geometrical isomerism
(d) Optical isomerism and geometrical isomerism

Ans. (d)

Pair of optical isomerism and geometrical isomerism are able to exhibit the phenomenon of stereoisomerism because both type of isomers differ only in their orientation in space.

37 The molecular formula of diphenyl methane



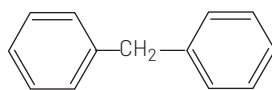
is $C_{13}H_{12}$

How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom?
[CBSE AIPMT 2004]

- (a) 6 (b) 4
(c) 8 (d) 7

Ans. (b)

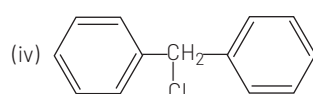
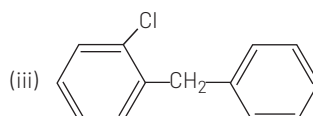
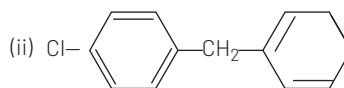
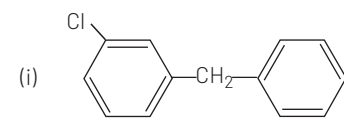
The molecular formula of diphenyl methane shows four isomers in form of mono chloro derivatives.



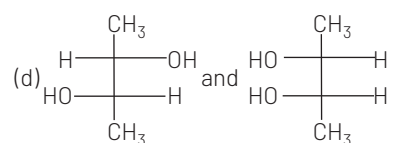
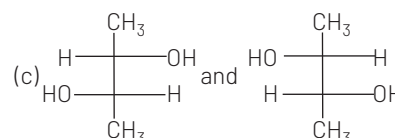
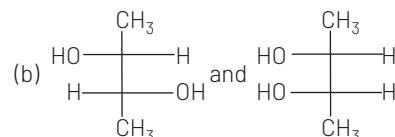
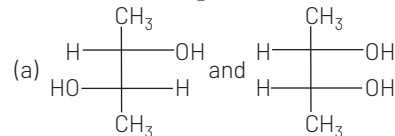
(diphenyl methane)

$C_{13}H_{12}$

Monochloro derivatives

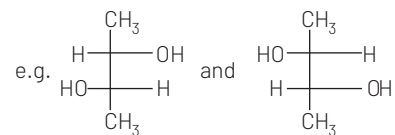


38 Which of the following pair of compounds are enantiomers?
[CBSE AIPMT 2003]



Ans. (c)

Enantiomers are mirror images of each other but they are not superimposable on each other.

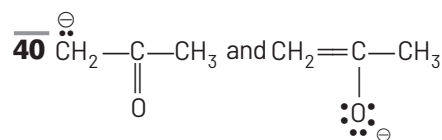


39 Geometrical isomers differ in
[CBSE AIPMT 2002]

- (a) position of functional group
(b) position of atoms
(c) spatial arrangement of atoms
(d) length of carbon chain

Ans. (c)

Geometrical isomers The isomers having same molecular formula but differ in the position of atoms or groups in space due to hindered rotation about a double bond.

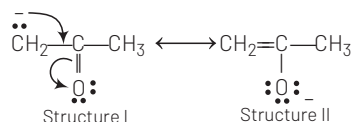


are

[CBSE AIPMT 2002]

- (a) resonating structures
(b) tautomers
(c) geometrical isomers
(d) optical isomers

Ans. (a)



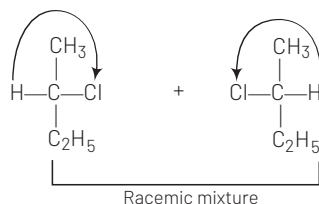
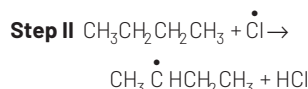
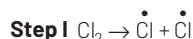
Structure I and structure II are the resonating forms because the position of atoms remains the same and only redistribution of electrons take place.

- 41** $\text{CH}_3 - \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \text{CH}_3$ obtained by chlorination of *n*-butane, will be
[CBSE AIPMT 2001]

- (a) *meso* form
(b) racemic mixture
(c) *d*-form
(d) *l*-form

Ans. (b)

Chlorination of *n*-butane takes place by free radical mechanism as follows:

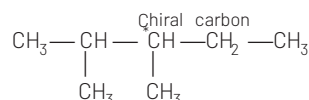


- 42** A compound of molecular formula C_7H_{16} shows optical isomerism, compound will be
[CBSE AIPMT 2001]

- (a) 2, 3-dimethyl pentane
(b) 2, 2-dimethyl butane
(c) 2-methyl hexane
(d) None of the above

Ans. (b)

2,3-dimethylpentane



shows the property of optical isomerism due to presence of an asymmetric C-atom.

- 43** The (*R*)- and (*S*)- enantiomers of an optically active compound differ in
[CBSE AIPMT 2000]

- (a) their solubility in a chiral solvent
(b) their reactivity with a chiral reagent
(c) their optical rotation of plane polarised light
(d) their melting points

Ans. (c)

R and *S* forms of an optically active compound differ in their behaviour towards plane polarised light. The species which rotate the plane polarised light towards right is called *R*-form (*rectus* form) or *d*-form (*dextro*-form) and the species which rotate the plane polarised light towards left is known as *S*-form (*sinister*-form) or *l*-form (*laevo*-form).

- 44** But-2-ene exhibits *cis-trans*-isomerism due to
[CBSE AIPMT 2000]

- (a) rotation around $\text{C}_2 - \text{C}_3$ double bond
(b) rotation around $\text{C}_3 - \text{C}_4$ sigma bond
(c) rotation around $\text{C}_1 - \text{C}_2$ bond
(d) restricted rotation around $\text{C} = \text{C}$ bond

Ans. (d)

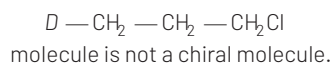
Due to presence of $>\text{C} = \text{C} <$ in but-2-ene, it shows restricted rotation. Hence, give two types of arrangements around the space of $>\text{C} = \text{C} <$ as *cis* and *trans*-forms.

- 45** Which of the following compounds is not chiral ? [CBSE AIPMT 1998]

- (a) $\text{DCH}_2\text{CH}_2\text{CH}_2\text{Cl}$ (b) $\text{CH}_3\text{CH}_2\text{CHDCl}$
(c) $\text{CH}_3\text{CHDCH}_2\text{Cl}$ (d) $\text{CH}_3\text{CHClCH}_2\text{D}$

Ans. (a)

Chiral carbon is that carbon whose all the four valencies are satisfied by four different groups. Due to absence of asymmetric (chiral) C-atom

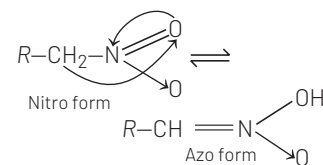


- 46** Tautomerism will be exhibited by
[CBSE AIPMT 1997]

- (a) $(\text{CH}_3)_3\text{CNO}$ (b) $(\text{CH}_3)_2\text{NH}$
(c) R_3CNO_2 (d) RCH_2NO_2

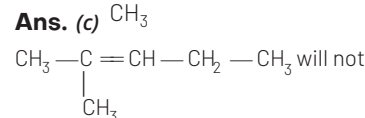
Ans. (d)

It is due to the presence of α -hydrogen atom in $-\text{NO}_2$ and $-\text{NO}$ compounds.



- 47** Which of the following will not show *cis-trans*-isomerism?
[CBSE AIPMT 1996]

- (a) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$
(b) $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$
(c) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} = \text{CH} - \text{CH}_2 - \text{CH}_3$
(d) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$



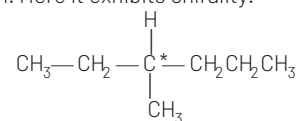
show *cis-trans* isomerism because double bonded carbon atom have two same groups ($-\text{CH}_3$, methyl group).

- 48** Which of the following will exhibit chirality?
[CBSE AIPMT 1996]

- (a) 2-methyl hexane
(b) 3-methyl hexane
(c) Neopentane
(d) Isopentane

Ans. (b)

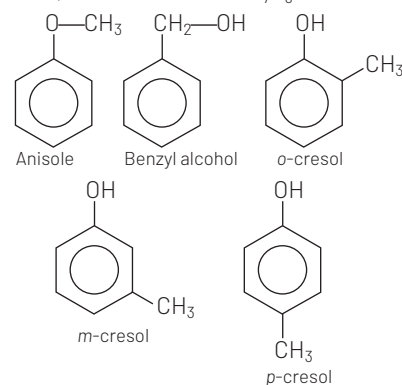
3-methyl hexane contains chiral carbon atom. Here it exhibits chirality.



- 49** The number of possible isomers of the compound with molecular formula $\text{C}_7\text{H}_8\text{O}$ is [CBSE AIPMT 1995]
(a) 3 (b) 5 (c) 7 (d) 9

Ans. (b)

The possible isomers of $\text{C}_7\text{H}_8\text{O}$ are



50 The process of separation of a racemic modification into *d* and *l*-enantiomers is called

[CBSE AIPMT 1994]

- (a) resolution (b) dehydration
(c) revolution
(d) dehydrohalogenation

Ans. (a)

The process of separation of a racemic mixture into *d*- or *l*-forms (enantiomers) is called resolution. The racemic mixture of enantiomers is resolved by treating with an enantiomers of some chiral compound. The products are diastereomers which can be separated by usual methods such as recrystallisation, chromatography, etc.

51 The most important chemical method to resolve a racemic mixture makes use of the formation of

[CBSE AIPMT 1994]

- (a) a *meso*-compound
(b) enantiomers
(c) diastereomers
(d) racemates

Ans. (c)

Diastereomers have different physical properties such as melting point, boiling point, solubilities in a given solvent, densities, refractive index, etc. Because of the differences in the boiling points and the solubilities, they can be separated by fractional distillation and fractional crystallisation.

52 Isomers of a substance must have the same

[CBSE AIPMT 1991]

- (a) structural formula
(b) physical properties
(c) chemical properties
(d) molecular formula

Ans. (d)

Two or more compounds having the same molecular formula but different physical, chemical properties and structural formula are called isomers.

53 Which one of the following can exhibit *cis-trans*-isomerism?

[CBSE AIPMT 1989]

- (a) $\text{CH}_3 - \text{CHCl} - \text{COOH}$
(b) $\text{H} - \text{C} \equiv \text{C} - \text{Cl}$
(c) $\text{Cl} - \text{CH} = \text{CHCl}$
(d) $\text{ClCH}_2 - \text{CH}_2\text{Cl}$

Ans. (c)

The main conditions for geometrical isomerism are

- (i) The molecule must have a double bond and the double bond should have restricted rotation
(ii) The two atoms or groups attached to the same carbon atom must be different.

These two conditions are only obeyed by $\text{Cl} - \text{CH} = \text{CH} - \text{Cl}$, so it shows geometrical isomerism.

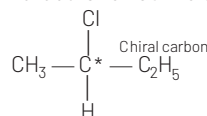
54 Which of the following is an optically active compound?

[CBSE AIPMT 1988]

- (a) 1-butanol
(b) 1-propanol
(c) 2-chlorobutane
(d) 4-hydroxybutanal

Ans. (c)

2-chlorobutane has the structure



It is optically active due to the presence of asymmetric carbon atom (C^*).

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

[CBSE AIPMT 1988]

- (a) Four
(b) Five
(c) Six
(d) Seven

Ans. (b)

Hexane (C_6H_{14}) has five chain isomers and these are

- (i) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
(ii) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$
(iii) $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3$
(iv) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$
(v) $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_3$

TOPIC 3

Bond Fission and Electric Displacement

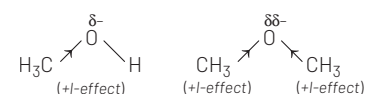
56 The compound that is most difficult to protonate is

[NEET (National) 2019]

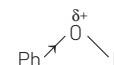
- (a) $\text{H}_3\text{C} - \text{O} - \text{H}$ (b) $\text{H}_3\text{C} - \text{O} - \text{CH}_3$
(c) $\text{Ph} - \text{O} - \text{H}$ (d) $\text{H} - \text{O} - \text{H}$

Ans. (c)

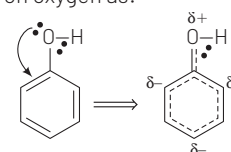
In CH_3OH and CH_3OCH_3 , $-\text{CH}_3$ group shows +I-effect due to which oxygen acquires partial negative charge in both the compounds.



On the other hand in $\text{Ph}-\text{OH}$, $-\text{Ph}$ shows $-I$ effect due to which oxygen acquires partial positive charge.



Along with, the lone pair of oxygen also shows conjugation with benzene ring which further increases the positive charge on oxygen as:



Thus, further decreasing the process of protonation.

Therefore, incoming proton will not be able to attack easily on partial positive 'O' atom. Hence, phenol is most difficult to protonate. Thus, option (c) is correct.

57 Which of the following is correct with respect to $-I$ effect of the substituents? ($R = \text{alkyl}$) [NEET 2018]

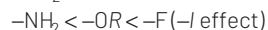
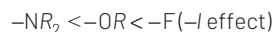
- (a) $-\text{NH}_2 > -\text{OR} > -\text{F}$
(b) $-\text{NR}_2 < -\text{OR} < -\text{F}$
(c) $-\text{NH}_2 < -\text{OR} < -\text{F}$
(d) $-\text{NH}_2 > -\text{OR} > -\text{F}$

Ans. (b, c)

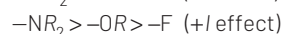
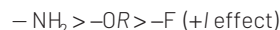
$-I$ effect is related to the ability of substituent for the electron attraction capacity from the attached carbon atom.

i.e. It is based on electronegativity of an atom. This effect increases with increase in the electronegativity of an atom.

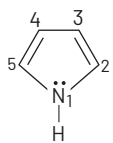
From above we can conclude that options (b) and (c) are correct.



Also, options (a) and (d) shows the order of +I effect.



58 In pyrrole



the electron density is maximum on **[NEET 2016, Phase II]**

(a) 2 and 3

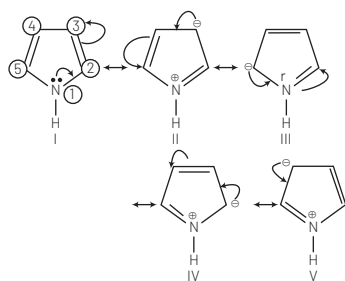
(b) 3 and 4

(c) 2 and 4

(d) 2 and 5

Ans. (d)

The conjugation (delocalisation) of electrons in pyrrole can be visualised as



As resonating structures III and IV are more stable than II and V. Thus, maximum electron density will be found on carbon 2 and 5.

59 The pair of electron in the given carbanion, $CH_3C \equiv C^-$, is present in which orbitals?

[NEET 2016, Phase I]

(a) sp^3

(b) sp^2

(c) sp

(d) $2p$

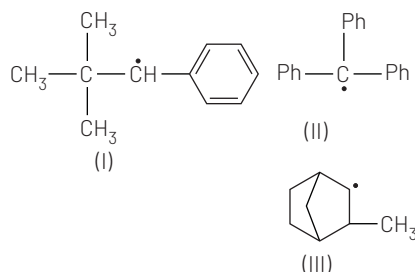
Ans. (c)

$$\begin{aligned} \text{Hybridisation} &= \frac{\text{Number of } \sigma \text{-electrons}}{2} \\ &= \frac{2 + 2(\text{negative ion})}{2} \\ &= 2 = sp \end{aligned}$$

Hence, in the carbanion, $CH_3C \equiv C^-$, pair of electron as (–)ve charge is present in sp -hybridised-orbital.

60 Consider the following compounds

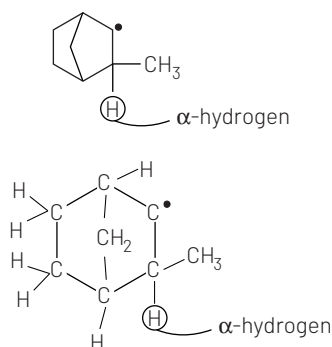
[CBSE AIPMT 2015]



Ans. (c)

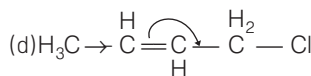
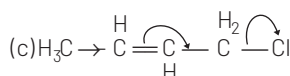
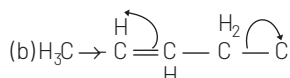
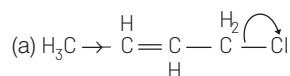
Hyperconjugation occurs through the H-atoms present on the carbon atom next to the double bond i.e. α -hydrogen atoms.

There is no α -H in the structures I and II. So, hyperconjugation occurs in structure III only i.e.



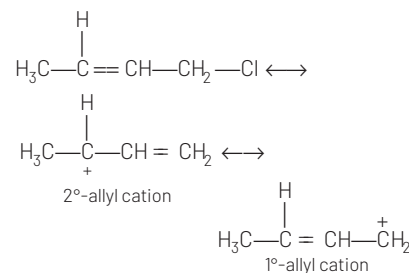
61 Which of the following is the most correct electron displacement for a nucleophilic reaction to take place?

[CBSE AIPMT 2015]



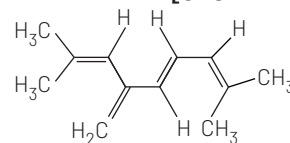
Ans. (d)

Allylic and benzylic halides show high reactivity towards S_N1 reaction. Further, due to greater stabilisation of allyl and benzyl carbocations intermediates by resonance, primary allylic and primary benzylic halides show higher reactivity in S_N1 reactions than other simple primary halides.



Hence, it undergoes nucleophilic reaction readily.

62 The total number of π -bond electrons in the following structure is **[CBSE AIPMT 2015]**



(a) 4

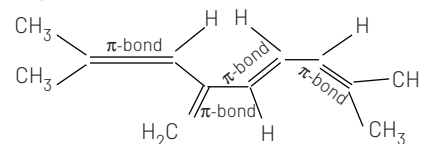
(b) 8

(c) 12

(d) 16

Ans. (b)

In a given structure there are 4 π -bonds. Hence, total number of π -electrons are 8.



63 The correct order of decreasing acidic strength of trichloroacetic acid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D) is **[CBSE AIPMT 2012]**

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

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

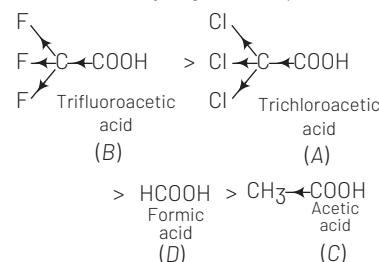
(c) $A > B > C > D$

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

Ans. (a)

If an electron withdrawing group (–I-showing group) is present, e.g. CF_3 has more (–I-effect) withdrawing power than CCl_3 , it makes the removal of proton more easy by stabilising the remaining carboxylate ion and thus, makes the acid more acidic.


The order of acidity of given compounds is

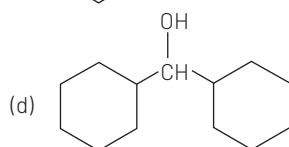
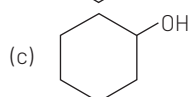
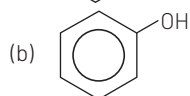


(a) $C-C < C \equiv C < C-O < C-H$
 (b) $C-O < C-H < C-C < C \equiv C$
 (c) $C-H < C-O < C-C < C \equiv C$
 (d) $C-H < C \equiv C < C-O < C-C$


C—H : 0.109 nm
C=C : 0.134 nm
C—O : 0.143 nm
C—C : 0.154 nm

$$C-H < C=C < C-O < C-C$$

(a) 



Key Idea Presence of electron withdrawing substituent increases the acidity while electron releasing substituent, decreases the acidity. Phenyl is an electron withdrawing substituent while —CH_3 is an electron releasing substituent. Moreover, phenoxide ion is more resonance stabilised as compared to benzyloxide ion, thus releases proton more easily. That's why phenol is a strong acid among the given compounds.

(i) $RC\equiv C^-$ (ii) 

(iii) $R_2C=CH^-$ (iv) $R_3C-\overset{\ominus}{\underset{|}{\text{C}}H_2}$

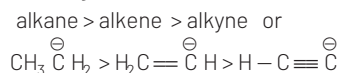
[CBSE AIPMT 2008]

$$RC\equiv\overset{\ominus}{C} > C_6H_5\overset{\ominus}{C} > R_2C=\overset{\ominus}{CH} > R_3C-\overset{\ominus}{CH_2}$$
$$(i) \text{H}_3\text{C}\overset{\ominus}{\text{C}}\text{H}_2$$
$$(ii) \text{H}_2\text{C}=\overset{\ominus}{\text{C}}\text{H}$$

(iii) $\text{H}-\text{C}\equiv\text{C}^{\ominus}$

(a) (ii) > (i) > (iii) (b) (iii) > (ii) > (i)
(c) (i) > (iii) > (ii) (d) (i) > (ii) > (iii)

Weaker the acid, stronger is its conjugate base. Among alkane, alkene and alkyne, alkynes are most acidic and alkanes are least acidic, so the order of base strength is



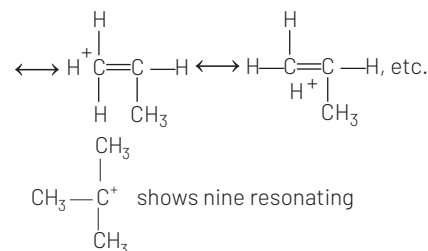
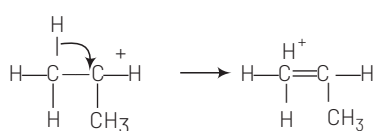
(a) $\text{CH}_3 - \overset{+}{\underset{\text{CH}_3}{\text{C}}} - \text{H}$ (b) $\text{CH}_3 - \overset{+}{\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}}} - \text{H}$

$$(c) \dot{C}H_3^+$$

The most stable carbocation is t-alkyl carbocation. The order of stability of alkyl carbocation is

ter-alkyl>sec-alkyl> *pri*-alkyl > CH₃⁺
carbocation. This stability order is described with the help of hyperconjugation and inductive effect. On the basis of hyperconjugation,

$(\text{CH}_3)_2\text{CH}^+$ shows six resonating structures due to the presence of six $\alpha\text{-C}-\text{H}$ bonds.



Greater the α H-atom greater will be the hyper conjugation resonating structure and therefore, greater will be the stability.

CH_3^+ does not show the property of

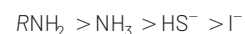
resonance while $\text{CH}_3-\overset{+}{\text{C}}\text{H}_2$ shows three resonating structures due to presence of three $\alpha\text{-C}-\text{H}$ bonds. Hence, larger number of resonating structures are possible in (b), so it is most stable. The above order of stability is also explained with the help of (+) *I*-effect of $-\text{CH}_3$ group. More the number of $-\text{CH}_3$ group more will be tendency to displace the electrons towards positively charged carbon of carbocation. Thus, positive charge is decreased or compensated and stability of carbocation is increased.

(a) $I^- > NH_3 > RNH_2 > HS^-$
 (b) $NH_3 > RNH_2 > HS^- > I^-$
 (c) $RNH_2 > NH_3 > HS^- > I^-$
 (d) $HS^- > RNH_2 > NH_3 > I^-$

Basic strength \propto rate of accepting a proton.

In $R-\ddot{N}H_2$, N— has lone pair of

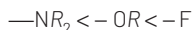
electron which increases the intensity due to electron releasing *R*-group and increases the tendency to donate lone pair of electrons to H^+ . Secondly as the size of the ion increases, there is less attraction for H^+ and form weaker bond with H -atom and less basic. The order of the given series is



(a) $-NR_2 < -OR > -F$
 (b) $-NR_2 > -OR > -F$
 (c) $-NR_2 < -OR < -F$
 (d) $-NR_2 > -OR < -F$

Ans. (c)

The electronegativity follows the order $N < O < F$. So, due to electronegative character the order of $-I$ -effect is



71 Correct the increasing order of acidity is as [CBSE AIPMT 1994]

- (a) H_2O, C_2H_2, H_2CO_3 , phenol
 (b) C_2H_2, H_2O, H_2CO_3 , phenol
 (c) Phenol, C_2H_2, H_2CO_3, H_2O
 (d) C_2H_2, H_2O , phenol and H_2CO_3

Ans. (d)

C_2H_2 have acidic nature but it is less acidic than water. Phenol is more acidic than water due to resonance stabilisation of phenoxide ion. H_2CO_3 is most acidic due to resonating stabilisation of carbonate ion (CO_3^{2-}).

Thus, the correct order is



TOPIC 4 Reaction Intermediates

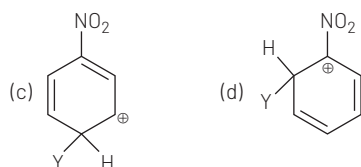
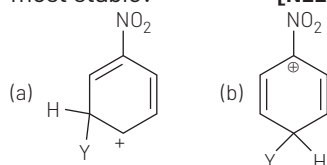
72 The most stable carbocation, among the following is [NEET (Odisha) 2019]

- (a) $(CH_3)_3C-\overset{+}{C}H-CH_3$
 (b) $CH_3-CH_2-\overset{+}{C}H-CH_2-CH_3$
 (c) $CH_3-\overset{+}{C}H-CH_2-CH_2-CH_3$
 (d) $CH_3-CH_2-\overset{+}{C}H_2$

Ans. (c)

$CH_3\overset{+}{C}HCH_2CH_2CH_3$ is the most stable carbocation among the given carbocations. It is because the number of α -H atom attached to carbocation is maximum in $CH_3\overset{+}{C}HCH_2CH_2CH_3$. Thus, it has maximum number of hyperconjugating structure hence, it is most stable.

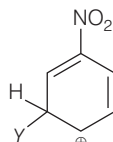
73 Which of the following carbocations is expected to be most stable? [NEET 2018]



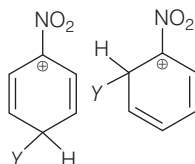
Ans. (a)

$-NO_2$ group is an electron withdrawing group and exhibit $-I$ effect. This effect increases with decrease in distance of positive charge present on C-atom and hence lesser is the stability of carbocation.

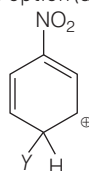
In option (a), the positive charge is at maximum distance to NO_2 group, so $-I$ effect due to NO_2 group will be minimum and stability will be maximum.



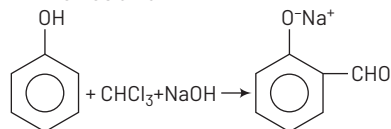
In option (b) and (d) the positive charges is at minimum distance to NO_2 group hence the stability will be minimum.



Also, in option (c) the distance of positive charge to NO_2 group is more than *ortho* but less than *para*, so it will be less stable as compared to option (a).



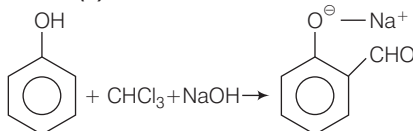
74 In the reaction



the electrophile involved is [NEET 2018]

- (a) dichloromethyl anion ($\ddot{C}HCl_2$)
 (b) formyl cation ($\overset{+}{C}HO$)
 (c) dichloromethyl cation ($\overset{+}{C}HCl_2$)
 (d) dichlorocarbene ($\ddot{C}Cl_2$)

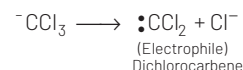
Ans. (d)



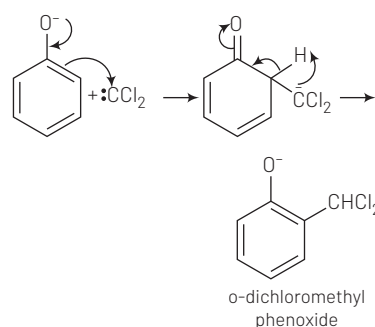
The above given reaction is known as Reimer-Tiemann reaction. In this reaction, electrophile involved is dichlorocarbene ($\ddot{C}Cl_2$) which is formed in the 1st step of mechanism. It is given as follows :

Mechanism

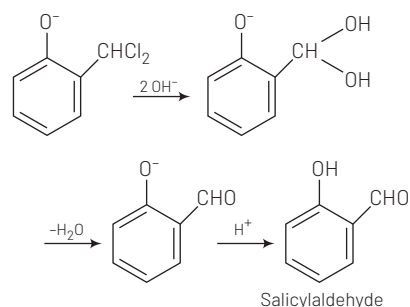
Step I Generation of electrophile
 $CHCl_3 + OH^- \rightleftharpoons \overset{-}{C}Cl_3 + H_2O$



Step II Reaction of electrophile with phenoxide



Step III Hydrolysis



75 The correct statement regarding electrophile is [NEET 2017]

- (a) Electrophile is a negatively charge species and can form a bond by accepting a pair of electrons from a nucleophile
 (b) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
 (c) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile
 (d) Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile

Ans. (d)

An electrophile is defined as electron deficient species which attacks on electron rich areas. Being electron deficient, the electrophile behaves as Lewis acids.

e.g. H^+ , Cl^+ , Br^+ , NO_2^+ , NO^+ etc.

The electrophiles can be seen in the form of neutral molecules also

e.g. CR_2 , NR , BF_3 etc.

Thus, we can say that electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile.

76 Which of the following statements is not correct for a nucleophile? **[CBSE AIPMT 2015]**

- (a) Nucleophile is a Lewis acid
- (b) Ammonia is a nucleophile
- (c) Nucleophiles attack low electron density sites
- (d) Nucleophiles are not electron seeking

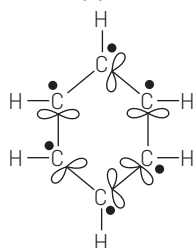
Ans. (a)

Nucleophiles are electron rich species. Hence, act as a Lewis base but not Lewis acid.

77 The radical $\text{C}_6\text{H}_5\dot{\text{C}}\text{H}_2$ is aromatic because it has **[NEET 2013]**

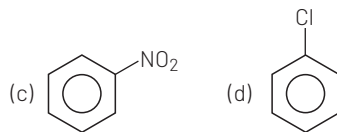
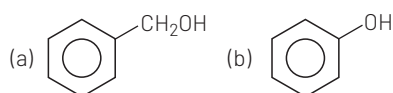
- (a) 6p-orbitals and 6 unpaired electrons
- (b) 7p-orbitals and 6 unpaired electrons
- (c) 7p-orbitals and 7 unpaired electrons
- (d) 6p-orbitals and 7 unpaired electrons

Ans. (a)



Because of the presence of 6p-orbitals and 6 unpaired electrons, it is aromatic in nature as these unpaired electrons delocalise in p-orbitals.

78 Which one of the following is most reactive towards electrophilic attack? **[CBSE AIPMT 2008]**



Ans. (b)

The group showing electron-donating effect (such as $-\text{NH}_2$, $-\text{OH}$) should stabilise the intermediate ions, i.e. makes the ring more reactive towards electrophilic substitution than benzene and are called activating group while electron withdrawing group (such as $-\text{Cl}$, NO_2) increases the positive charge on ring, thus deactivates the ring. Hence, phenol is more readily attacked by an electrophile and is most reactive towards an electrophile.

79 The order of decreasing reactivity towards an electrophilic reagent, for the following

- (i) Benzene
- (ii) Toluene
- (iii) Chlorobenzene
- (iv) Phenol

would be **[CBSE AIPMT 2007]**

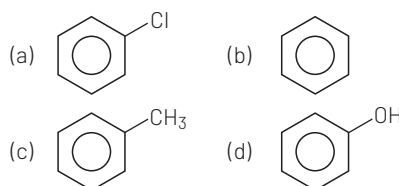
- (a) (i) > (ii) > (iii) > (iv)
- (b) (ii) > (iv) > (i) > (iii)
- (c) (iv) > (iii) > (ii) > (i)
- (d) (iv) > (ii) > (i) > (iii)

Ans. (d)

Benzene having any activating group, i.e. OH , R , etc, undergoes electrophilic substitution very easily as compared to benzene itself. Thus, toluene ($\text{C}_6\text{H}_5\text{CH}_3$), phenol ($\text{C}_6\text{H}_5\text{OH}$) undergo electrophilic substitution very readily than benzene. Chlorine with +E and +M-effect deactivates the ring due to strong -I-effect. So, it is difficult to carry out the substitution in chlorobenzene than in benzene, so the correct order is

Phenol > Toluene > Benzene
(iv) (ii) (i)
> Chlorobenzene (iii)

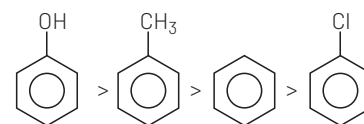
80 Which one of the following compounds will be most easily attacked by an electrophile? **[CBSE AIPMT 99, 1998]**



Ans. (d)

$-\text{Cl}$ -atom shows +R-effect that o/p-directive influence but deactivate the benzene ring. While $-\text{OH}$, $-\text{CH}_3$ groups also shows o/p-influence but activate the benzene ring. But in these $-\text{OH}$ group activates more than $-\text{CH}_3$.

Hence, order of electrophilic substitution is



81 Which one of the following compounds is resistant to nucleophilic attack by hydroxyl ions? **[CBSE AIPMT 1998]**

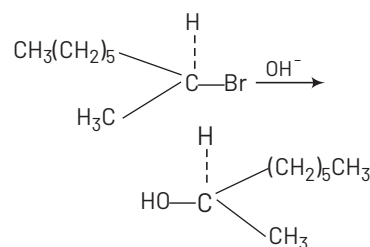
- (a) Methyl acetate
- (b) Acetonitrile
- (c) Dimethyl ether
- (d) Acetamide

Ans. (c)

Dimethyl ether does not show nucleophilic attack due to absence of multiple bond.

Other compounds have multiple bonded C-atom and bears partial positive charges, therefore they undergo nucleophilic attack by OH^- ions.

82 The reaction is described as **[CBSE AIPMT 1997]**



- (a) $\text{S}_{\text{E}}2$
- (b) $\text{S}_{\text{N}}1$
- (c) $\text{S}_{\text{N}}2$
- (d) $\text{S}_{\text{N}}0$

Ans. (c)

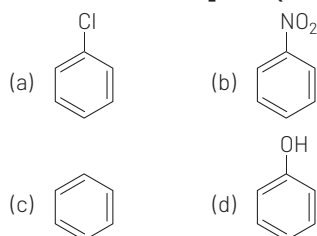
When the attack of nucleophile takes place on the opposite side of the leaving group in the substrate molecule, a transition state is obtained. It is partially bonded to both the attacking nucleophile and the leaving group and results in the formation of product. Such reactions are called as $\text{S}_{\text{N}}2$ (bimolecular nucleophilic substitution reaction) because in such reactions, rate depends on the concentration of both, the substrate and the nucleophile.

TOPIC 5

Types of Organic Reactions

83 Which of the following compound is most reactive in electrophilic aromatic substitution?

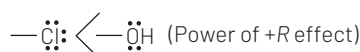
[NEET (Oct.) 2020]



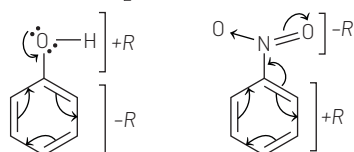
Ans. (d)

Electron Donating Group (EDG : + R > + hyperconjugation) increases electron density of benzene nucleus (which acts as nucleophile) and make it more susceptible for electrophilic attack in electrophilic aromatic substitution (ArS_E2) reaction.

Lone pair of electrons on the central atom of a group (substituent) show + R or + M effect with the benzene ring, like-



whereas —NO_2 group shows $-R$ effect and makes the benzene nucleus least reactive in ArS_E2 reaction.



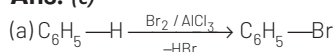
So, with the options, order of reactivity in ArS_E2 reaction will be
(d) > (a) > (c) > (b)

84 Which of the following is a free radical substitution reaction?

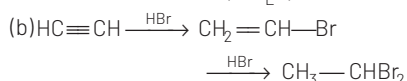
[(NEET (Oct.) 2020)]

- (a) Benzene with Br₂ / AlCl₃
(b) Acetylene with HBr
(c) Methane with Br₂/hν
(d) Propene with HBr/(C₆H₅COO)₂

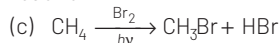
Ans. (c)



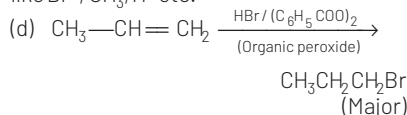
It is an electrophilic aromatic substitution (ArS_E2) reaction.



It is an example of electrophilic addition reaction.



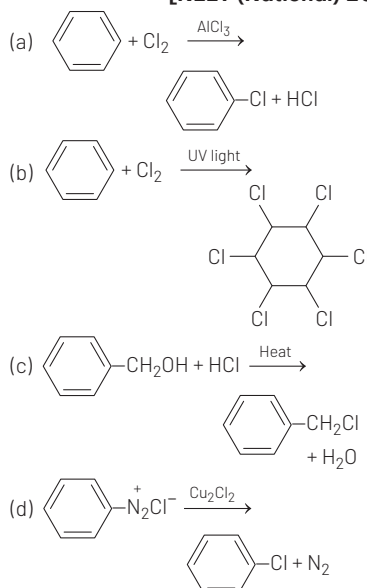
It is a free radical substitution reaction, which have free radical intermediates like Br•, CH₃•, H• etc.



It is a free radical addition reaction.
Hence, option (c) is correct.

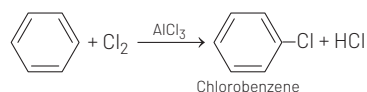
85 Among the following, the reaction that proceeds through an electrophilic substitution, is

[NEET (National) 2019]



Ans. (a)

Halogenation of benzene is an example of electrophilic substitution reaction.



Reaction given in option (b) is an example of addition reaction, reaction in option (c) is an example of nucleophilic substitution and option (d) is an example of substitution reaction.

86 In an S_N1 reaction on chiral centres there is

[CBSE AIPMT 2015]

- (a) 100% racemisation
(b) inversion more than retention leading to partial racemisation
(c) 100% retention
(d) 100% inversion

Ans. (b)

In S_N1 reaction, there is slight more inversion product than retention product because S_N1 reaction also depend on shielding effect of the front side of the reacting carbon.

87 Which of the following organic compounds has same hybridisation as its combustion (CO₂) product?

[CBSE AIPMT 2014]

- (a) Ethane (b) Ethyne
(c) Ethene (d) Ethanol

Ans. (b)

Hybridisation of carbon
= sp^{3-number of π-bonds}

In CO₂, (O=C=O) hybridisation of carbon $\frac{2\pi}{1\pi}$

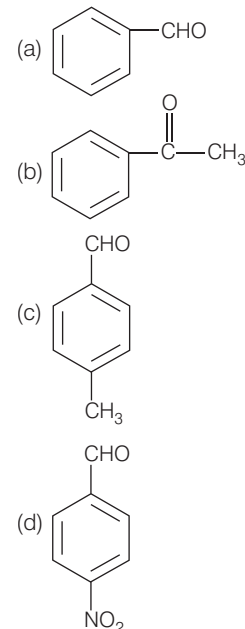
$$= sp^{3-2} = sp$$

In ethyne or acetylene, C₂H₂,

$$(\text{H—C}\frac{2\pi}{\text{—}}\text{C—H}) \text{ hybridisation of carbon} = sp^{3-2} = sp$$

88 Which one is most reactive towards nucleophilic addition reaction?

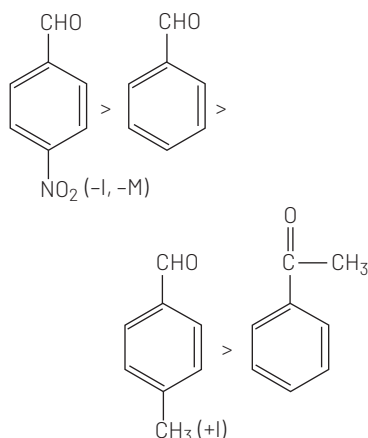
[CBSE AIPMT 2014]



Ans. (d)

Reactivity of carbonyl compounds towards nucleophilic addition reactions depends on the presence of substituted group.

Electron withdrawing ($-I$, $-M$) groups increase reactivity towards nucleophilic addition reactions. Thus, correct order is



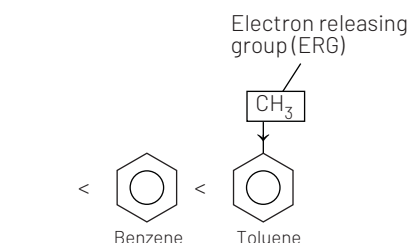
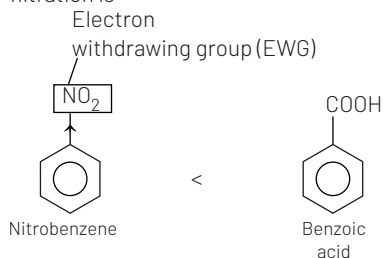
89 Among the following compound one that is most reactive towards electrophilic nitration is

[CBSE AIPMT 2012]

- (a) benzoic acid (b) nitrobenzene
(c) toluene (d) benzene

Ans. (c)

Presence of electron releasing groups like $-R$, $-OH$, etc. increases the electron density at o/p -position and thus, makes the benzene ring more reactive (at o/p -positions) towards an electrophile. On the other hand, electron withdrawing groups like $-COOH$, $-NO_2$, etc. if present, reduces electron density and thus, reduces the activity of benzene nucleus towards an electrophile. Thus, the order of the given compounds towards electrophilic nitration is



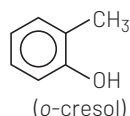
Thus, toluene is most reactive towards electrophilic nitration.

90 Which one of the following is most reactive towards electrophilic reagent?

[CBSE AIPMT 2011]

- (a) (b)
(c) (d)

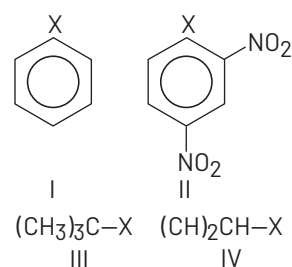
Ans. (a)



Due to +M-effect of $-OH$ group and hyperconjugation of $-CH_3$ group, the benzene of o-cresol is highly reactive towards electrophilic substitution.

91 The correct order of increasing reactivity of $C-X$ bond towards nucleophile in the following compounds is

[CBSE AIPMT 2010]



- (a) $I < II < IV < III$ (b) $II < III < I < IV$
(c) $IV < III < I < II$ (d) $III < II < I < IV$

Ans. (a)

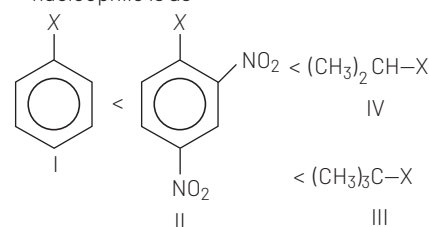
Key Idea Alkyl halides are more reactive towards nucleophilic substitution. Reactivity depends upon the stability of carbocation intermediate formed.

Among the given halides, aryl halide (C_6H_5X) is least reactive towards nucleophile, due to the four possible reason

- (i) Resonance effect
(ii) Hybridisation
(iii) Unstability of phenyl cation

(iv) Double bond character

$C-X$ bond acquire some double bond character due to resonance. Presence of electron withdrawing groups like $-NO_2$ at *ortho* and *para*-positions facilitate the nucleophilic displacement of $-X$ of aryl halide. Among alkyl halides, 3° halides are more reactive as compared to 2° halides due to the formation of more stable carbocation. Hence, the order of reactivity of $C-X$ bond towards nucleophile is as

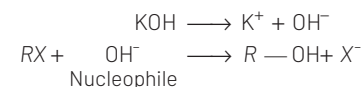


92 Which of the following reactions is an example of nucleophilic substitution reaction?

[CBSE AIPMT 2009]

- (a) $RX + KOH \longrightarrow ROH + KX$
(b) $2RX + 2Na \longrightarrow R-R + 2NaX$
(c) $RX + H_2 \longrightarrow RH + HX$
(d) $RX + Mg \longrightarrow RMgX$

Ans. (a)



OH^- is a stronger nucleophile than halogen. So it easily replace the weaker nucleophile.

Nucleophiles are either negative charge or lone pair of electrons bearing species, e.g. OH^- , \ddot{NH}_3 , etc.

93 Which of the following is least reactive in a nucleophilic substitution reaction?

[CBSE AIPMT 2004]

- (a) $(CH_3)_3C-Cl$ (b) $CH_2=CHCl$
(c) CH_3CH_2Cl (d) $CH_2=CHCH_2Cl$

Ans. (b)

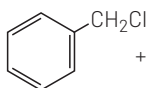
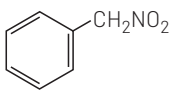
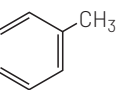
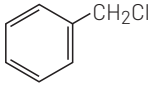

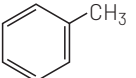
Chlorine of vinyl chloride ($CH_2=CHCl$) is non-reactive (less reactive) towards nucleophile (in nucleophilic substitution reaction) because it shows the following resonating structure due to +M-effect of $-Cl$ -atom.



In structure II, Cl-atom have positive charge and partial double bond character with C of vinyl group, so it is more tightly attracted towards the nucleus and does not get replaced by nucleophile in S_N reaction.

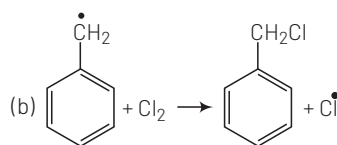
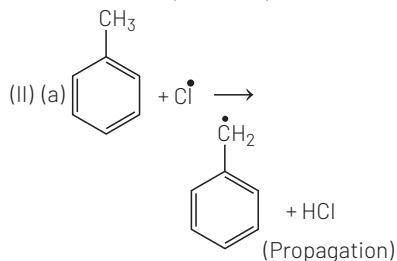
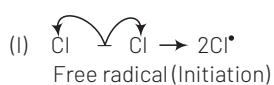
94 Which one of the following is a free radical substitution reaction ?

[CBSE AIPMT 2003]

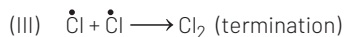
- (a)  + $\text{AgNO}_2 \longrightarrow$ 
- (b) $\text{CH}_3\text{CHO} + \text{HCN} \longrightarrow \text{CH}_3\text{CH}(\text{OH})\text{CN}$
- (c)  + $\text{Cl}_2 \xrightarrow{\text{Boiling}}$ 
- (d)  + $\text{CH}_3\text{Cl} \xrightarrow{\text{Anhy. AlCl}_3}$ 

Ans. (c)

At higher temperature the reaction of toluene with chlorine is an example of free radical substitution.



Benzylic free radical is resonating stable.



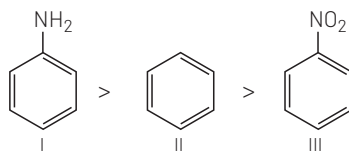
95 The correct order of reactivity towards the electrophilic substitution of the compounds aniline (I), benzene (II) and nitrobenzene (III) is

[CBSE AIPMT 2003]

- (a) $\text{II} < \text{III} > \text{I}$ (b) $\text{I} > \text{II} > \text{III}$
(c) $\text{III} > \text{II} > \text{I}$ (d) $\text{II} > \text{III} > \text{I}$

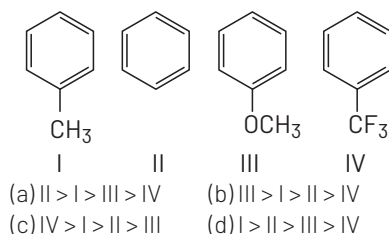
Ans. (b)

In aniline $-\text{NH}_2$ group is attached with benzene ring. $-\text{NH}_2$ group shows +M-effect. So, it activates the benzene ring. Hence, rate of electrophilic substitution is increased due to increase in the electron density at o/p-position. In case of nitrobenzene, $(-\text{NO}_2)$ -M-effect deactivates the benzene ring. So in nitrobenzene, rate of electrophilic substitution is lower than benzene. Hence, order of S_E reaction is



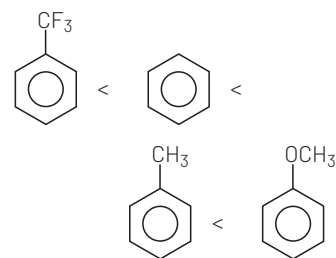
96 Among the following compounds the decreasing order of reactivity towards electrophilic substitution is

[CBSE AIPMT 2000]

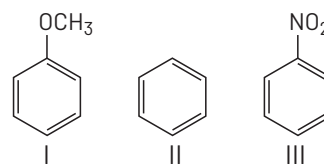


Ans. (b)

In $-\text{CH}_3$, $-\text{OCH}_3$ and CF_3 , CH_3 and $-\text{OCH}_3$ are electron donating group. Hence, they activate the benzene nucleus. In these, order of activation is $-\text{OCH}_3 > -\text{CH}_3$ while $-\text{CF}_3$ group deactivates the benzene nucleus. So, it shows lower rate of electrophilic substitution on benzene ring. Thus, order of electrophilic substitution is



97 Among the following compounds (I-III), the correct order of reaction with electrophile is



[CBSE AIPMT 1997]

- (a) $\text{II} > \text{III} > \text{I}$
(b) $\text{III} < \text{I} < \text{II}$
(c) $\text{I} > \text{II} > \text{III}$
(d) $\text{I} > \text{III} > \text{II}$

Ans. (c)

Due to +I as well as +R-effect of $-\text{OCH}_3$ group, it activates the benzene ring. While $-\text{NO}_2$ deactivates the benzene ring due to its -I-effect and also decrease the reaction rate, as well as -R-effect.

So, order of S_E reaction is

