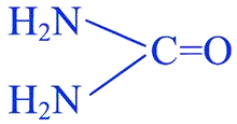
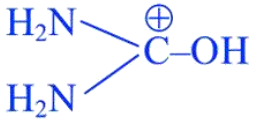
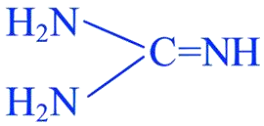
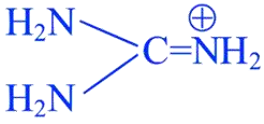
Organic Chemistry - Some Basic Principles and Techniques

1. Which amongst the following compounds/ species is least basic? **(2023)**

(a) 

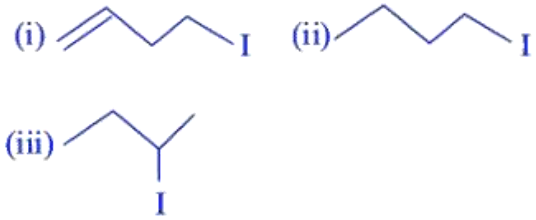
(b) 

(c) 

(d) 

2. Which amongst the following compounds will show geometrical isomerism? **(2023)**
   (a) Pent-1-ene
   (b) 2,3-Dimethylbut-2-ene
   (c) 2-Methylprop-1-ene
   (d) 3,4-Dimethylhex-3-ene

3. The correct order for the rate of α, β-dehydrohalogenation for the following compound is _____. **(2023)**



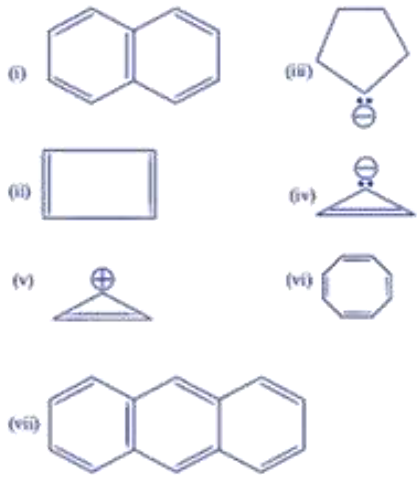
   (a) i < ii < iii
   (b) ii < i < iii
   (c) iii < ii < i
   (d) ii < iii < i

4. Given below are two statements: **(2023)**
   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:
   (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.

5. The number of σ bonds, π bonds and lone pair of electrons in pyridine, respectively are: **(2023)**
   (a) 12, 3, 0
   (b) 11, 3, 1
   (c) 12, 2, 1
   (d) 11, 2, 0

6. 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- **(2023)**
   (a) NaSCN
   (b) $[Fe(CN)_5NO]^{4-}$
   (c) $[Fe(SCN))]^{2+}$
   (d) $Fe_4[Fe(CN)_6)]_3 \cdot xH_2O$

7. Consider the following compound/species:



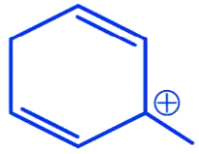
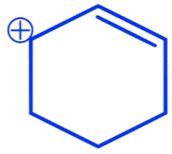
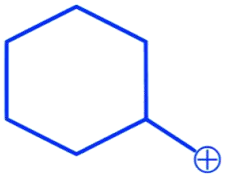
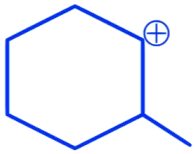
   The number of compounds species which obey Hucker's rule is _____. **(2023)**
   (a) 6
   (b) 2
   (c) 5
   (d) 4

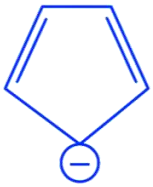
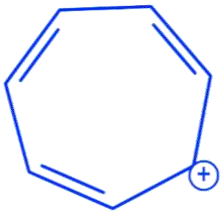
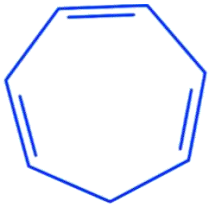
8. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R). **(2022)**
Assertion (A): Chlorine is an electron withdrawing group but it is ortho, para directing in electrophilic aromatic.
Reason (R): Inductive effect of chlorine destabilises the intermediate carbocation formed during the electrophilic substitution, however due to 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.

9. Predict the order of reactivity of the following four isomers towards S_N2 reaction. **(2022)**
1. $CH_3CH_2CH_2CH_2Cl$
2. $CH_3CH_2CH(Cl)CH_3$
3. $(CH_3)_2CHCH_2Cl$
4. $(CH_3)_3CCl$

(a) 4 > 2 > 3 > 1
(b) 4 > 3 > 2 > 1
(c) 1 > 2 > 3 > 4
(d) 1 > 3 > 2 > 4

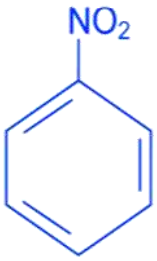
10. What is the hybridization shown by C_1 and C_2 carbons, respectively in the given compound? **(2022)**
$OHC–CH=CH–CH_3COOCH_3$
(a) sp^3 and sp^3
(b) sp^2 and sp^3
(c) sp^2 and sp^2
(d) sp^3 and sp^2

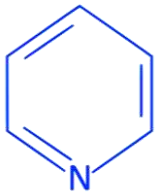
11. Which of the following is the most stable carbocation? **(2022)**
(a) 
(b) 
(c) 
(d) 

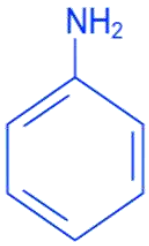
12. Which compound amongst the following is not an aromatic compound? **(2022)**
(a) 
(b) 
(c) 
(d) 

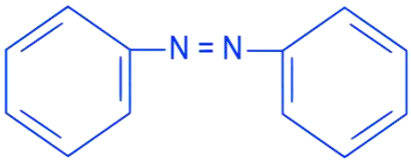
13. The incorrect statement regarding chirality is **(2022)**
(a) S_N1 reaction yields 1 : 1 mixture of both enantiomers
(b) The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration
(c) Enantiomers are superimposable mirror images on each other
(d) A racemic mixture shows zero optical rotation

14. 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? **(2022)**

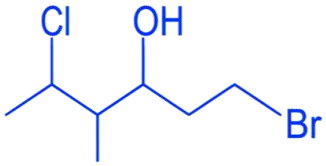
(a) 

(b) 

(c) 

(d) 

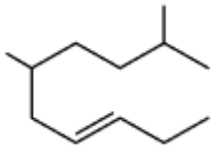
15. The correct IUPAC name of the following compound is: **(2022)**

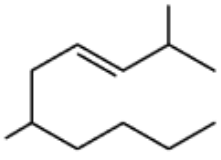


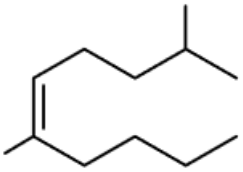
(a) 1-bromo-5-chloro-4-methylhexan-3-ol
(b) 6-bromo-2-chloro-4-methylhexan-4-ol
(c) 1-bromo-4-methyl-5-chlorohexan-3-ol
(d) 6-bromo-4-methyl-2-chlorohexan-4-ol

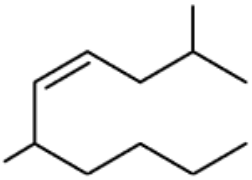
16. The compound which shows metamerism is: **(2021)**
(a) C_3H_8O
(b) C_3H_6O
(c) $C_4H_{10}O$
(d) C_5H_{12}

17. The correct structure of 2, 6-Dimethyl-dec-4-ene is: **(2021)**

(a) 

(b) 

(c) 

(d) 

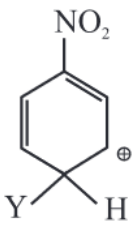
18. Paper chromatography is an example of : **(2020)**
(a) Partition chromatography
(b) Thin layer chromatography
(c) Column chromatography
(d) Adsorption chromatography

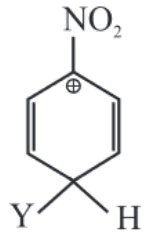
19. A tertiary butyl carbocation is more stable than a secondary butyl carbocation because of which of the following? **(2020)**
(a) +R effect of – CH_3 groups
(b) –R effect of – CH_3 groups
(c) Hyperconjugation
(d) –I effect of –CH_3 groups

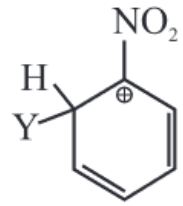
20. A liquid compound (x) can be purified by steam distillation only if it is **(2020 Covid Re-NEET)**
(a) Not steam volatile, miscible with water
(b) Steam volatile, miscible with water
(c) Not steam volatile, immiscible with water
(d) Steam volatile, immiscible with water

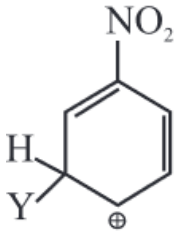
21. Which of the following molecules represents the order of hybridization sp^2, sp^2, sp, sp from left to right atoms? **(2018)**
(a) $HC \equiv C - C \equiv CH$
(b) $CH_2 = CH - C \equiv CH$
(c) $CH_3 - CH = CH - CH_3$
(d) $CH_2 = CH - CH = CH_2$

22. Which of the following carbocations is expected to be most stable? **(2018)**

(a) 

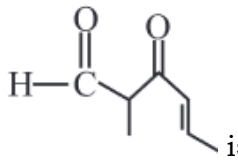
(b) 

(c) 

(d) 

23. Which of the following is correct with respect to –I effect of the substituents? (R = alkyl) **(2018)**
    (a) $-NH_2 < -OR < -F$
    (b) $-NR_2 < -OR < -F$
    (c) $-NR_2 > -OR > -F$
    (d) $-NH_2 > -OR > -F$

24. The most suitable method of separation of 1 : 1 mixture of ortho and para-nitrophenols is **(2017-Delhi)**
    (a) Steam distillation
    (b) Sublimation
    (c) Chromatography
    (d) Crystallisation

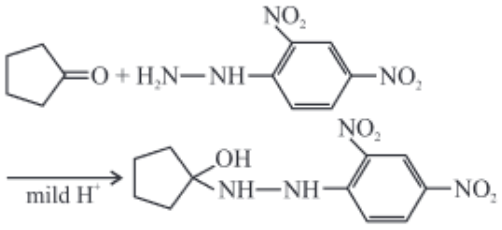
25. The IUPAC name of the compound  is **(2017-DELHI)**
    (a) 3-keto-2-methylhex-5-enal
    (b) 3-keto-2-methylhex-4-enal
    (c) 5-formylhex-2-en-3-one
    (d) 5-methyl-4-oxohex-2-en-5-al

26. The correct statement regarding electrophile is: **(2017-Delhi)**
    (a) Electrophile can be either neutral or positively charged 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 a nucleophile
    (c) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
    (d) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile

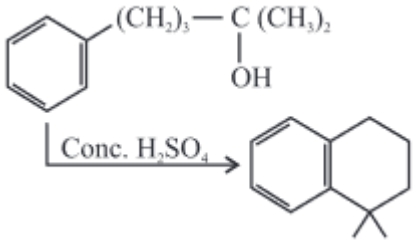
27. Amongst the following compounds, the one which is most easily sulphonated is: **(2017-Gujarat)**
    (a) Chlorobenzene
    (b) Benzene
    (c) Nitro benzene
    (d) Toluene

28. Match Column-I with Column-II **(2017-Gujarat)**

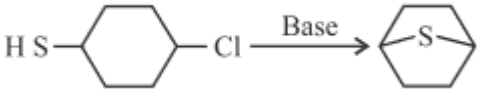
Column-I

(A) 

(P) Electrophilic Substitution

(B) 

(Q) Nucleophilic Substitution

(C) 

(R) Nucleophilic addition

Column-II

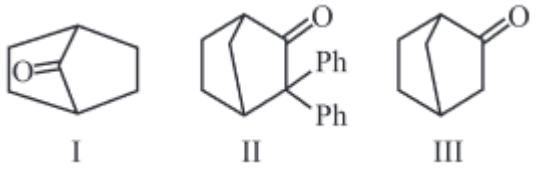
(a) $A-R; B-Q; C-P$
(b) $A-P; B-Q; C-R$
(c) $A-Q; B-R; C-P$
(d) $A-R; B-P; C-Q$

29. Which of the following statements is incorrect? **(2017-Gujarat)**

(a) Of $\bar{O}-C\equiv\overset{+}{O}, O=C=O$, the structures, $\bar{O}-C\equiv\overset{+}{O}$, is most stable structure
(b) The bond angle follows the order $CH_4 > NH_3 > H_2O > H_2S$
(c) The bond order follows the order $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(d) Strength of 'H' bond follows the order

$HF > H_2O > NH_3 > HCl$

30. Which among the given molecules can exhibit tautomerism? **(2016-II)**

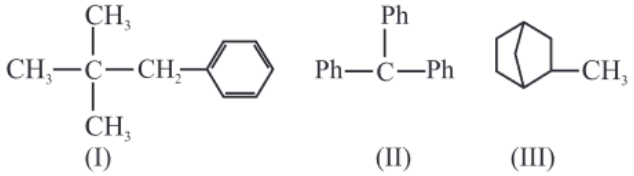


I II III

(a) III only
(b) Both I and III
(c) Both I and II
(d) Both II and III

31. Which of the following statements is not correct for a nucleophile? **(2015 Re)**
(a) Nucleophiles are not electron seeking
(b) Nucleophile is a lewis acid
(c) Ammonia is a nucleophile
(d) Nucleophiles attack low electron density sites

32. Consider the following compounds



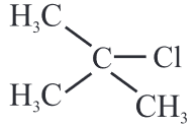
(I) (II) (III)

(2015)

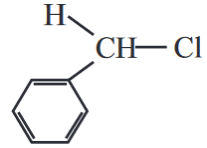
Hyperconjugation occurs in:
(a) II only
(b) III only
(c) I and III
(d) I only

33. In which of the following compounds, the $C-Cl$ bond ionization shall give most stable carbonium ion? **(2015)**

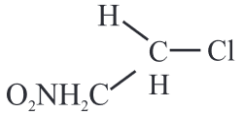
(a)



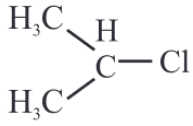
(b)



(c)

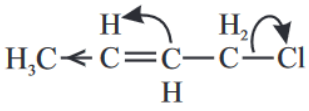


(d)

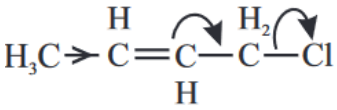


34. Which of the following is the most correct electron displacement for a nucleophilic reaction to take place? **(2015)**

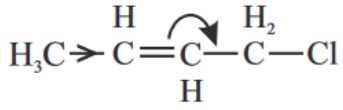
(a)



(b)



(c)

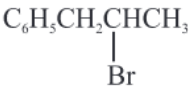


(d)

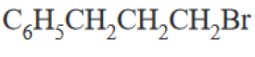
35. In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is:
(a) 18.20
(b) 16.76
(c) 15.76
(d) 17.36

36. The reaction of $C_6H_5CH=CHCH_3$ with HBr produces: **(2015)**

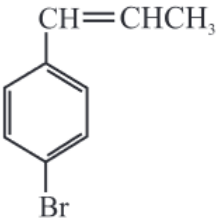
(a)



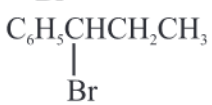
(b)



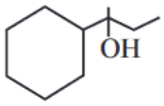
(c)

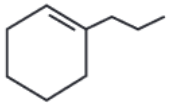


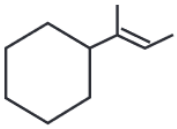
(d)

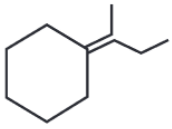


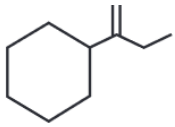
37. Which of the following is not the product of dehydration of **(2015 Re)**

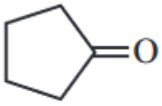


(a) 

(b) 

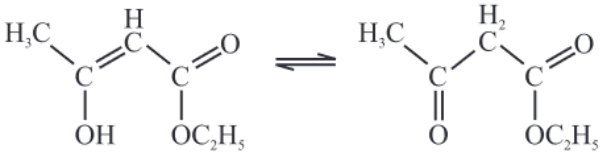
(c) 

(d) 

38. Treatment of cyclopentanone  with methyl lithium gives which of the following species? **(2015)**
    (a) Cyclopentanonyl radical
    (b) Cyclopentanonyl biradical
    (c) Cyclopentanoyl anion
    (d) Cyclopentanonyl cation

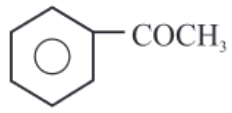
39. Which of the following species contains equal number of σ-bonds and π-bonds? **(2015)**
    (a) $(CN)_2$
    (b) $CH_2(CN)_2$
    (c) HCO_3^-
    (d) XeO_4

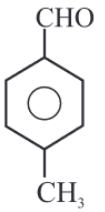
40. The enolic form of ethyl acetoacetate as shown below has **(2015)**

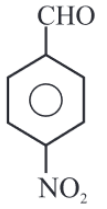


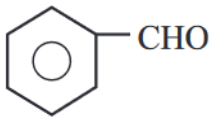
    (a) 9 σ-bonds and 2 π-bonds
    (b) 9 σ-bonds and 1 π-bonds
    (c) 18 σ-bonds and 2 π-bonds
    (d) 16 σ-bonds and 1 π-bonds

41. Which one is most reactive towards nucleophilic addition reaction? **(2014)**

(a) 

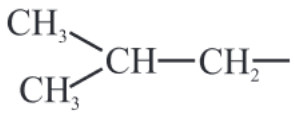
(b) 

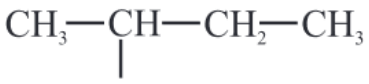
(c) 

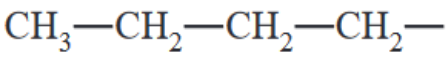
(d) 

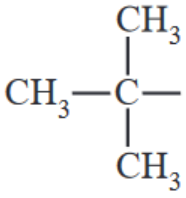
42. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g of sample neutralized 10 mL of 1 MH_2SO_4. The percentage of nitrogen in the soil is **(2014)**
    (a) 45.33
    (b) 35.33
    (c) 43.33
    (d) 37.33

43. The structure of isobutyl group in an organic compound is: **(2013)**

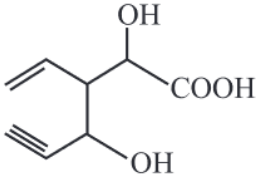
(a) 

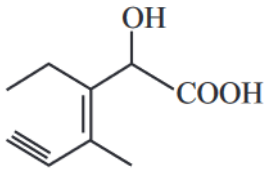
(b) 

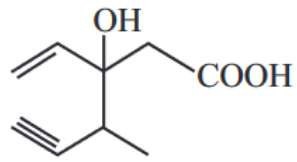
(c) 

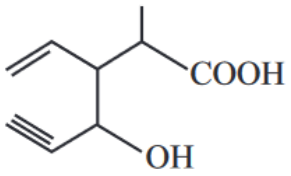
(d) 

44. Structure of the compound whose IUPAC name is 3-Ethyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid is: **(2013)**

(a) 

(b) 

(c) 

(d) 

45. Some meta-directing substituents in aromatic substitution are given. Which one is most deactivating? **(2013)**

(a) $-COOH$
(b) $-NO_2$
(c) $-C \equiv N$
(d) $-SO_3H$

Answer Key

S1. Ans. (b)

S2. Ans. (d)

S3. Ans. (d)

S4. Ans. (b)

S5. Ans. (b)

S6. Ans. (c)

S7. Ans. (d)

S8. Ans. (d)

S9. Ans. (d)

S10. Ans. (b)

S11. Ans. (a)

S12. Ans. (d)

S13. Ans. (c)

S14. Ans. (c)

S15. Ans. (a)

S16. Ans. (c)

S17. Ans. (d)

S18. Ans. (a)

S19. Ans. (c)

S20. Ans. (d)

S21. Ans. (b)

S22. Ans. (d)

S23. Ans. (a, b)

S24. Ans. (a)

S25. Ans. (b)

S26. Ans. (a)

S27. Ans. (d)

S28. Ans. (d)

S29. Ans. (a)

S30. Ans. (a)

S31. Ans. (b)

S32. Ans. (b)

S33. Ans. (a)

S34. Ans. (b)

S35. Ans. (b)

S36. Ans. (d)

S37. Ans. (a)

S38. Ans. (c)

S39. Ans. (d)

S40. Ans. (c)

S41. Ans. (c)

S42. Ans. (d)

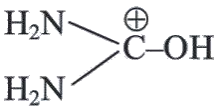
S43. Ans. (a)

S44. Ans. (b)

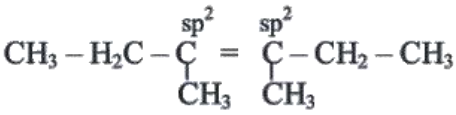
S45. Ans. (b)

Solutions

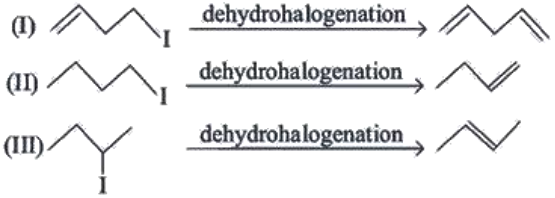
S1. Ans.(b)



S2. Ans.(d)



S3. Ans.(d)

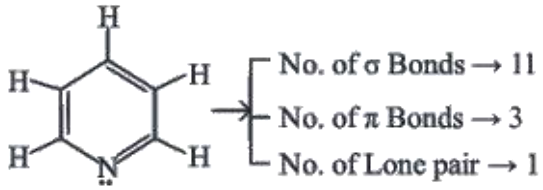


Rate of Dehydrohalogenation: II < III < I.

S4. Ans.(b)

Statement I is false but Statement II is true.

S5. Ans.(b)



S6. Ans.(c)

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.

$Na + C + N + S \longrightarrow NaSCN$

$Fe^{+3} + SCN^{\ominus} \longrightarrow [Fe(SCN)]^{2+}$ Blood red

S7. Ans.(d)

Huckle's rule = $(4n + 5)\pi$ electrons

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

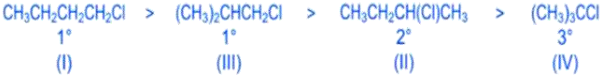
S8. Ans.(d)

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

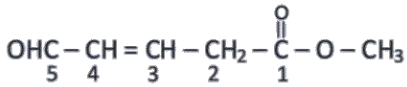
S9. Ans.(d)

Lesser the steric hinderance on halide carbon, more will be the reactivity of alkyl halide towards S_N2 reaction.

So correct order towards S_N2 reactivity is:



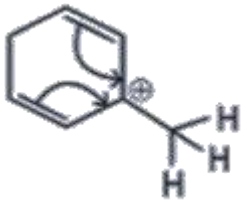
$-COOCH_3$ has higher priority than – C = C – and – CHO in IUPAC nomenclature.



$C_1 = sp^2$

$C_2 = sp^3$

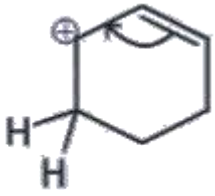
S11. Ans.(a)



(1)

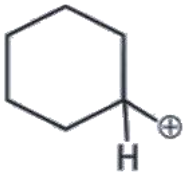
⟶ Cross conjugation and 3α-H [Hyperconjugation]

Due to cross-conjugation and 3α-H [Hyperconjugation], (1) is most stable.



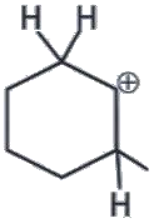
(2)

⟶ Resonance & 2α-H [Hyperconjugation]



(3)

⟶ 1α-H [Hyperconjugation]

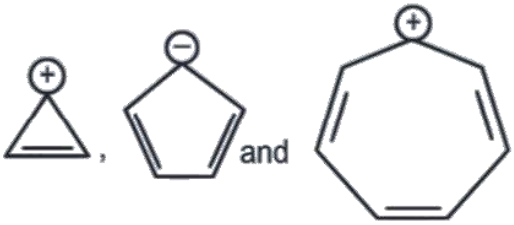


(4)

→ 3α-H [Hyperconjugation]

S12. Ans.(d)

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



are aromatic species.

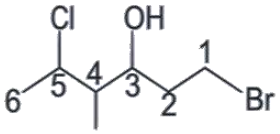
S13. Ans.(c)

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

S14. Ans.(c)

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.

S15. Ans.(a)



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

S16. Ans.(c)

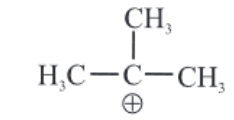
S17. Ans.(d)

S18. Ans.(a)

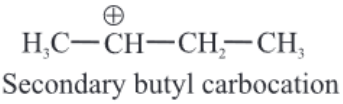
The example of partition chromatography is seen in paper chromatography.

In this process, chromatography paper is used as a stationary phase which is suspended in a mixture of solvents that act as a mobile phase.

S19. Ans.(c)



Tertiary butyl carbocation
(9 α-H atoms)



Secondary butyl carbocation
(5 α-H atoms)

A tertiary butyl carbocation has 9 alpha hydrogen atoms whereas secondary butyl carbocation has 5 alpha hydrogen atoms.

So when more number of a-H atoms is present, more will be the hyperconjugation effect hence more will be the stability of carbocation.

Thus tertiary butyl carbocation is more stable than a secondary butyl carbocation due to hyperconjugation

S20. Ans.(d)

Steam distillation technique is applied to separate the substances which are steam volatile and immiscible with water

S21. Ans.(b)

$\overset{sp^2}{C}\ H_2 = \overset{sp^2}{C}\ H - \overset{sp}{C} \equiv \overset{sp}{C}\ H$ Number of orbital require in hybridization = Number of σ- bonds around each carbon atom.

S22. Ans.(d)

NO_2 group exhibit-I effect and it decreases with increase in distance. In option (d), positive charge present on C atom at maximum distance S –I effect reaching to it is minimum and stability is maximum.

S23. Ans.(a, b)

–I effect increases on increasing electronegativity of atom. So, correct order of –I effect is

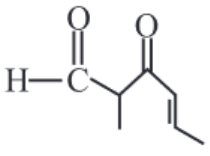
$-NH_2 < -OR < -F$.

Also $-NR_2 < -OR < -F$

S24. Ans.(a)

The most suitable method of separation of 1 : 1 mixture of ortho and para – nitrophenol is steam distillation, because there is large difference in the boiling point of ortho and para position as ortho form intra hydrogen bonding and there is large difference in the boiling point of ortho and para position as ortho form intra hydrogen bonding and para form inter-molecular hydrogen bonding.

S25. Ans.(b)



$\rightarrow -keto-2-methylhex-4-enal$

The order of decreasing priority for some functional groups is:-

$-COOH, -SO_3H, -COOR, -COCl, -CONH_2, -CN, -HC=O, >C=O, -OH, -NH_2, >C=C<, -C\equiv C-$.

S26. Ans.(a)

Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from nucleophile.

An electron loving species is called electrophile.

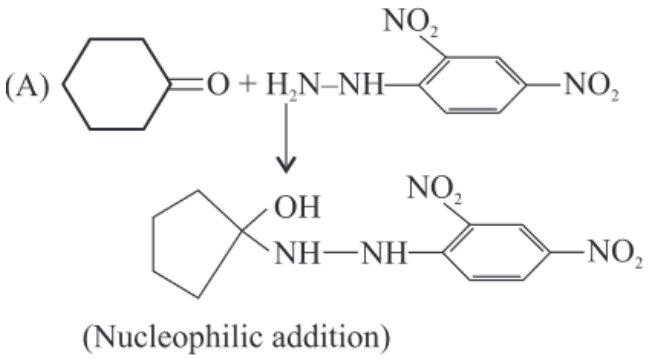
Electrophile: Electron can be accepted by positively charged or neutral species.

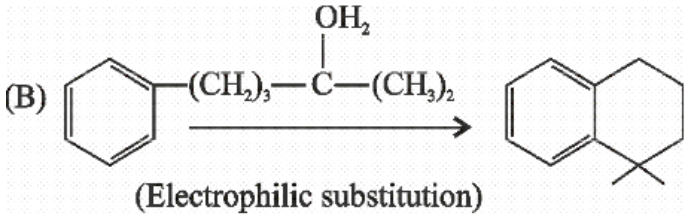
Nucleophile: A negatively charged species or neutral species can accepted by positive charge or donate their electron to positively charge species or neutral species.

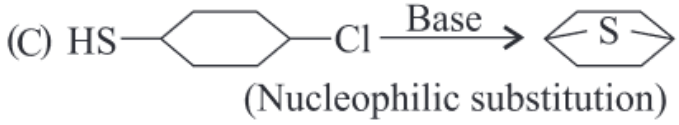
S27. Ans.(d)

In toluene CH_3 group is attached which is donating in nature. Therefore; it can easily be sulphonated.

S28. Ans.(d)







S29. Ans.(a)

$\overset{\ominus}{O}-C\equiv\overset{\oplus}{O}$ is less stable than O = C = C, as charge separation occur in it.

S30. Ans.(a)

$\alpha - H$ at bridge carbon never participate in tautomerism.

Thus, only (III) shows tautomerism.

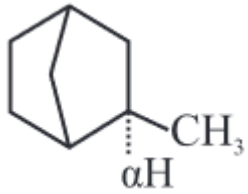
S31. Ans.(b)

Nucleophiles are positive charge loving species or electron rich compounds. Lewis acids are those species which are

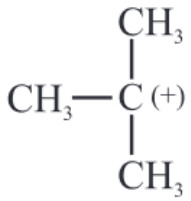
electron deficient so nucleophiles cannot act as Lewis acids, they instead are Lewis bases.

S32. Ans.(b)

Hyperconjugation provides extra stability by removal of H from α carbon which is only possible in:



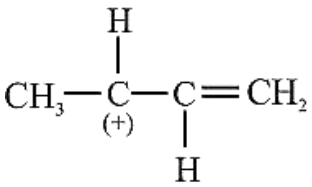
S33. Ans.(a)



3° carbocation is most stable than benzyol carbocation because of 9 hyper-conjugation of 3 inductive effects of $-CH_3$.

S34. Ans.(b)

So, the new species formed will be resonance stabilisied (alternating positive and negative charge).



S35. Ans.(b)

According to Duma's method:

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Longrightarrow V_1 = \frac{P_2V_2T_1}{P_1T_2}$

$\frac{(725-25)\times 40}{300} = \frac{760V_2}{273}$

$V_2 = 33.53$ ml

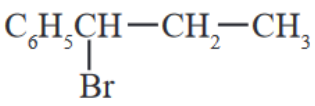
Mass = $\frac{33.53}{22400} \times 28 = 0.042\ g$

% N = $\frac{28\times V\times 100}{22400\times m}$

% of nitrogen = $\frac{0.042}{0.25} \times 100 = 16.76\%$

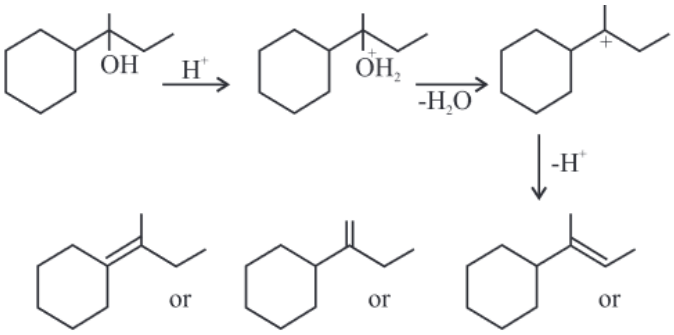
S36. Ans.(d)

Reaction of $C_6H_5 = CHCH_3$ with HBr yields

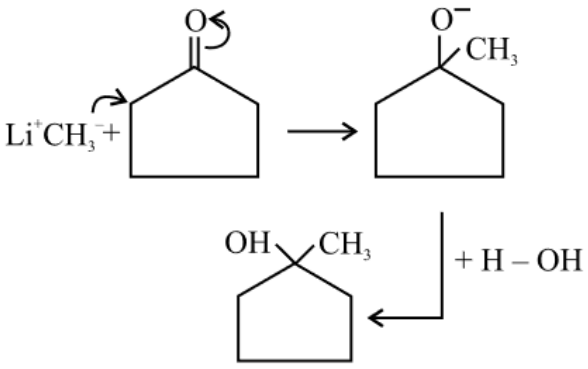


As benzoyl carbocation formed here will be most stable due to resonance.

S37. Ans.(a)

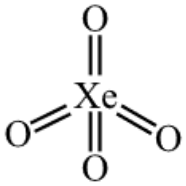


S38. Ans.(c)



S39. Ans.(a)

$4-\sigma$ and $4-\pi$ bonds



S40. Ans.(c)

S41. Ans.(c)

NO_2 is an electron withdrawing group, it will favour nucleophilic attack.

S42. Ans.(d)

Kjeldahl's method is used for estimation of N in organic sample where

$\%N = \frac{1.4 \times N \times V}{w}$

N = Normality of acid H_2SO_4 = 2

W = weight of NH_3 evolved

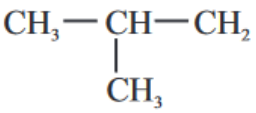
V = Vol. of H_2SO_4

$= \frac{1.4 \times 10 \times 2}{0.75}$

= 37.33%

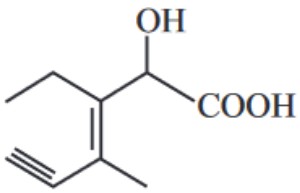
S43. Ans.(a)

Isobutyl group is represented as:



S44. Ans.(b)

Structure of 3-Ethyl-2-hydroxy-4-methyl hex 3-en-5-ynoic acid



S45. Ans.(b)

$-NO_2$ is most deactivating due to –I and –M effect.