General Organic Chemistry

SOLUTIONS

Exercise-I (Conceptual Questions)

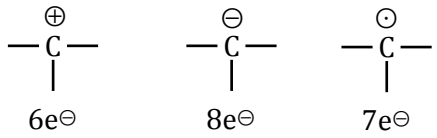
1. Ans. (2)

SO_3 is an electrophile because S is having vacant d-orbial i.e. incomplete octet.

2. Ans. (3)

$\overset{\ominus}{N}H_2$ acts as a Nucleophile because it shows excess of electrons i.e. ⊖ve charge containing species.

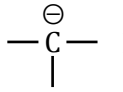
3. Ans. (2)



$6e^{\ominus}$ $8e^{\ominus}$ $7e^{\ominus}$

3 pair of $e^{\ominus}$

4. Ans. (3)

 Base as well as Nucleophile

5. Ans. (3)

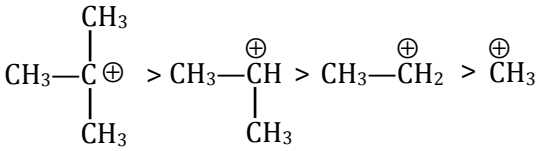
$\overset{\ominus}{C}H_2 - NO_2 > \overset{\ominus}{C}H_3$

$\boxed{-I}$

6. Ans. (1)

$-\overset{\oplus}{N}H_3 > -NO_2 > -CN$ {–I order}

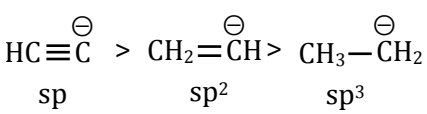
7. Ans. (1)



8. Ans. (3)

$-CH_3$ shows +I effect.

9. Ans. (2)

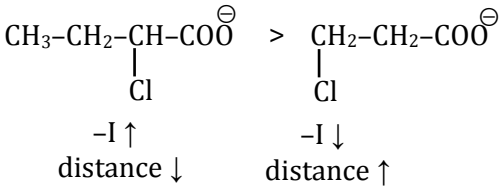


sp sp^2 sp^3

$E.N._{max}$ $E.N._{min}$

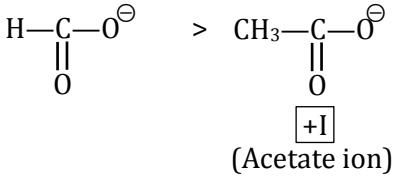
{%S ∝ E.N.}

10. Ans. (1)



$\left[I-\text{effect} \propto \frac{1}{\text{Distance}}\right]$

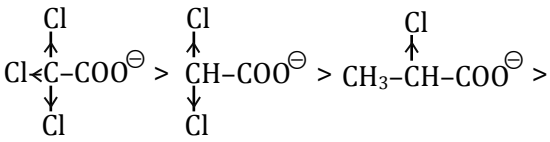
11. Ans. (2)



(Acetate ion)

[A.S. ∝ stability of C.B. $\propto \frac{-I}{+I} \propto \frac{K_a}{pK_a}$]

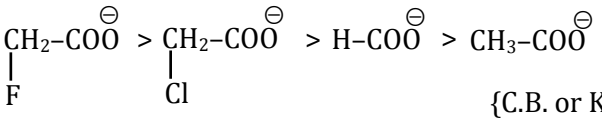
12. Ans. (3)



$\left[I-\text{effect} \propto \frac{1}{\text{Distance}}\right]$

$\left[A.S. \propto K_a \propto \frac{1}{pk_a}\right]$

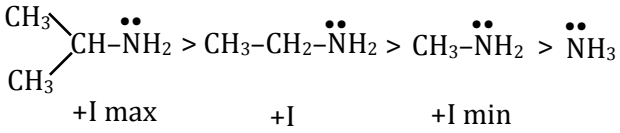
13. Ans. (3)



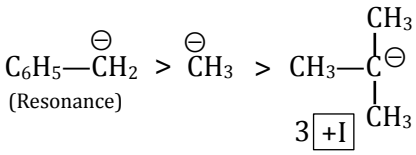
{C.B. or Ka}

$\left[pK_a \propto \frac{1}{k_a}\right]$

14. Ans. (4)



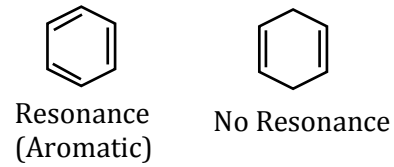
15. Ans. (2)



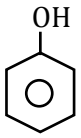
16. Ans. (2)

Delocalisation of π e$^{\ominus}$'s

17. Ans. (4)

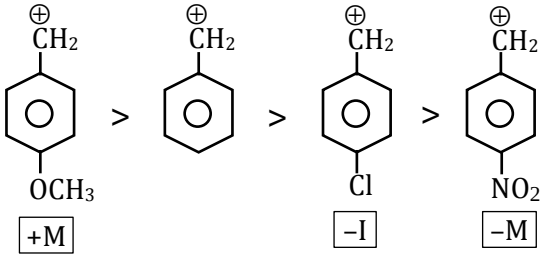


18. Ans. (3)



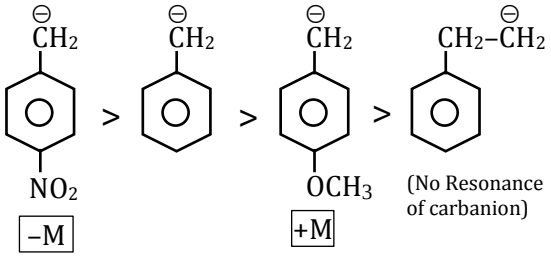
+M as well as –I.

19. Ans. (3)

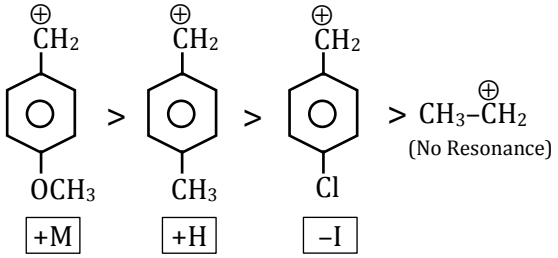


Stability of carbocation $\propto \frac{+M}{-M} \propto \frac{+H}{-H} \propto \frac{+I}{-I}$

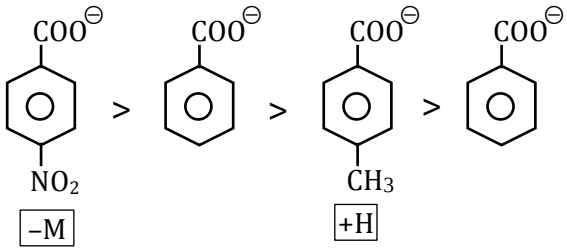
20. Ans. (4)



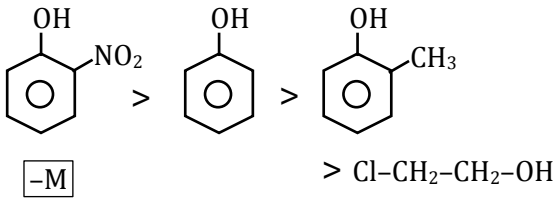
21. Ans. (1)



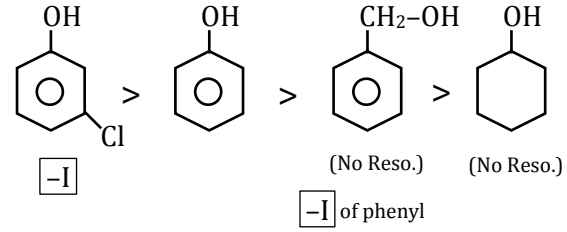
22. Ans. (4)



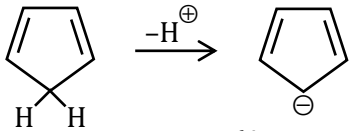
23. Ans. (1)



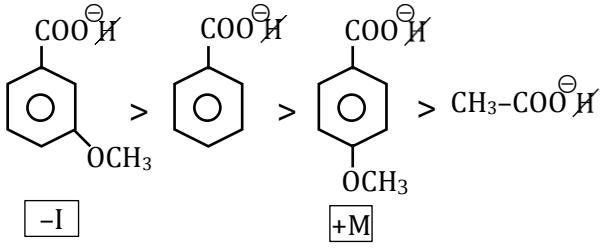
24. Ans. (3)



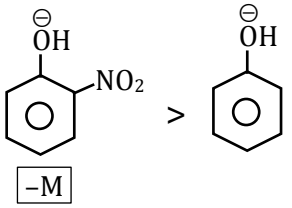
25. Ans. (4)



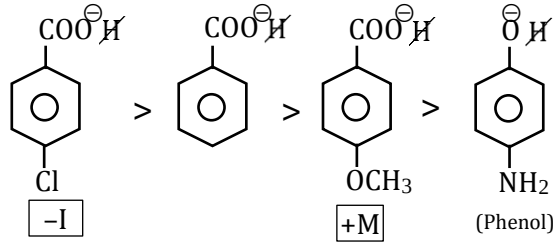
26. Ans. (3)



27. Ans. (2)

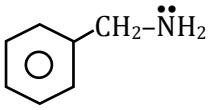


28. Ans. (2)



{A.S. ⇒ C. acid > Phenol}

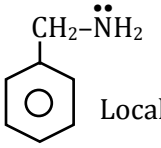
29. Ans. (4)



Localised ℓ.p.

hence most basic

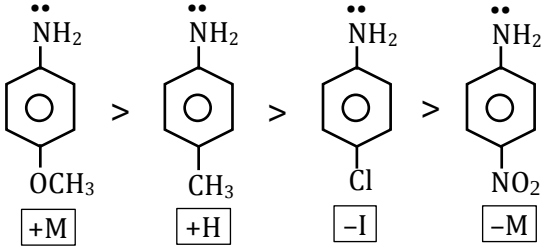
30. Ans. (4)



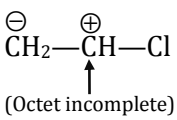
Localised L.P.

Localised L.P. is always more basic than delocalised L.P.

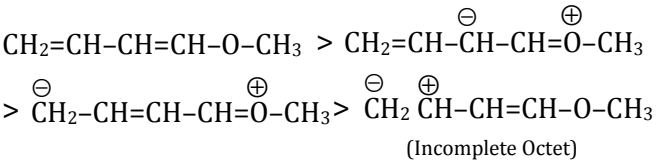
31. Ans. (1)



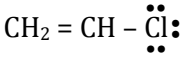
32. Ans. (3)



33. Ans. (3)

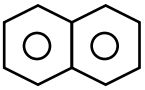


34. Ans. (3)



Because of Resonance C—Cl bond distance in minimum.

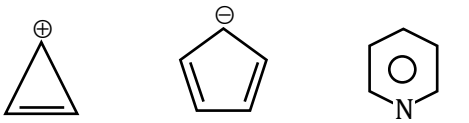
35. Ans. (3)



Aromatic

1. Planar
2. Cyclic Resonance
3. Huckle's Rule

36. Ans. (4)



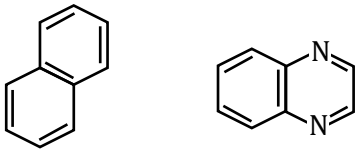
(Aromatic) (Aromatic) (Aromatic)

37. Ans. (1)

Non-planar

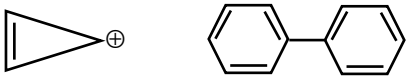
cyclic Resonance ×

38. Ans. (4)



Both are planar, cyclic Resonance & follows Huckle's Rule

39. Ans. (4)



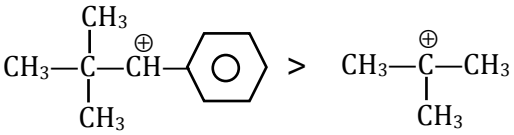
(Aromatic) (Aromatic)

40. Ans. (4)

Propene ($CH_3 - CH = CH_2$)

α-H = 3

41. Ans. (2)



Resonance

(α-H = 9)

+H max.

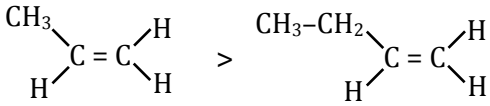
> $CH_3-\overset{\oplus}{C}H-CH_3$ > $CH_3-CH_2-\overset{\oplus}{C}H_2$

(α-H = 6)

(α-H = 2)

+H min.

42. Ans. (2)

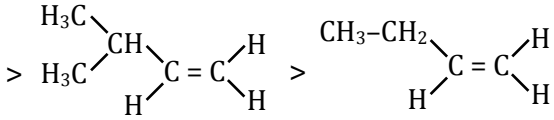


(α-H = 3)

+H max.

(α-H = 2)

+H



(α-H = 1)

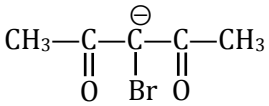
+H min.

(α-H = 0)

43. Ans. (3)

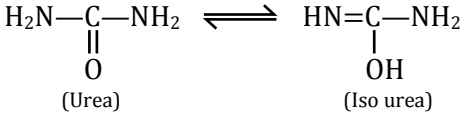
Tautomerism is due to migration of active H-atom.

44. Ans. (3)



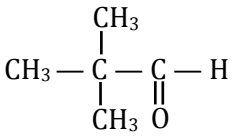
Max. stable anion

45. Ans. (4)



(Urea) (Iso urea)

46. Ans. (4)

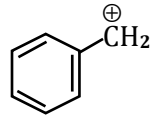


It doesn't have any active / α-H

Exercise-II (Conceptual Questions)

1. Ans. (2)

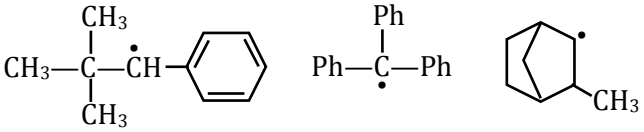
C–Cl Bond ionisation gives carbonium i.e. carbocation.

i.e. 

Here, carbocation is stabilised by Resonance.

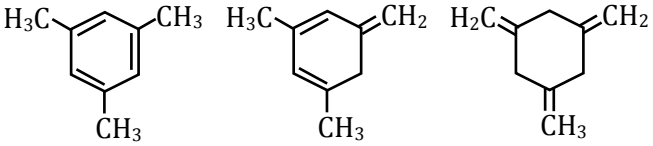
2. Ans. (2)

At least, 1 α-H must be required for hyperconjugation.



(α-H = 0) (α-H = 0) (α-H = 1)

3. Ans. (1)



(Aromatic) (Resonance) (No. Resonance)

Enthalpy of Hydrogenation ∝ No. of π-bonds

If no. of π-bonds ⇒ same

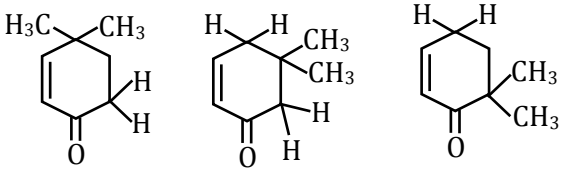
Then

$$\text{Enthalpy of hydrogenation} \propto \frac{1}{\text{Stability of Alkene}}$$

Hence stability order ⇒ I > II > III

Enthalpy of hydrogenation ⇒ III > II > I

4. Ans. (3)

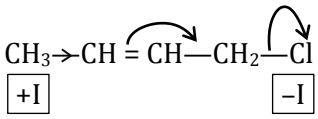


(I) (II) (III)

Above all three options are having active/α-H

They all can exhibit tautomerism.

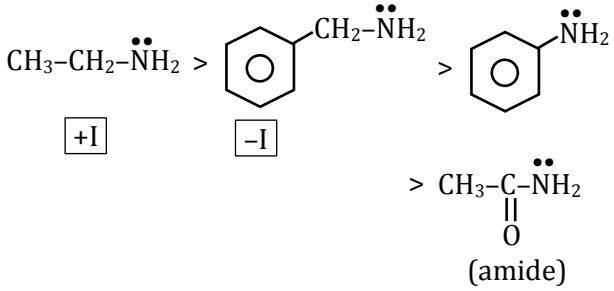
5. Ans. (2)



6. Ans. (3)

Incorrect statement ⇒ Nucleophile is a lewis acid.

7. Ans. (2)

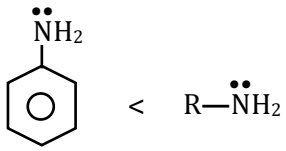


{localised l.p. > Delocalised l.p.}

8. Ans. (4)

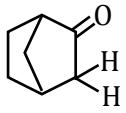
A carbonyl compound with a hydrogen atom on its alpha carbon rapidly equilibrates with its corresponding enol & this process is known as keto enol tautomerism.

9. Ans. (1)



Delocalisd l.p. Localised l.p.

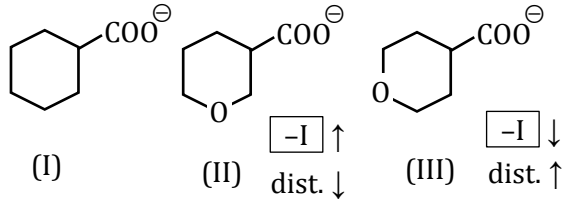
10. Ans. (3)



III only can exhibit tautomerism.

(α-H = 2)

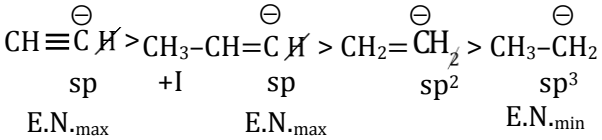
11. Ans. (4)



(I) (II) (III)

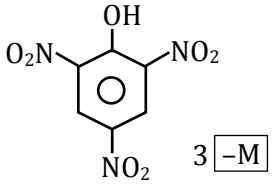
II > III > I

12. Ans. (1)



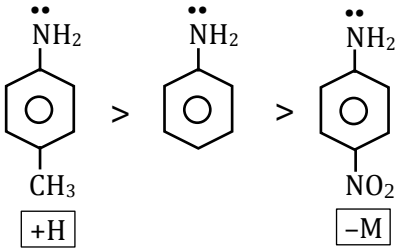
{%S ∝ E.N.)

13. Ans. (3)



(Picric acid)

14. Ans. (3)



II < I < III

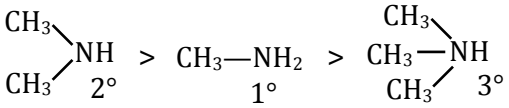
15. Ans. (3)

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

16. Ans. (1)

$-NH_2 < -OR < -F$ (Order of –I effect)

17. Ans. (1)

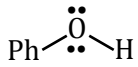


{Basic strength)

For aqueous solution, consider following factors

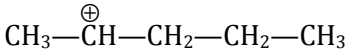
1. I-effect
2. Solvation
3. H-bonding
4. Steric hinderance

18. Ans. (4)



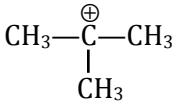
is most difficult to protonate because it has delocalised l.p.

19. Ans. (3)



(α-H = 5)

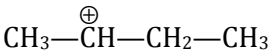
20. Ans. (1)



(α-H = 9)

+H ↑

Tert. butyl cation

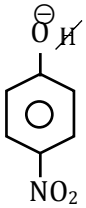


(α-H = 5)

+H ↓

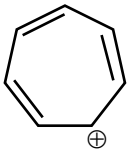
Sec. butyl cation

21. Ans. (1)

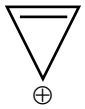


–M

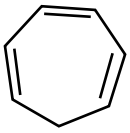
22. Ans. (3)



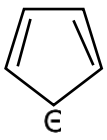
Aromatic



Aromatic



Non-Aromatic

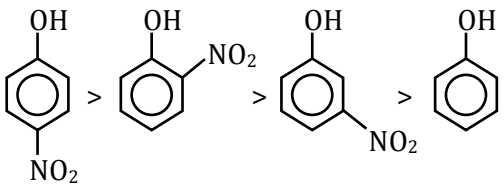


Aromatic

23. Ans. (2)

Acidic strength of phenolic group increases due to electron withdrawing groups.

Order of acidic strength



24. Ans. (4)

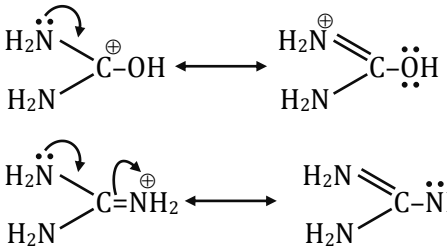
Huckle's rule = (4n + 2)□□electrons

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

25. Ans. (2)

Basic strength ∝ tendency to donate the e^-

∴ In compound (1) and (3) both are neutral species hence there basic strength is more



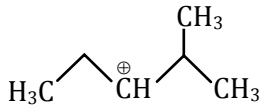
In compound (2) and (4) after resonance species become neutral and due to more E.N. of oxygen atom as compare to nitrogen atom basic strength will decrease.

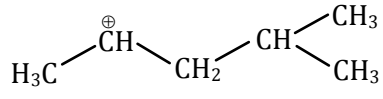
26. Ans. (2)

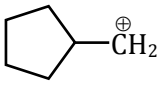
When inductive and electromeric effect operates in opposite direction, the electromeric effect predominates, because it is strong effect.

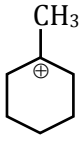
O-xylene is an aromatic compound with two methyl groups attached to the benzene ring in ortho position. However, hyperconjugation occurs because in o-xylene alpha hydrogen are present.

27. Ans. (4)

(1)  $\alpha_H = 3$

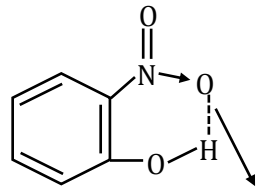
(2)  $\alpha_H = 5$

(3)  $\alpha_H = 1$

(4)  $\alpha_H = 7$

28. Ans. (1)

O-nitrophenol will show intra molecular H-Bonding



Intra molecular H-bond

29. Ans. (3)

$CH_3-\overset{\oplus}{C}H_2$ Carbocation is stabilised by hyperconjugation effect.

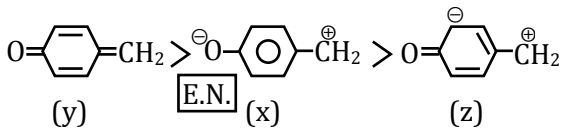
Exercise-III (Analytical Questions)

1. Ans. (2)

BF_3, $CH_3-\overset{\oplus}{C}=O$, O=C=O are Electrophile

$(CH_3)\overset{\odot}{N}$ is Nucleophile

2. Ans. (3)



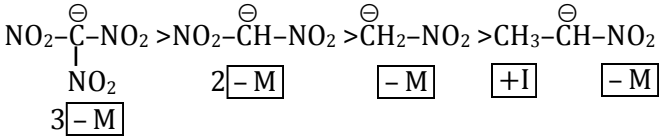
(y) E.N. (x) (z)

3. Ans. (1)

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

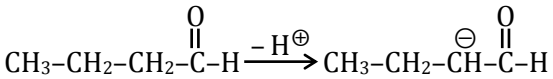
(Sigma Bond) (Partial Double Bond) Due to resonance

4. Ans. (1)



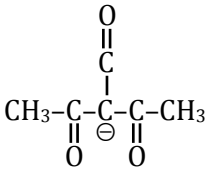
NO_2 3[– M] 2[– M] [– M] [+I] [– M]

5. Ans. (2)



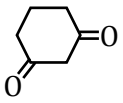
Anion is stabilised by resonance

6. Ans. (4)



Anion is stabilised by Resonance with three C=O groups; hence, it has most Acidic proton

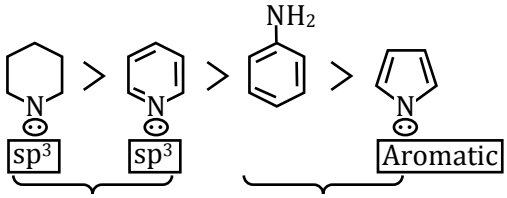
7. Ans. (2)



non-planar cyclic resonance X

It is non-Aromatic

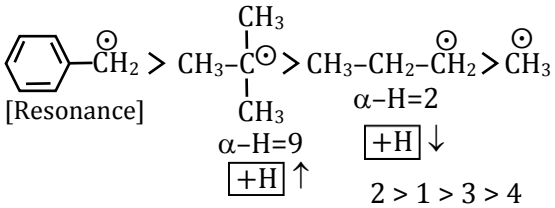
8. Ans. (4)



Localised Delocalised

II > III > IV > I

9. Ans. (4)



[Resonance] α–H=9 [+H] α–H=2 [+H]

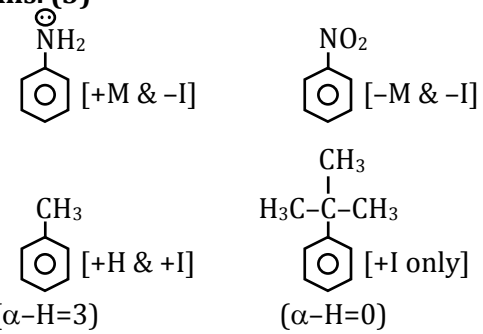
2 > 1 > 3 > 4

10. Ans. (3)

–OR [+M & –I] –C(=O)–OH [–M & –I]

$-CH_3$ [+H & +I] $-\overset{\ominus}{O}$ [+M & +I]

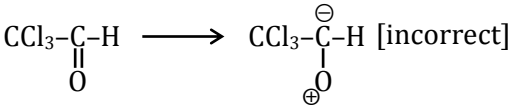
11. Ans. (3)



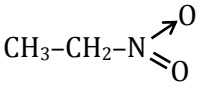
[+M & –I] [–M & –I]

[+H & +I] (α–H=3) [+I only] (α–H=0)

12. Ans. (3)



13. Ans. (2)



Migration of active/α–H

(α–H=2)

14. Ans. (1)

2-Pentanone $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3$

(α–H=5)