Electronic Displacement Effects (GOC)

SOLUTIONS

EXERCISE - O

1. **Ans. (D)**

It is permanent effect.

2. **Ans. (A)**

It involves displacement of σ–electrons.

3. **Ans. (A)**

(A) $CH_3-\overset{\oplus}{C}H_2$ ($+I$)

(B) $H_2\overset{\oplus}{C}-CH(Cl)Cl$ ($-I$)

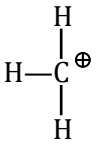
(C) $Cl-CH_2-\overset{\oplus}{C}H_2$ ($-I$)

(D) $O_2N-CH_2-\overset{\oplus}{C}H_2$ ($-I$)

Stability of $C^{\oplus} \propto \frac{(+I)}{(-I)}$

$C^{\oplus}$ order ; A>C>B>D

4. **Ans. (D)**



Here no alkyl group is present so no displacement σ–e⁻.
Hence no dispersal of the charge.

5. **Ans. (A)**

$-CH_2-CH_3 < -CH(CH_3)-CH_3 < -C(CH_3)_2-CH_3$

(+I) 2(+I) 3(+I)

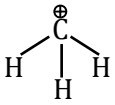
+I increases

6. **Ans. (A)**

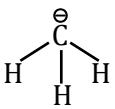
$CH_3-CH_2-Cl \xrightarrow[\text{fission}]{\text{homolytic}} CH_3-\dot{C}H_2 + \dot{Cl}$

7. **Ans. (B)**

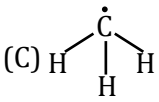
Intermediate having complete octet.

(A)  (6) electrons in outermost shell

Carbocation

(B)  (8) electron in outermost shell [complete octet]

Carbanion

(C)  (7) electrons in outermost shell

Free radical

(D)  (6) electron in outermost shell

Carbene

8. Ans. (A)

Most stable carbocation is :

(A) $CH_3-\overset{\oplus}{C}H_2$ + I group $\rightarrow$ so stable

(B) $Br-CH_2-\overset{\oplus}{C}H_2$ – I group Br $\rightarrow$ so unstable

(C) $Cl-CH_2-\overset{\oplus}{C}H_2$ – I group Cl $\rightarrow$ so unstable

(D) $F-CH_2-\overset{\oplus}{C}H_2$ – I group F $\rightarrow$ so unstable

9. Ans. (A)

(A) $\overset{\ominus}{C}H_2-CH_2-NO_2$ (B) $\overset{\ominus}{C}H_2-CH_2-CN$

–I group –I group

(C) $\overset{\ominus}{C}H_2-CH_2-COOH$ (D) $\overset{\ominus}{C}H_2-CH_2-CH_2-CH_2-F$

–I group –I group

–I effect is highest for $-NO_2$, so most stable carbanion is $\overset{\ominus}{C}H_2-CH_2-NO_2$

10. Ans. (A)

(a) $\overset{\ominus}{C}H_2$ (b) $\overset{\ominus}{N}H_2$ (c) $\overset{\ominus}{O}H$ (d) $F^{\ominus}$

Basic strength $\alpha \frac{1}{EN}$

$\Rightarrow$ EN : F > O > N > C

$\Rightarrow$ Order : (a) > (b) > (c) > (d)

11. Ans. (A)

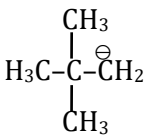
acidic strength $\propto \frac{-I}{+I}$

$\Rightarrow$ – I order = $-NO_2$ > –F > –Ph

$\Rightarrow$ $-CH_3$ shows +I effect.

$\Rightarrow$ order : a > b > c > d

12. Ans. (C)



very high +I

as basic strength α + I. So, most basic

13. Ans. (C)

–I order : $-NO_2$ > – F > –Cl > –I

acidic strength α –I strength

so, 3 is strongest acid.

14. Ans. (A)

$CH_2=CH-Cl > :\overset{\oplus}{C}H_2-CH=\overset{\ominus}{Cl}: > :\overset{\oplus}{C}H_2-CH=\ddot{Cl}:^{\ominus}$

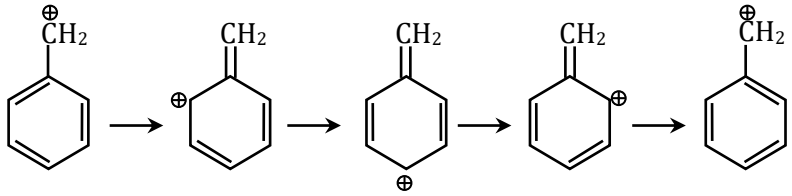
Neutral structure complete octet Incomplete octet

I > II > III

15. Ans. (A)

A = $Ph-\overset{\ominus}{C}H_2$

B = $CH_2=CH-\overset{\ominus}{C}H_2$

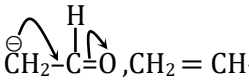
(A) 

(B) $CH_2=CH-\overset{\oplus}{C}H_2 \longleftrightarrow \overset{\oplus}{C}H_2-CH=CH_2$

$\Rightarrow$ (A) Will have greater number of resonating structure.

16. Ans. (B)

(A) $CH_2=CH-OH, CH_3-\overset{O}{\overset{\|}{C}}-H \Rightarrow$ Hence not represent resonance.

(B)  $\Rightarrow$ Represent resonance

(C) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3, CH_3-\overset{OH}{\overset{|}{C}}=CH_2 \Rightarrow$ Not represent resonance

(D) $CH_3-\overset{\oplus OH}{\overset{\|}{C}}-CH_3, \quad CH_3-\overset{OH}{\overset{|}{\underset{H}{|}C}}-CH_3 \Rightarrow$ Position of H is changed.

$\Rightarrow$ not represent resonance

17. Ans. (D)

(a) $G-\overset{O}{\overset{\|}{C}}-OH \longrightarrow H_2\overset{\ominus}{C}-\overset{O}{\overset{\|}{C}}-OH$

(b) $G-\overset{O}{\overset{\|}{C}}-OCH_3 \longrightarrow H_2\overset{\ominus}{C}-\overset{O}{\overset{\|}{C}}-OCH_3$

(c) $G-\overset{O}{\overset{\|}{C}}-Cl \longrightarrow H_2\overset{\ominus}{C}-\overset{O}{\overset{\|}{C}}-Cl$

But (d) $G-\overset{\oplus}{N}\begin{matrix}H\\-H\\H\end{matrix} \rightarrow$ Will not have any conjugation due to unavailable empty p orbital.

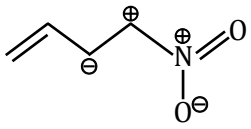
(e) $G-\overset{O}{\overset{\|}{C}}H_2^{\oplus} \longrightarrow H_2\overset{\ominus}{C}-\overset{\oplus}{C}\begin{matrix}H\\H\end{matrix}$

18. Ans. (D)

$CH_3-\ddot{O}-\overset{\ominus}{C}H-\overset{\oplus}{C}H-CH=CH_2$

Because octet of carbon is incomplete and there is repulsion between negative charge of carbon and lone pair of oxygen.

19. Ans. (A)



(a) will be least stable, as positive -positive charges are close to each other.

20. Ans. (D)

(A) $H_2C=CH-\overset{O}{\overset{\|}{C}}-H \longleftrightarrow \overset{\oplus}{C}H_2-CH=\overset{O^{\ominus}}{\overset{|}{C}}-H$

(B) $CH_2=CH-\overset{\oplus}{C}HCl$; $\overset{\oplus}{C}H_2-CH=CH-Cl$

(C) $CH_3-\overset{O}{\overset{\|}{C}}-O^{\ominus} \longleftrightarrow CH_3-\overset{O^{\ominus}}{\overset{|}{C}}=O$

(D) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$, $CH_3-CH=\overset{HO}{\overset{|}{C}}-CH_3$ (Not resonance)

21. Ans. (A)

$\therefore$ Negative charge on more E.N atom is more stable.

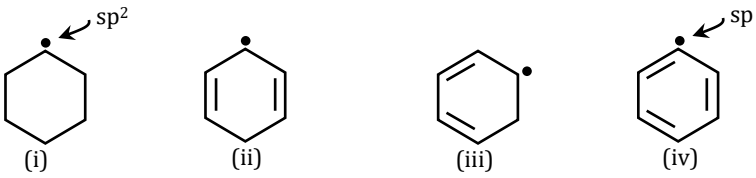
22. Ans. (B)

For a compound to show resonating structure only π–bond should be broken of formed and no dislocation of atom takes place.

$CH_3-\overset{3}{C}H=\overset{2}{C}H-\overset{1}{C}H_2$ (H) $\not\longleftrightarrow CH_3-CH_2-CH=CH_2$

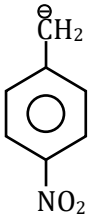
Here H–atom is transferred from to 3 position by breaking of σ–bond.

23. Ans. (B)

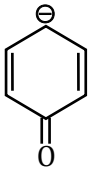


(i) (ii) (Cross conjugation) (iii) Extended (conjugation) (iv)

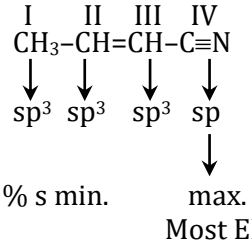
24. Ans. (D)

Most stable carbanion is 

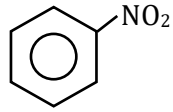
25. Ans. (B)

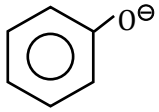
More Stable due to Resonance. 

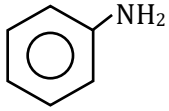
26. Ans. (D)

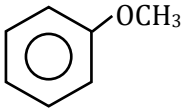


27. Ans. (B)

(A)  –M of NO_2

(B)  +M of $O^{\ominus}$

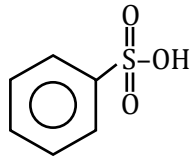
(C)  +M of NH_2

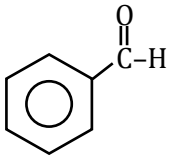
(D)  +M of OCH_3

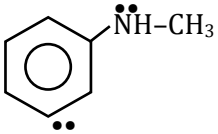
$\Rightarrow \pi$–$e^{\ominus}$ density in benzene ring $\propto \frac{+M}{-M}$

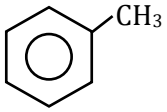
$\Rightarrow$ +M of $-O^{\ominus}$ > $-NH_2$ > $-OCH_3$

28. Ans. (C)

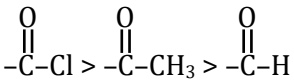
(A)  –M of $-SO_3H$

(B)  – M of –CHO

(C)  +M of $-\ddot{N}H-CH_3$

(D)  Neither +M nor –M

29. Ans. (C)



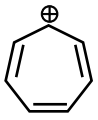
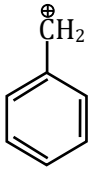
most δ+ least δ+

Group having highest (partial positive charge) gives more –M effect.

30. Ans. (A)

(P)	(Q)	(R)	(S)	(T)
–OH	$-NO_2$	$-CH_2-CH_3$	$-\overset{\oplus}{N}H_3$	$-NH_2$
+M	–M	Neither +M, – M	Neither +M, – M	+M
–I	–I	+I	–I	–I

31. Ans. (D)

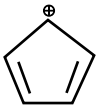
(I)  (II) $CH_2=CH-\overset{\oplus}{C}H_2$ (III)  (IV) $CH_3-\overset{\oplus}{C}H-CH_3$

Aromatic ⇓ Most Stable | Resonance | Resonance (More) | 6 α-H ⇓ Least Stable

Because for stability of $C^{\oplus}$ we will see –

(1)	Dancing Resonance	Increase stability	(6)	+I	Increase stability
(2)	Aromati city		(7)	Hybridisation	
(3)	+M		(8)	–I	Decrease stability
(4)	Resonance		(9)	–H	
(5)	+H		(10)	–M	
			(11)	Antiaromatic	

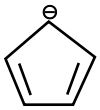
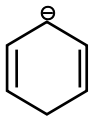
32. Ans. (C)

Anti–Aromatic | Anti–Aromatic | Aromatic | Anti–Aromatic

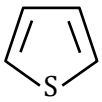
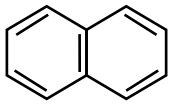
$(4n+2)\pi e^{\ominus}$ cyclic planer

33. Ans. (B)

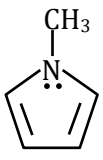
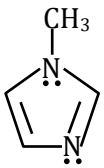
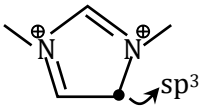
Anti–Aromatic | Aromatic $(4n+2)\pi e^{\ominus}$ cyclic planar | Non–Aromatic | Non–Aromatic

34. Ans. (D)

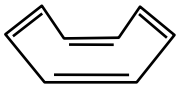
Aromatic | Aromatic | Cyclic planar | Non–Aromatic Non–planer

35. Ans. (D)

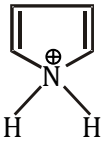
(i) Cyclic Planar $(4n+2)\pi e^{\ominus}$ (Aromatic) | (ii) Cyclic Planar $(4n+2)\pi e^{\ominus}$ (Aromatic) | (iii) Cyclic Non–planar (Non–Aromatic)

36. **Ans. (B)**

 This is actually non-planar. 

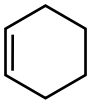
Hence, non-aromatic.

37. **Ans. (A)**



Compound is non–planar and their is no complete conjugation. so, non-aromatic. (Nitrogen is sp^3 hybridise)

38. **Ans. (D)**

 $\rightarrow sp^3$ –carbon

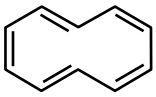
$\rightarrow sp^3$ –carbon

Compound is non-planar and their is no complete conjugation. so, non-aromatic.

39. **Ans. (D)**

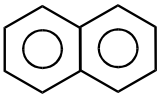
All compounds are aromatic as they complete all conditions of aromaticity.

40. **Ans. (C)**



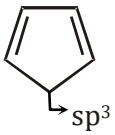
Compound is non-planar. So, non-aromatic

41. **Ans. (C)**



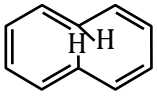
$\Rightarrow$ follows all conditions of aromatic compound. So, aromatic

42. **Ans. (A)**



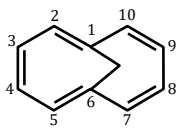
Incomplete conjugation and non-planar. So, non-aromatic.

43. **Ans. (B)**



$\rightarrow$ non-aromatic

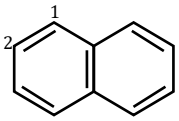
Due to steric repulsion between H-atom, ring becomes unstable. To become stable, ring becomes non-planar. Hence, non-aromatic.



$\Rightarrow$ aromatic

Ring containing carbon atoms 1 to 10 is aromatic. So, whole compound is aromatic.

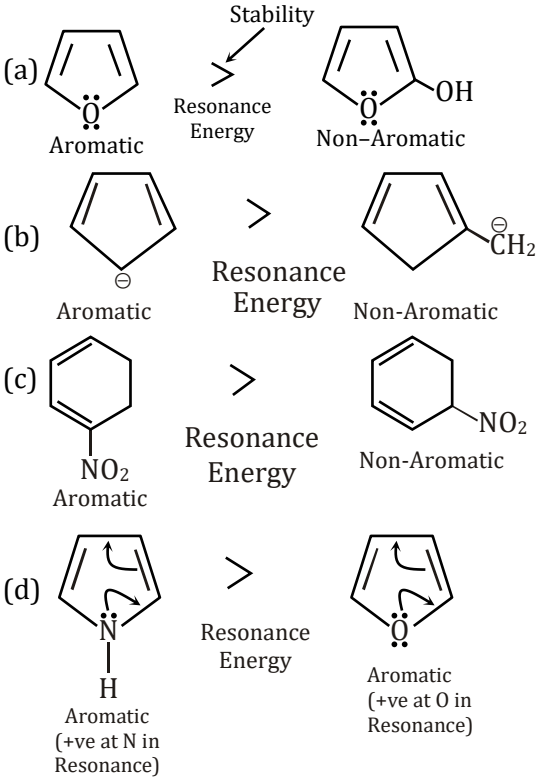
44. Ans. (B)



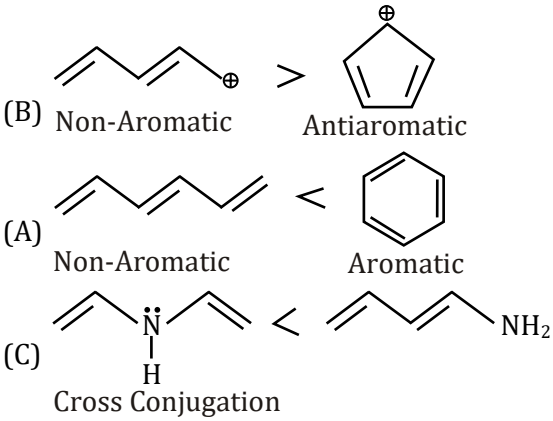
Fries Rule (2 benzenoid ring)

This structure is more contributing in R.H. so, it has double bond character b/w (1–2) so bond is shorter

45. Ans. (D)



46. Ans. (B)



47. Ans. (D)

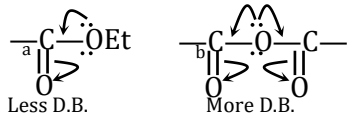
$CH_3-\underset{\underset{6\alpha H}{|}}{\overset{\overset{CH_3}{|}}{C}}=CH_2$ more hyperconjugation = converted into more single bond. B.L. ↑

48. Ans. (A)

$CH_2=C=CH_2$ no resonance, no hyperconjugation(shortest B.L.)

sp C

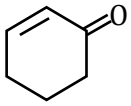
49. Ans. (D)

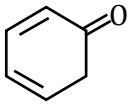


Less D.B. Character at (a) ⇓ BL ↑

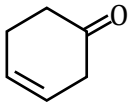
More D.B. Character at (b) ⇓ BL ↓

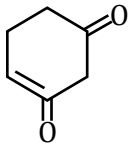
50. Ans. (B)

(A) 

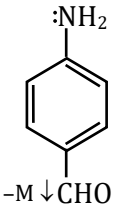
(B) 

Long conjugation more single bond character

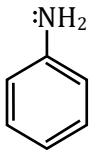
(C) 

(D) 

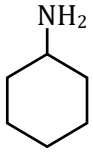
51. Ans. (C)

(I) 

more conjugation due to -M of CHO more C=N character

(II) 

Less C = N Character

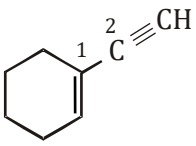
(III) 

Pure C— N

(IV) Pure C=N

Order : - III > II > I > IV

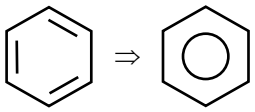
52. Ans. (D)



⇒ Carbon 1 is sp^2 and carbon 2 is sp

The bond between sp^2 and sp C is shortest

53. Ans. (A)

(A)  ⇒

All C — C bond
Length equal

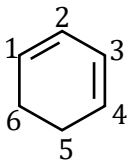
(B) $\overset{1}{CH_2}=\overset{2}{CH}-\overset{3}{CH}=\overset{4}{CH_2} \leftrightarrow \overset{\oplus 1}{CH_2}-\overset{2}{CH}=\overset{3}{CH}-\overset{\ominus 4}{CH_2}$

(I) (II)

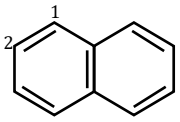
R.S. (I) > (II) (Stability)

C_1 — C_2 more double bond character
C_2 — C_3 more single bond character

⇒ All BL not equal

(C) 

No cyclic conjugation
All Bond length not equal

(D)  Fries Rule (2 benzenoid ring)

This structure is more contributing in R.H. so, it has double bond character b/w (1–2) so bond is shorter

54. Ans. (B)

H_3C-CH_3 ⇒ Complete C — C

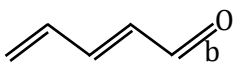
 ⇒ partial C = C

$H_2C=CH_2$ ⇒ Complet C = C

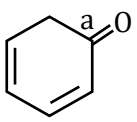
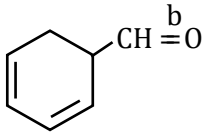
$HC\equiv CH$ ⇒ Complet C≡C

Order : $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$
Option : (B)

55. Ans. (A)

(A) 

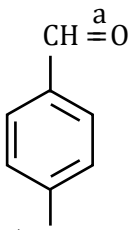
more conjugation, so more single bond character around C–O bond.

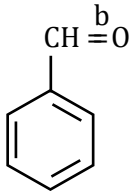
(B)  

⇒ Conjugation
⇒ C ---- O character
⇒ a > b

⇒ No Conjugation
⇒ Complete C = O

(C)





$\Rightarrow$ +M $\uparrow$ NH_2

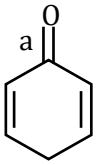
$\Rightarrow$ More conjugation due to +M of -NH_2

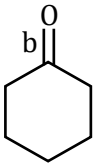
$\Rightarrow$ Less conjugation

Conjugation $\propto$ C — O BL

$\Rightarrow$ a > b

(D)





$\Rightarrow$ Conjugation

$\Rightarrow$ C ---- O

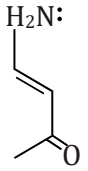
$\Rightarrow$ No conjugation

$\Rightarrow$ complete C = O

$\Rightarrow$ a > b

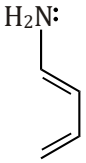
56. Ans. (D)

(A)



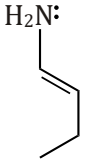
More conjugation

(B)



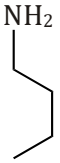
Less conjugation

(C)



Least conjugation

(D)

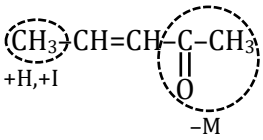


Pure single bond

$\Rightarrow$ conjugation $\alpha \frac{1}{C-N\ BL}$

$\Rightarrow$ order : - D > C > B > A

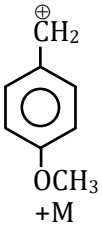
57. Ans. (C)



58. Ans. (B)

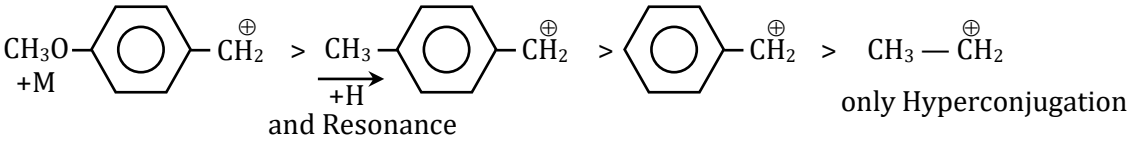
Only α–H.

59. Ans. (C)



due to +M effect of –OCH_3 option (3) carbocation is most Stable.

60. **Ans. (A)**



a > c > b > d → Stability order

61. **Ans. (D)**

In $H_3C-\overset{O^{\ominus}}{\underset{|}{C}}=O$, negative charge resonates on more electronegative oxygen atom so, D is most stable.

62. **Ans. (D)**

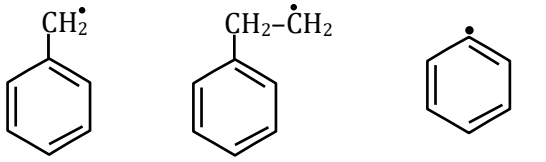
In D, there is least angle strain. So, most stable.

63. **Ans. (B)**

B is aromatic. Hence, most stable.

64. **Ans. (C)**

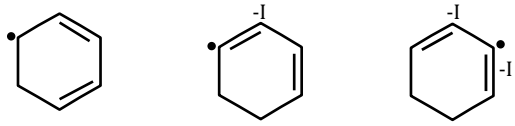
(i)



(p) In Resonance | (q) Hyperconjugation | (r) sp^2 Hybridised

Stability order : p > q > r

(ii)



(x) conjugation | (y) sp^2 hybridised, Less –I | (z) sp^2 Hybridised, More –I

Stability order : x > y > z

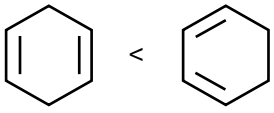
65. **Ans. (D)**

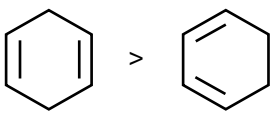
Heat of combustion $\propto \frac{1}{\text{stability}}$. (When number of carbons are same)

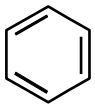
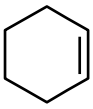
i < iv < iii < ii (Stability)

i > iv > iii > ii (HOC)

66. **Ans. (C)**

(a)  (Stability due to conjugation)

 (H.O.H.)

(b)  and  (No. of double bond) $\propto$ H.O.H

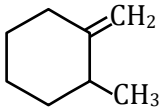
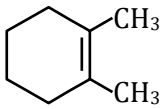
(c) $CH_3-CH=CH-CH_3 > CH_3-CH_2-CH=CH_2$

($6\propto$ H) ($2\propto$ H)

Stability

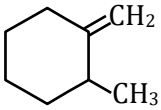
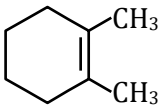
$CH_3-CH=CH-CH_3 > CH_3-CH_2-CH=CH_2$

$CH_3-CH=CH-CH_3 < CH_3-CH_2-CH=CH_2$ (H.O.H)

(d)  and  (stability)

3α – H 10α – H

H.O.H. $\propto \frac{1}{\text{stability}}$ (when no. of π bonds are same)

 >  (H.O.H)

67. Ans. (C)

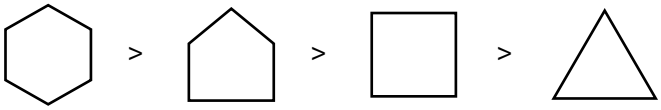
For same number of π-bonds, Heat of hydrogenation $\propto \frac{1}{\text{stability}}$

Stability order: B > D > A > C

So, heat of hydrogenation order: C > A > D > B

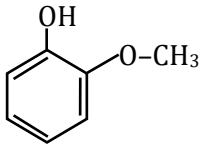
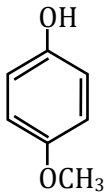
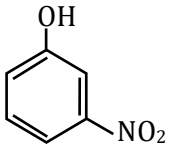
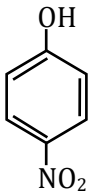
68. Ans. (A)

HOC $\propto$ No. of Carbon atom



$\boxed{a > b > c > d}$

69. Ans. (D)

(I)  (II)  (III)  (IV) 

(+M, –I) (+M, –I) (–I) (–M)

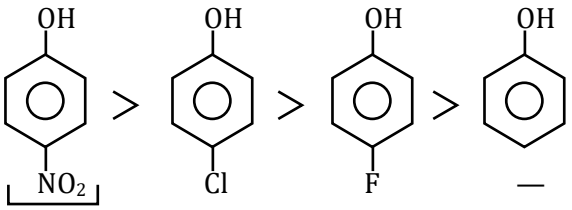
(No H–bonding)

* EWG increases acidity of substituted phenol.

Acidity order $\Rightarrow$ IV > III > I > II

70. **Ans. (C)**

Acidic Strength

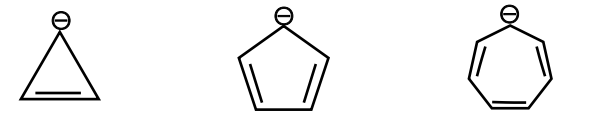


Acidic strength order $\Rightarrow$ – R > –H > –I > +I > +H > + R

71. **Ans. (B)**

due to stability of conjugate base

Conjugate base:



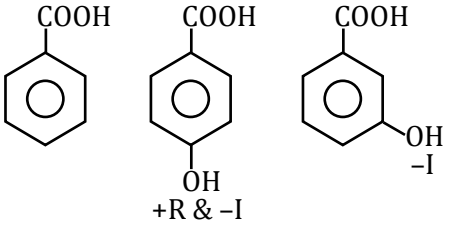
Anti–Aromatic

Aromatic ↓ [most stable]

Anti–Aromatic

72. **Ans. (B)**

Acidic strength of benzoic acid $\Rightarrow$ ortho effect > –R > –H > –I > + I > + H > + R



Ortho effect & +R & –I

73. **Ans. (C)**

According to Bronsted-Lowry concept strong acid, transfers it's $H^{\oplus}$ for water solvent.

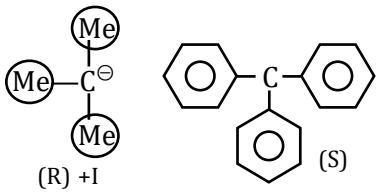
in options a, b & c acid tranfer it's $H^{\oplus}$ from breaking of covalent bond. While in option (C) H–F + SbF_5 presence in ionic form $\boxed{H^{\oplus}SbF_6^{\ominus}}$ which is easily transfer $H^{\oplus}$ when dissolved in H_2O solvent. So strongest acid is [C].

74. **Ans. (C)**

$CH{\equiv}CH$ $CH_2{=}CH_2$ $Me_3C{-}H$ $Ph_3{-}H$

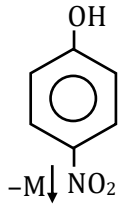
(a) (b) (c) (d)

Conjugate base: $CH{\equiv}C^{\ominus}$ (P) $CH_2{=}CH^{\ominus}$ (Q)

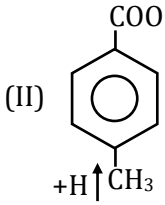


Least stable conjugate base is (R) So (C) is weakest acid.

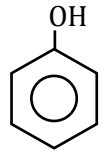
75. Ans. (C)

(I) 

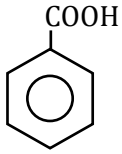
Phenol \ derivative

(II) 

benzoic acid derivative

(III) 

Phenol

(IV) 

benzoic acid

$\Rightarrow$ benzoic acid > phenol (II & IV > I & III)

$\Rightarrow$ Acidic sength $\propto \frac{-M, -H, -I}{+M, +H, +I}$

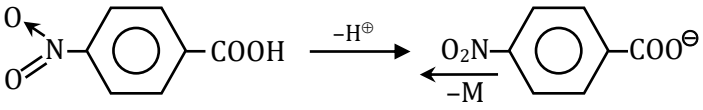
$\Rightarrow$ IV > II & I > III

$\Rightarrow$ overall order : - IV > II > I > IV

$\Rightarrow$ Option (c)

76. Ans. (D)

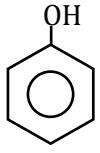
Most acidic compound



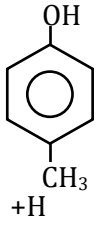
Most stable conjugate base due to –M of $-NO_2$

Option (D) is correct.

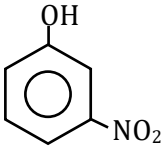
77. Ans. (B)

(A) 

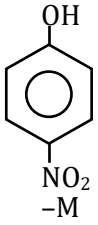
Phenol

(B) 

+H

(C) 

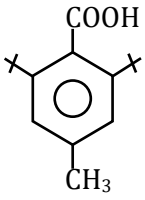
–I

(D) 

–M

D > C > A > B

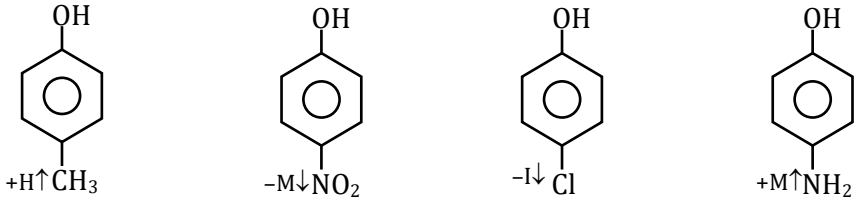
78. Ans. (B)



$\therefore$ Due to maximum ortho effect, it is most acidic.

79. Ans. (A)

(i)



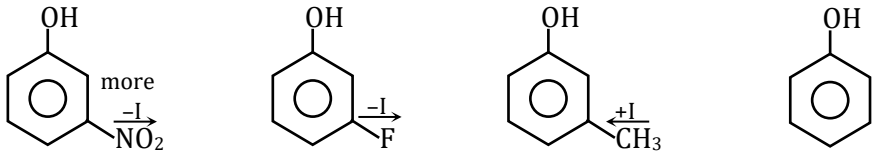
(a) (b) (c) (d)

$\Rightarrow$ Acidic strength $\propto \frac{-M,-H,-I}{+M,+H,+I}$

$\Rightarrow$ Most acidic = (b)

$\Rightarrow$ Power :– M > H > I

(ii)



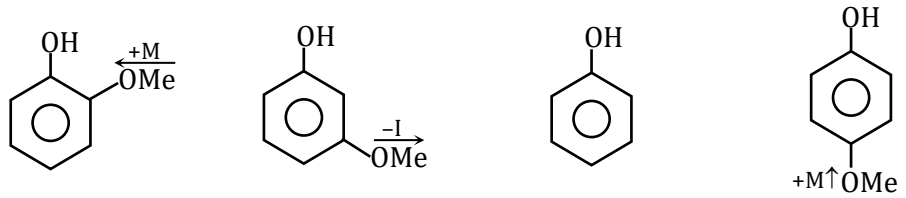
(a) (b) (c) (d)

$\Rightarrow$ Acidic strength $\propto \frac{-I}{+I}$

$\Rightarrow$ Most acidic = (a)

$\Rightarrow$ –I order $-NO_2 > -F$

(iii)

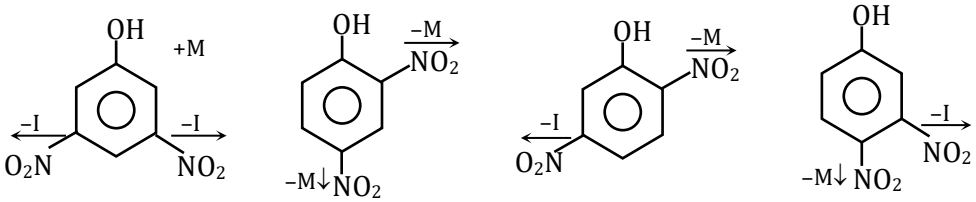


(a) (b) (c) (d)

$\Rightarrow$ Acidic strength $\propto \frac{-M,-H,-I}{+M,+H,+I}$

$\Rightarrow$ Most acidic = (b)

(iv)



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

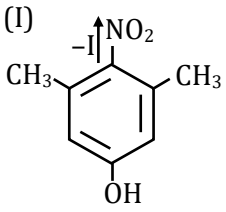
$\Rightarrow$ Acidic strength $\propto \frac{-M,-H,-I}{+M,+H,+I}$

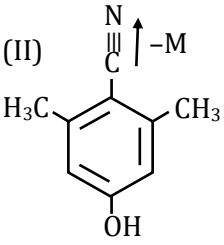
$\Rightarrow$ Most acidic = (b)

$\Rightarrow$ Power :– More -M groups, more -M effect

80. Ans. (D)

(1) False

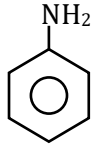
(I) 

(II) 

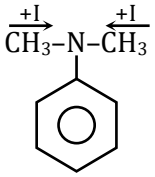
SIR effect $-NO_2$ deviates w.r.t. ring)

$\Rightarrow$ option (D)

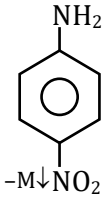
81. Ans. (C)



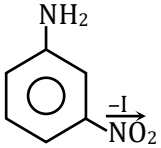
(I)



(II)



(III)



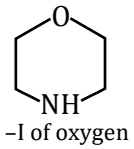
(IV)

$\Rightarrow$ Basic strength $\propto \frac{-M,-H,-I}{+M,+H,+I}$

$\Rightarrow$ order - II > I > IV > III

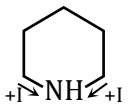
82. Ans. (A)

(A)

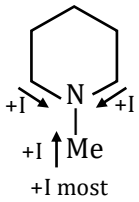


–I of oxygen

(a)



(b)



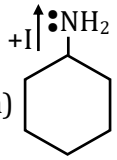
+I most

(c)

$\Rightarrow$ Acidic strength $\propto \frac{+I}{-I}$

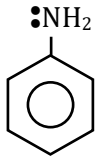
$\Rightarrow$ order = c > b > a

(B)

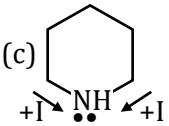
(a) 

l_p localised

+I less

(b) 

lp delocalised

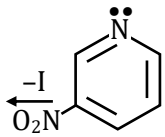
(c) 

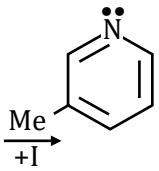
l_p localised

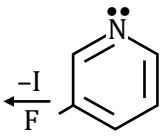
+I more

$\Rightarrow$ basic strength $\propto \frac{+I}{-I}$

$\Rightarrow$ order : - c > a > b

(C) (a) 

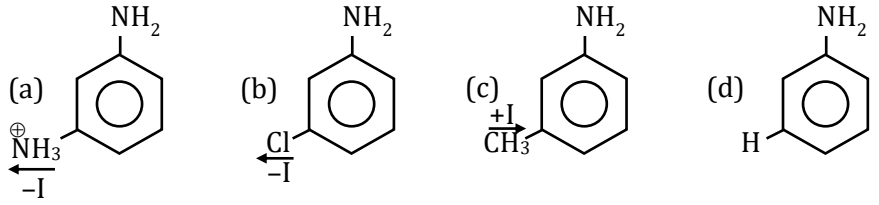
(b) 

(c) 

$\Rightarrow$ –I of $-NO_2$ > –F

$\Rightarrow$ order : - b > c > a

(D)



$\Rightarrow$ Basic strength $\propto \frac{+I}{-I}$

$\Rightarrow$ –I of $-\overset{\oplus}{N}H_3$ > – Cl $\Rightarrow$ order : - c > d > b > a

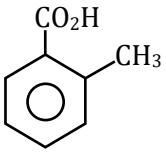
83. Ans. (C)

$\therefore$ (R) lone pair is localised so it is most basic N-atom.

84. Ans. (A)

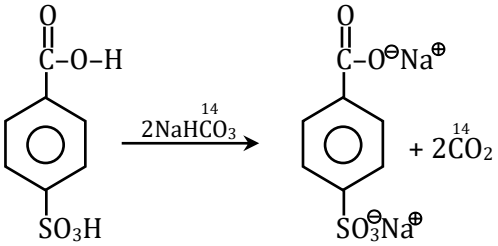
$\therefore$ (A) lone pair is localised and nitrogen sp^3 hybridised so it is most basic

85. Ans. (B)

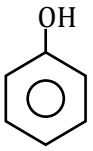


It is most acidic due to ortho effect.

86. Ans. (C)

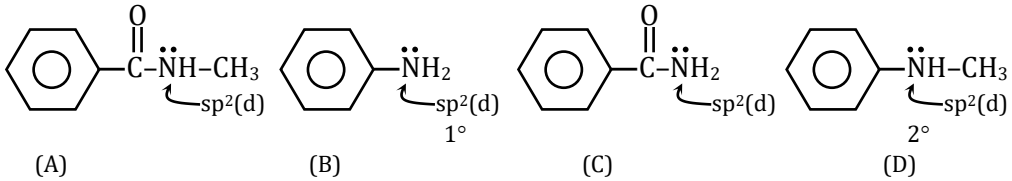


87. Ans. (A)



is a weak acid as compared to H_2CO_3 and so does not produce CO_2 with $NaHCO_3$ Option (A) is Answer.

88. Ans. (D)

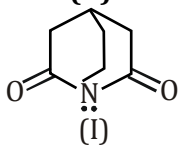


(A) (B) (C) (D)

(D) its resonating structure is less stable hence its basicity in higher than (a).

Basicity order :– (D) > (B) > (A) > (C)

89. Ans. (A)



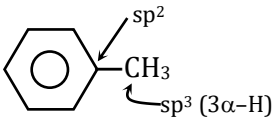
(I)

In this lone pair is localised because formation of π-bond at bridgehead carbon is highly unstable (Bredt's rule).

whereas, in (II) lone pair is delocalised. So, less (II) is basic.

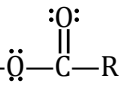
90. **Ans. (B)**

sp^2–C directly bonded with sp^3–C having H shows hyperconjugation.



Its shows hyperconjugation.

91. **Ans. (C,D)**

ortho and para directing groups are :- $-NH_2$, 

92. **Ans. (C,D)**

$\Rightarrow$ lp containing groups show +M –effect

+M effect : $-NH_2$, –SR

93. **Ans. (A,B)**

– M effect : -  –SO_3H

94. **Ans. (B,C)**

Both NO and $-CH=CH_2$ can show +M as well as –M effect.

95. **Ans. (B,D)**

$-\overset{\oplus}{N}H_3$ and $-CH_3$ can neither show +M nor –M effect.

96. **Ans. (A,D)**

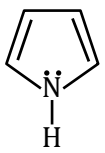
–OH and –Cl groups can show both –I and +M effect.

97. **Ans. (A,B,C)**

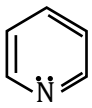
On the basis of no. of Ha or α–H

$CH_3-C\equiv C-CH_3$ 6Hα

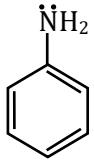
98. **Ans. (A,B,C)**

(A) 

(a) Aromatic l_p

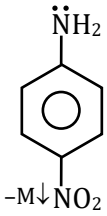


(b) Localised l_p

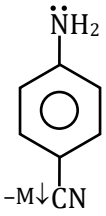


(c) delocalised l_p

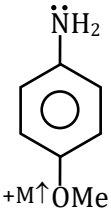
$\Rightarrow$ order b > c > a

(B) 

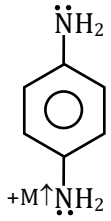
(a)



(b)



(c)



(d)

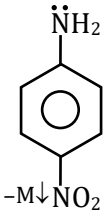
$\Rightarrow$ Basic strength $\propto \frac{+M}{-M}$

$\Rightarrow$ +M of $-NH_2$ > –OMe

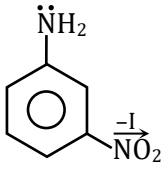
$\Rightarrow$ –M of $-NO_2$ > –CN

$\Rightarrow$ order d > c > b > a

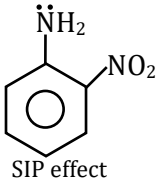
(C)



(a)



(b)

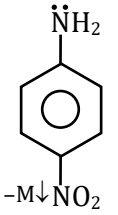


SIP effect
least basic

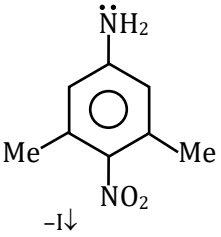
(c)

$\Rightarrow$ Order : b > a > c

(D)



(a)



(b)

$\Rightarrow$ Order : b > a

99. Ans. (B,D)

Reaction in which weak acid is formed at product side are feasible.

EXERCISE - S

1. Ans. (4)

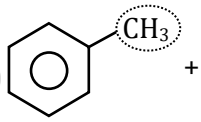
(a) – OH : – I (b) $-O^{\ominus}$: + I (c) $-NH_2$:- –I (d) $-\overset{\ominus}{N}H$: +I

(e) –COOH : – l (f) $-COO^{\ominus}$: +l (g) –Me : +I (h) –OMe : –I

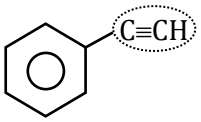
(i) –F :- –I (j) $-\overset{\oplus}{N}F_3$: –I

$\Rightarrow$ + I groups :- (b), (d), (f), (g) : - (4)

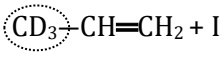
2. Ans. (5)

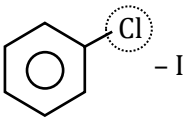
(i) 

+ I

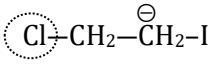
(ii) 

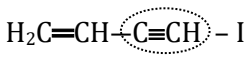
– I

(iii) 

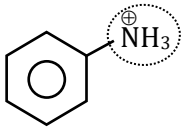
(iv) 

– I

(v) 

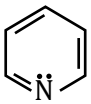
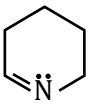
(vi) 

– I

(vii) 

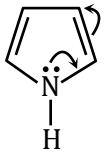
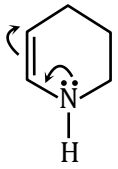
– I

3. Ans. (3)

(a)  (c)  (f) $CH_2 = CH - CH = \ddot{N}H$

$\Rightarrow$ In (a), (c) & (f) lone pair of N is in sp^2 –hybridised orbital.

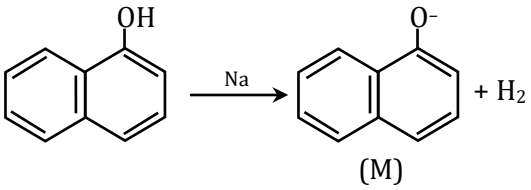
$\Rightarrow$ Not involved in resonance

(b)  (d)  (e) $\overset{\ominus}{C}H_2{=}CH{-}CH_2$

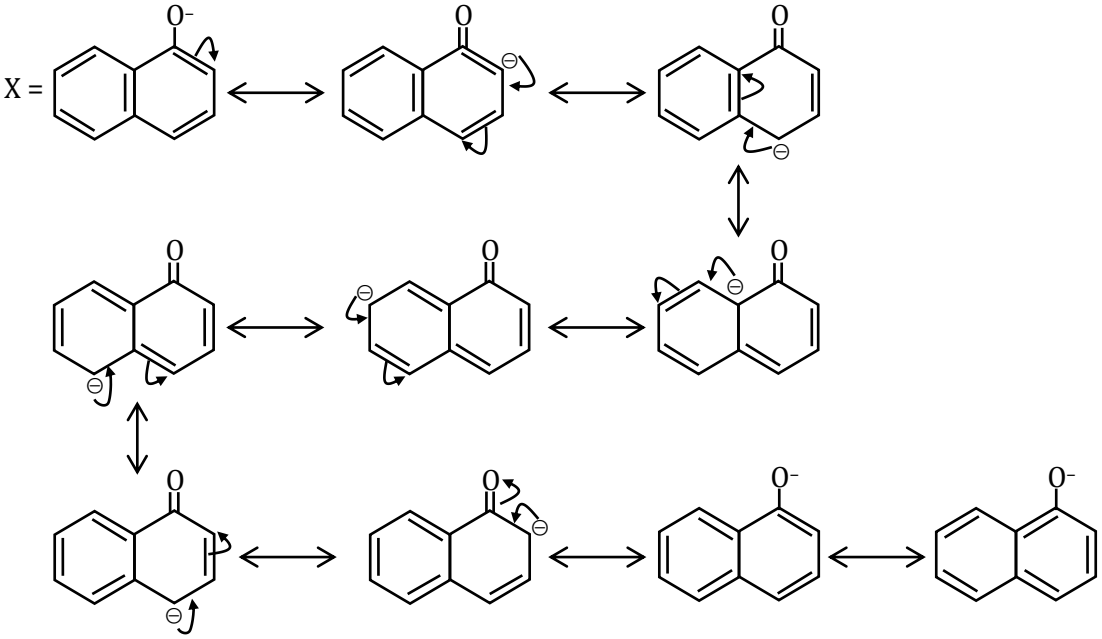
$\Rightarrow$ In (b), (d) & (e) lone pair is involved in resonance

$\Rightarrow$ Answer : (b), (d) & (e)

4. Ans. (8)

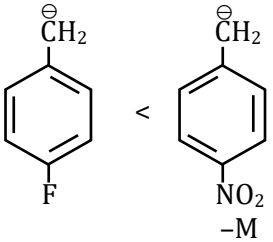


(M)

X = 

x = 10 ; y = 2 ; x–y = 8

5. Ans. (2)

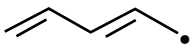
(i)  b > a

$\Rightarrow$ due to - M effect $-NO_2$

(ii) $\overset{\ominus}{C}H_2$ — CHO > $\overset{\ominus}{C}H_2$ — CH_3

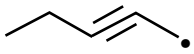
–M of –CHO

a > b

(iii) 

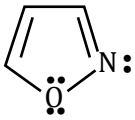
long conjugation

a > b

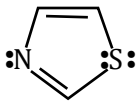


stability

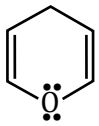
6. Ans. (2)

(a) 

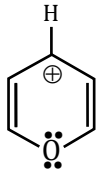
⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

(b) 

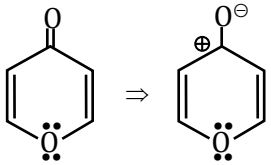
⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

(c) 

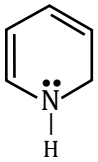
⇒ No cyclic conjugation
[Non - Aromatic]

(d) 

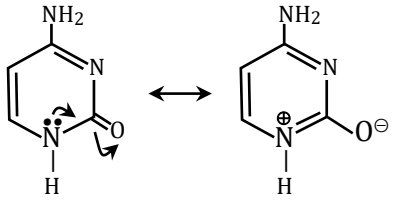
⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

(e) 

⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

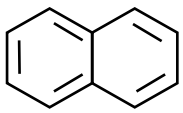
(f) 

⇒ No cyclic conjugation
[Non - Aromatic]

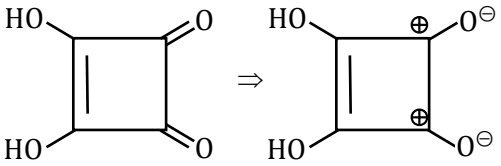
(g) 

⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

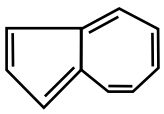
7. Ans. (4)

(a) 

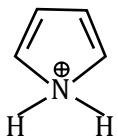
⇒ Planar
⇒ cyclic conjugation
⇒ $10\pi e^{\ominus}$
[Aromatic]

(b) 

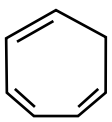
⇒ Planar
⇒ cyclic conjugation
⇒ $2\pi e^{\ominus}$
[Aromatic]

(c) 

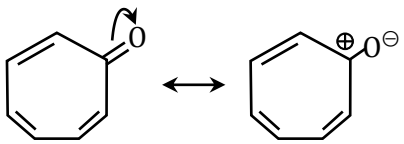
⇒ Planar
⇒ cyclic conjugation
⇒ $10\pi e^{\ominus}$
[Aromatic]

(d) 

⇒ No cyclic conjugation
⇒ [Non - Aromatic]

(e) 

No cyclic conjugation
[Non - aromatic]

(f) 

⇒ Planar
⇒ cyclic conjugation
⇒ $6\pi e^{\ominus}$
[Aromatic]

8. **Ans.** (7)

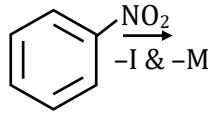
b, e, f, g, j, i, d

9. **Ans. (3)**

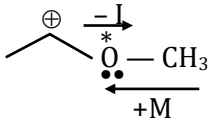
$-NO_2$, $-COCH_3$ and $-CONH_2$ will show -R effect.

10. **Ans. (3)**

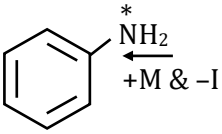
(a) $CH_3 - CH = CH - \overset{\overset{O}{\|}}{C} - H$ ($-I$ & $-M$)

(b) 

(c) $H_2C = CH - F:$ ($+M$, $-I$)

(d) 

(e) $H_3C - CH = CH - \overset{*}{C}H_3$ ($+I$)

(f) 

$\Rightarrow$ No. of –I & +M groups = 3

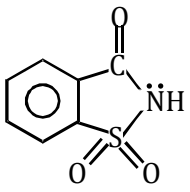
11. **Ans. (4)**

$-NO_2$, $-CN$, $-COOH$, $-CH=NH$ are $-M/-R$ group

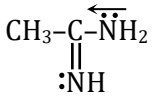
12. **Ans. (3)**

(a, c, f)

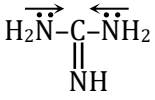
13. **Ans. (6)**



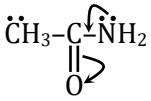
→ delocalised lp
→ M of $-SO_2$ group
→ $-M$ of $-\overset{\overset{O}{\|}}{C}-$ group

(i) 

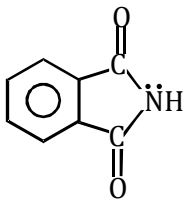
→ $+M$ of NH_2
→ super localized lp
→ More basic

(ii) 

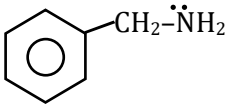
→ $+M$ of two $-NH_2$ groups
→ super duper localized lp
→ More basic

(iii) 

→ delocalized lp
→ More basic
→ $-M$ of $-\overset{\overset{O}{\|}}{C}-$ group

(iv) 

→ delocalized lp
→ More basic
(–M of $-SO_2$ > –CO)
→ –M of $-\overset{\overset{O}{\|}}{C}-$ group

(v) 

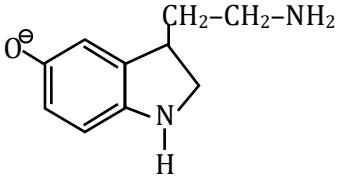
→ Localised lp
→ more basic

(v) 

→ Localised lp
→ more basic

→ Total 6 compounds are more basic than saccharin.

14. Ans. (3)



⇒ 3 basic groups are present :– $-O^{\ominus}$, $-\ddot{N}H-$, $-NH_2$

15. Ans. (2)

Benzoic acid and Benzene Sulphonic acid are more acidic compounds that H_2CO_3 so these are capable to react with $NaHCO_3$ to give a salt and CO_2 gas.

16. Ans. (7)

(b, c, d, e, f, g, h)

17. Ans. (6)

Compound that can give effervescence of CO_2 with $NaHCO_3$, should be stronger acid than H_2CO_3
These are (i), (ii), (iii), (iv), (v), (ix)

18. Ans. (5)

(a, b, c, f, i)

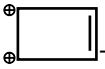
EXERCISE - JEE (Main) PYQ

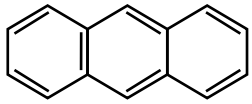
1. Ans. (1)

For the following ion/compounds

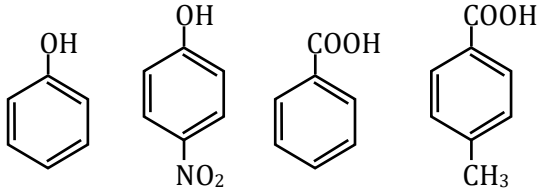
(1)  –Non aromatic

(2)  –Aromatic

(3)  –Aromatic

(4)  –Aromatic

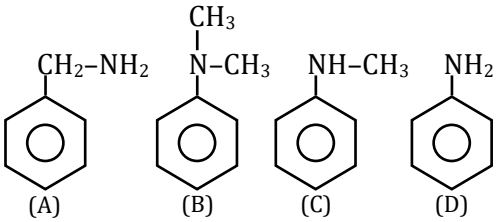
2. Ans. (4)



(I)	(II)	(III)	(IV)
Non eq. Reso	–I/–M	Eq. Reso	+I/+H.C

2 > 3 > 4 > 1

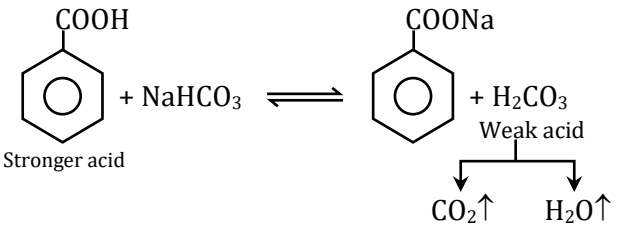
3. Ans. (4)



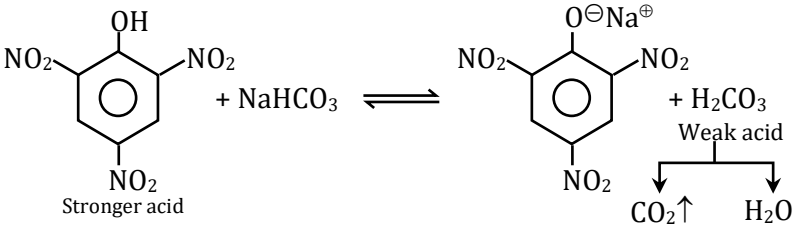
(A) (B) (C) (D)

B.S. order (A) > (B) > (C) > (D)

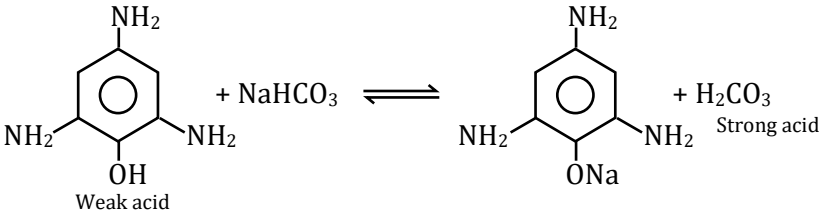
4. Ans. (3)



equilibrium favours forward direction and $CO_2\uparrow$ is librated.



Equilibrium favours forward direction and $CO_2\uparrow$ is librated.

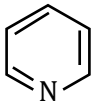


Weak acid

Equilibrium favours backward direction and $CO_2\uparrow$ is not librated.

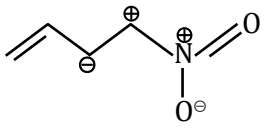
5. Ans. (3)

(1) NaH (sodium Hydride) is used as a reducing reagent.

(2)  In pyridine, due to free electron on N atom, it is basic in nature.

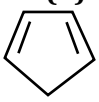
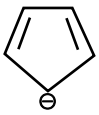
Hence statement I is false & II is true.

6. Ans. (1)



It is unstable RS (due to similar charge on adjacent atom)

7. Ans. (4)

 ; because its conjugate base is aromatic 

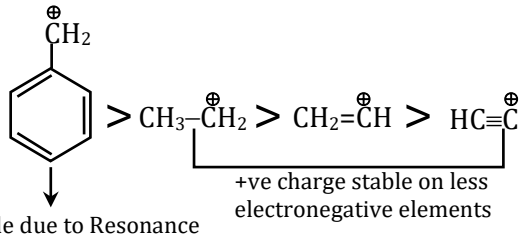
Strongest acid

8. Ans. (2)

Explanation :- aniline is more basic than acetamide because in acetamide, lone pair of nitrogen is delocalised to more electronegative element oxygen.

In Aniline lone pair of nitrogen delocalised over benzene ring.

9. Ans. (1)



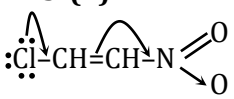
Stable due to Resonance

10. Ans. (3)

Statement I : It is correct statement

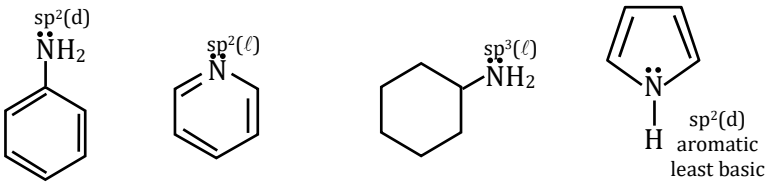
Statement II : $\left(CH_3-\overset{\oplus}{C}H_2\right)$ involve $C_{sp^2}-H_{1s}$ bond with empty 2p orbital hence given statement is false.

11. Ans. (4)



Due to –M effect of $-NO_2$ and + M effect of Cl more D.B. character between C–Cl bond. So shortest bond length.

12. Ans. (3)

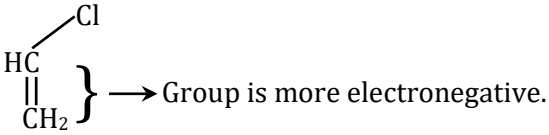


(I) (II) (III) (IV)

$$\text{Basicity} \propto \frac{1}{\text{EN of atom}}$$

Basicity order (III) > (II) > (I) > (IV)

13. Ans. (3)



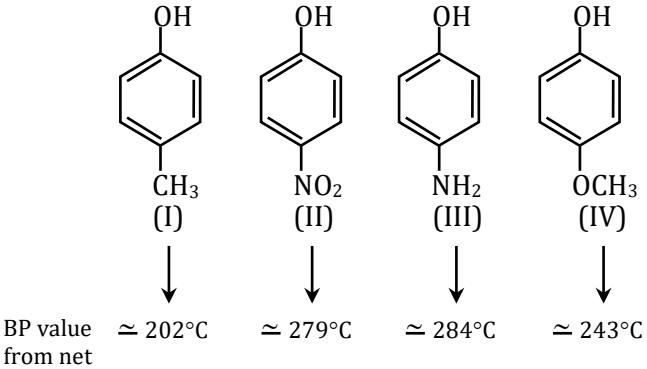
⟶ Group is more electronegative.

In option (3) C–Cl bond is shortest due to resonance of lone pair of –Cl.

Due to resonance C–Cl bond acquire partial double bond character.

Hence C–Cl bond length is least.

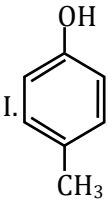
14. Ans. (1)



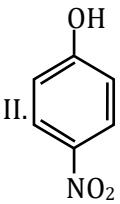
BP ∝ dipolemoment (μ)

Alter

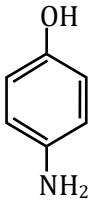
Increasing order of boiling point is :

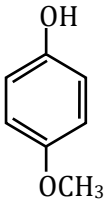


I. ⇒ Shows hydrogen bonding from –O–H group only



II. ⇒ Shows strongest hydrogen bonding from both sides of –OH group as well as $-NO_2$ group.

III.  ⇒ Shows stronger hydrogen from both side of –OH group as well as $-NH_2$ group.

IV.  ⇒ Shows stronger hydrogen bonding from one side –OH–group and another side of –

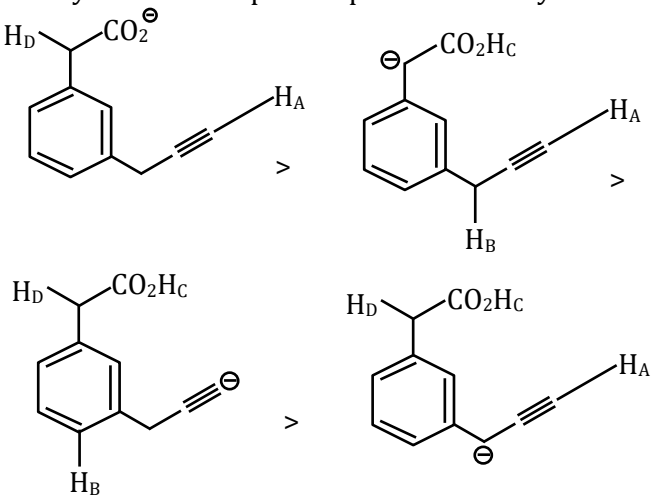
OCH_3 group shows only dipole-dipole interaction.

⇒ Hence correct order of boiling point is:

(I) < (IV) < (III) < (II)

15. Ans. (2)

acidity of an acid depends upon the stability of its conjugate base



16. Ans. (3)

Compound 2, 3, 7

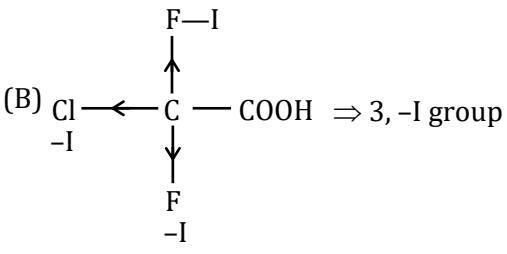
17. Ans. (4)

$$\text{Acidic Strength } \alpha \frac{1}{+I \text{ effect}}$$

$$\boxed{\text{Acidic Strength } \alpha -I \text{ effect}}$$

$\boxed{F > Cl > Br}$ –I effect order

(A) $\underset{+I}{CH_3} \longrightarrow COOH$

(B)  ⇒ 3, –I group

(C) Cl ←(+I)— CH_2 —→ COOH

(D) F ←(–I)— CH_2 —→ COOH

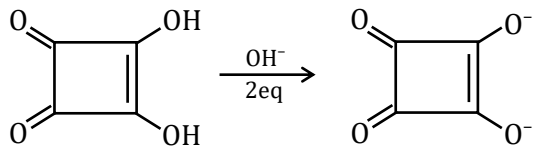
(E) Br ←(–I)— CH_2 —→ COOH

So, Option (4) B > D > C > E > A

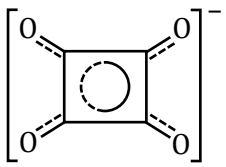
18. Ans. (2)

Stability order of cations is : C < A < B < D

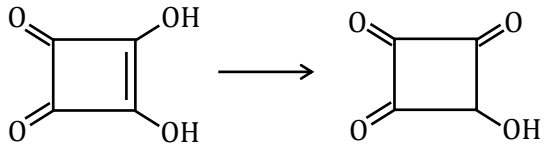
19. Ans. (4)



Squaric acid (B) Aromatic



Resonance hybrid of B showing all C-C bond length same

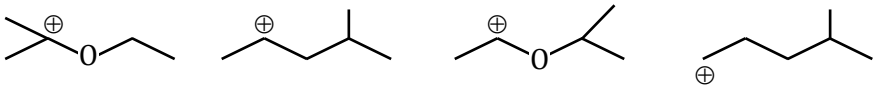


Eno form Keto form

it can show tautomer

EXERCISE - JEE (Advanced) PYQ

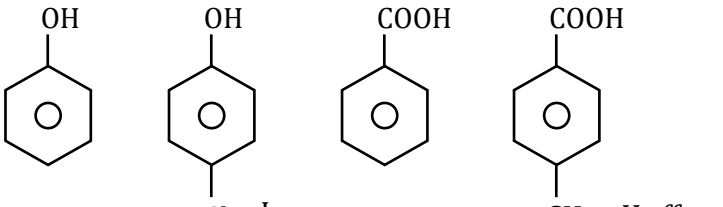
1. Ans. (D)



Back Bonding αH = 6 | αH = 5 | Back Bonding α H = 3 | α H = 2

Stability Order : I > III > II > IV

2. Ans. (A)



(I) | (II) Cl –I effect | (III) | (IV) CH_3 +H effect

Benzoic Acid is more Acidic than phenol. So, I, II are less acidic than III, IV –I effect increases acidic strength whereas +H decreases acidic strength. Hence, overall order :- III > IV > II > I

3. Ans. (B)

(I) Octet Complete | (II) Incomplete Octet | (III) Complete Octet | (IV) Incomplete Octet

Among I and II: - as negative charge is more stabilised at more electronegative atom N. So, stability: I > II.

Among II and IV, Negative charge is more stabilised on more electronegative N. So, stability II > IV

Hence, overall stability: - I > III > II > IV

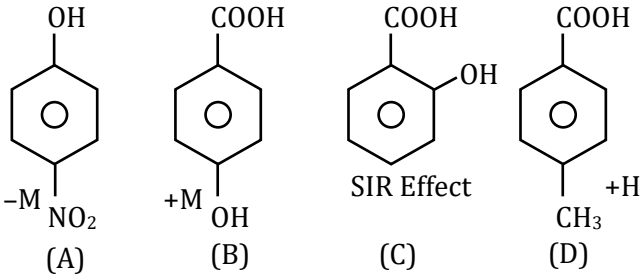
4. Ans. (4)

$HA + NaOH \rightleftharpoons NaA + H_2O$

Compounds which are more acidic than H_2O are soluble in aqueous NaOH.

BDFH are more acidic than water.

5. Ans. (C)



(A) –M NO_2 | (B) +M OH | (C) SIR Effect | (D) +H CH_3

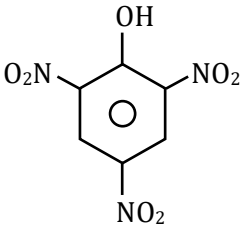
⇒ Carboxylic acids are more acidic than phenols

⇒ Among B, C and D, due to ortho effect in (C), it is most acidic.

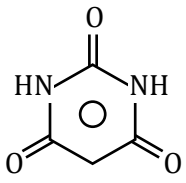
6. **Ans. (6)**

Total number of contributing structures showing hyper conjugation involving C–H bonds = number of α–H = 6.

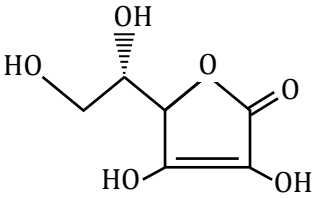
7. **Ans. (D)**



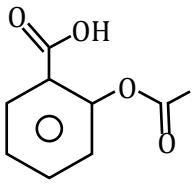
Picric acid



Barbituric Acid



Ascorbic acid



Aspirin

8. **Ans. (B,D)**

(B) C_6H_5-COOH (1)
+
$C_6H_5-CH_2-OH$ (2) $\xrightarrow{\text{aq. NaOH}}$ 1 (Soluble) + 2 (Insoluble)

$\downarrow$ aq. $NaHCO_3$

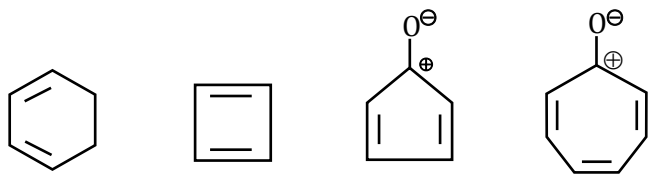
1 (Soluble) + 2 (Insoluble)

(D) $C_6H_5-CH_2-OH$ (1)
+
$C_6H_5-CH_2-COOH$ (2) $\xrightarrow{\text{aq. NaOH}}$ 1 Insoluble + 2 (Soluble)

$\downarrow$ aq. $NaHCO_3$

1 (Soluble) + 2 (Soluble)

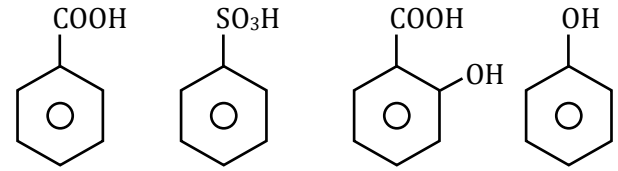
9. **Ans. (B,C)**



Non - aromatic Anti Aromatic Anti aromatic Aromatic

Anti-aromatic compounds are unstable at room temperature.

10. Ans. (D)



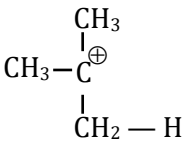
Benzoic Acid | Benzene Sulphonic acid | Salicylic acid | Phenol

$HA + NaHCO_3(aq) \longrightarrow H_2CO_3 + NaA$

Acidic Nature more than H_2CO_3 give CO_2 (g)

Phenol being less acidic than H_2CO_3 will not liberate CO_2.

11. Ans. (A)

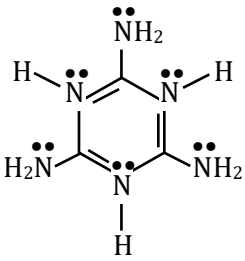


$CH_3 - CH = CH - CH_2 - H$

$\sigma \rightarrow \pi$

$\sigma \rightarrow$ empty p-orbital

12. Ans. (6)

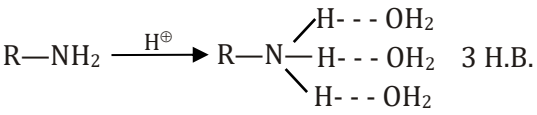


$\Rightarrow$ 6 lone pairs

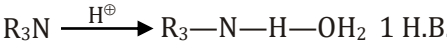
13. Ans. (A,B,D)

(A) Ice is less dense than water, due to open crystal structure of ice because of H–Bonding

(B) The Basicity of 1° Amine is more than 3° amine as after they donate lone pair to $H^{\oplus}$, they can form H–bonding with H_2O molecules and get easily stabilized by solvation. Where as in tertairy amines, the stabilisation by solvation is very less.

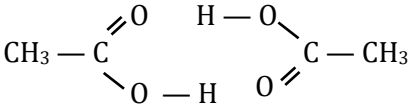


3 H.B.

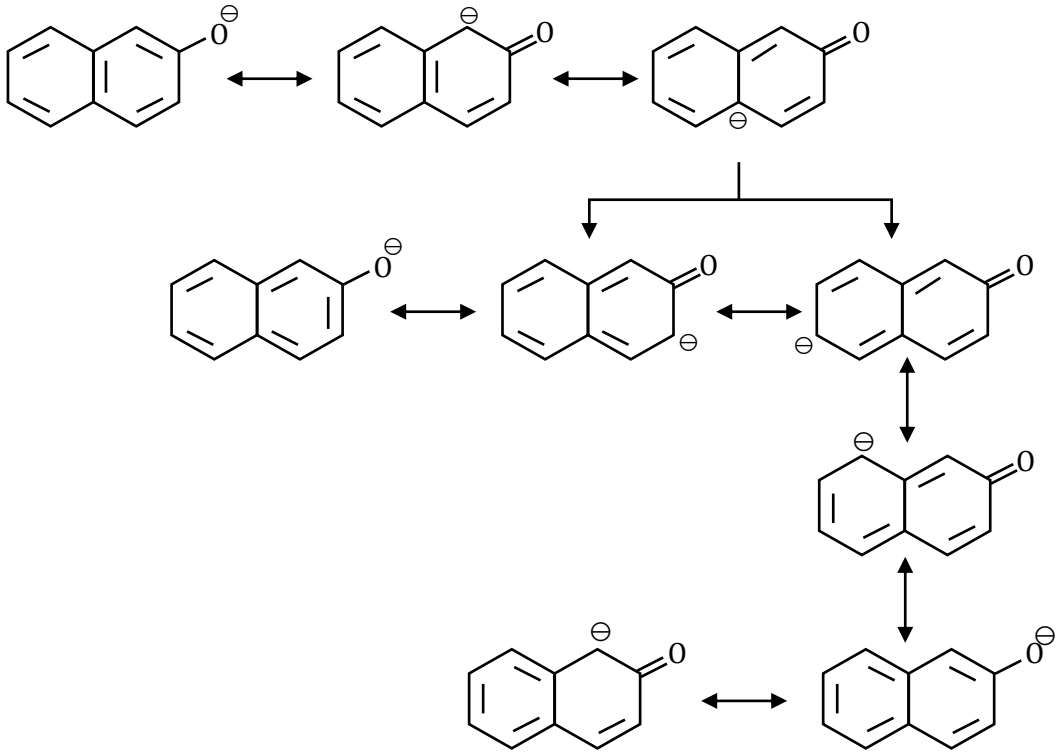


1 H.B.

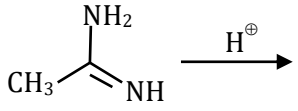
(D) Dimerization of Acetic acid in benzene is due to H - Bonding

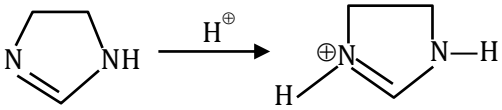


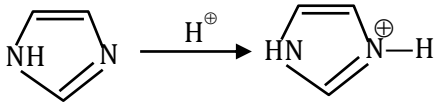
14. Ans. (9)

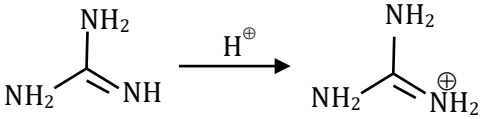


15. Ans. (D)

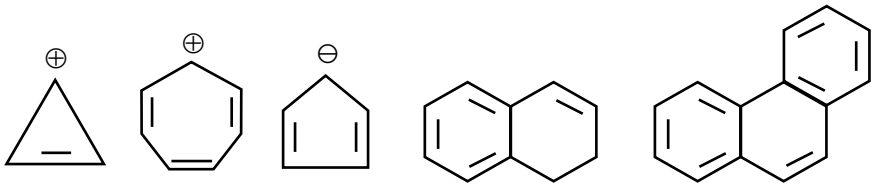
(I)  ⇒ Conjugated Acid is stabilised by resonance with one–NH_2 groupand also by 3∝H of CH_3 by hyperconjugation

(II)  ⇒ conjugated Acid is stabilised by resonance with only 1 - NH_2 group

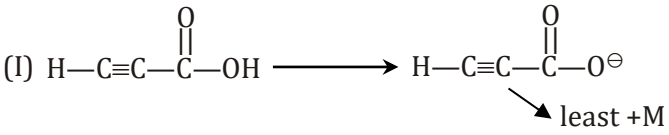
(III)  ⇒ Least basic

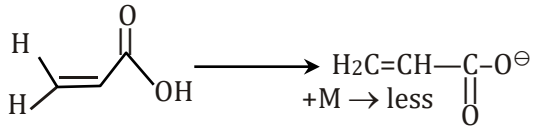
(IV)  ⇒ Conjugated Acidic stabilised by resonance with 2 different - NH_2 groups

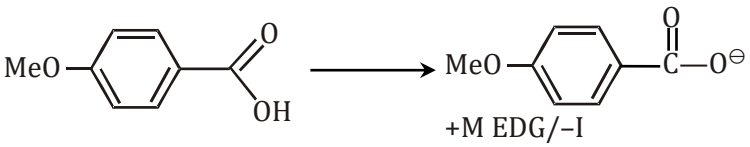
16. Ans. (5)

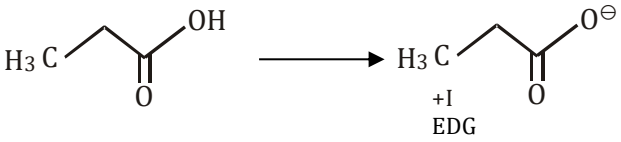
 are Aromatic

17. Ans. (D)

(I) 

(II) 

(III) 

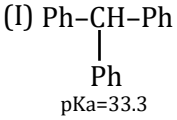
(IV) 

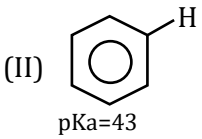
$$\text{Acidic strength} \propto \frac{1}{\text{EDG}}$$

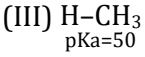
$$\text{Acidic strength} \propto \text{EWG}$$

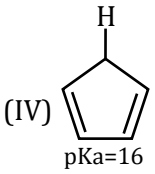
So, acidic Strength I > II > III > IV

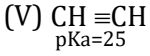
18. Ans. (A,B,C)

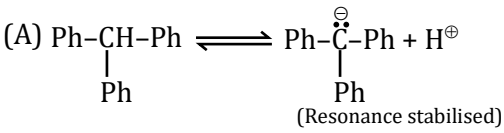
(I) 

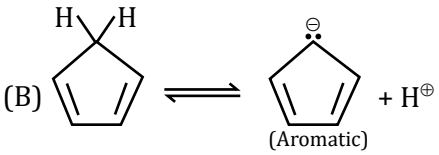
(II) 

(III) 

(IV) 

(V) 

(A) 

(B) 

(C) $-NO_2$ is –I group (electron withdrawing group). It increases acid strength.

(D) Acid strength order : IV > V > I > II > III

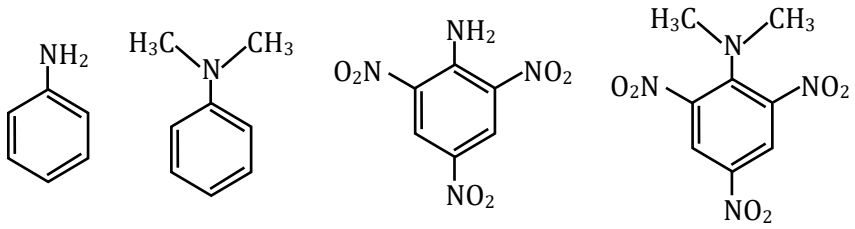
19. Ans. (6)

Here polar molecules in the liquid form will be attracted/deflected near charged comb.

Polar molecules : HF, H_2O, NH_3, H_2O_2, $CHCl_3$, C_6H_5Cl (6-polar molecules)

Nonpolar molecules : O_2, CCl_4, C_6H_6

20. Ans. (C,D)



(I) (II) (III) (IV)

pKb different between I and II is 0.53 and that of III and IV is 4.6.

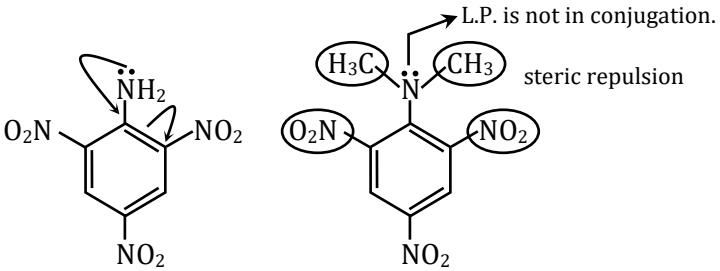
So option (B) is incorrect

Correct Statement (C), (D)

The most basic compound in the given option is (II) and least basic compound is (III)

In 2,4,6-trinitro aniline (III) due to strong –R effect of $-NO_2$ groups, the ℓ.p. of $-NH_2$ is more involved with benzene ring hence it has least basic strength.

Whereas (IV) N,N-Dimethyl 2,4,6-trinitro aniline, due to steric inhibition to resonance (SIR) effect; the lone pair of nitrogen is not in the plane of benzene, hence make it (ℓ.p.) more free to protonate



JEE (Main) Practice Paper

SECTION–A

1. Ans. (2)

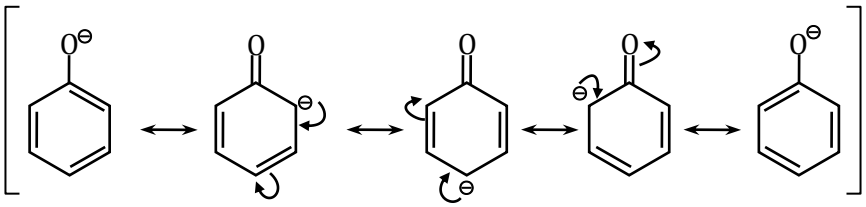
Acidic strength $\alpha \frac{1}{pH}$

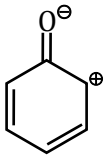
Acidic strength α Stability of conjugate base

Acidic strength $\Rightarrow 3 > 4 > 1 > 2$

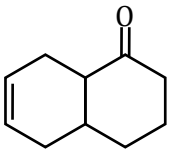
pH $\Rightarrow$ ii > i > iv > iii

2. Ans. (4)



$\Rightarrow$  :- Not valid

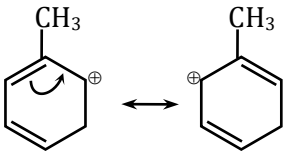
3. Ans. (3)



:- No conjugation

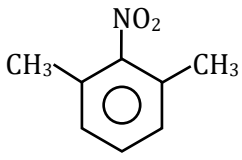
:- No Resonance

4. Ans. (3)



$\Rightarrow 3$

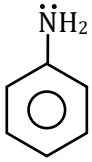
5. Ans. (1)

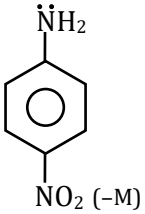


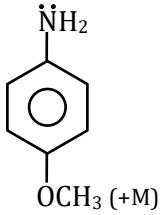
Due to repulsion of two – CH_3 groups, – NO_2 will go out of plane w.r.t benzene ring

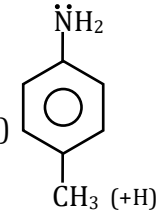
$\Rightarrow$ SIR

6. **Ans. (1)**

(I)  delocalised lone pair

(II) 

(III) 

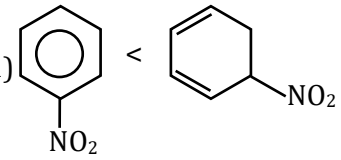
(IV) 

Basic strength $\propto \frac{+M, +H, +I}{-M, -I}$

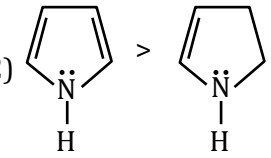
III > IV > I > II

7. **Ans. (2)**

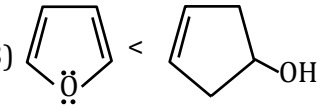
Generally R.E of Aromatic > Non-aromatic

(1)  : incorrect

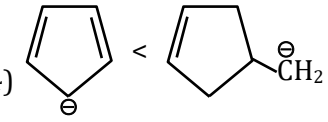
Aromatic

(2)  : correct

Aromatic

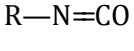
(3)  : incorrect

Aromatic

(4)  : incorrect

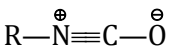
Aromatic

8. **Ans. (1)**



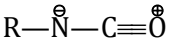
I

Non–polar



II

Polar –ve charge on more EN atom



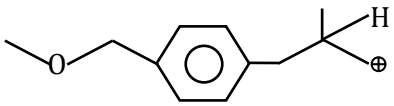
III

Polar –ve charge on Less EN atom less stable

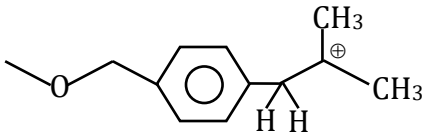
$\Rightarrow$ I > II > III

EN : O > N

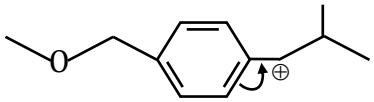
9. **Ans. (1)**

I. 

1α–H

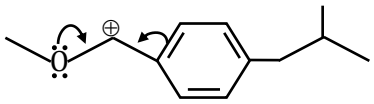
II. 

8α – H

III. 

Benzylic $C^{\oplus}$

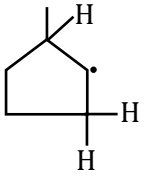
$\Rightarrow$ order : IV > III > II > I

IV. 

+M of

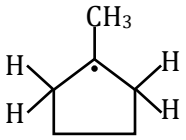
(Most Stable)

10. **Ans. (2)**



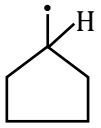
(I)

3α – H



(II)

7α – H



(III)

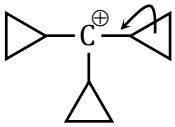
1α – H

(IV)

Resonance Stabilised

$\Rightarrow$ order : IV > II > I > III

11. **Ans. (3)**

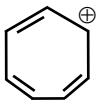


(I)

σ-bond resonance

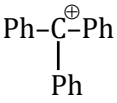
Dancing Resonance

most stable



(II)

Aromatic C-



(III)

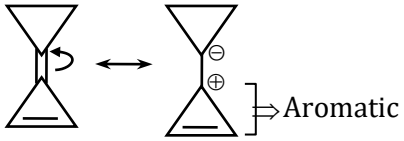
Resonance stabilised

least stable

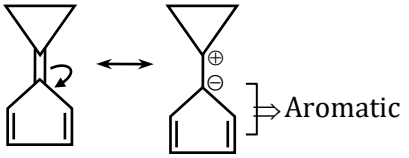
$\Rightarrow$ stability $\alpha \frac{1}{P.E}$ $\Rightarrow$ P.E. order : III > II > I

$\Rightarrow$ I :- C II :- B III :- A

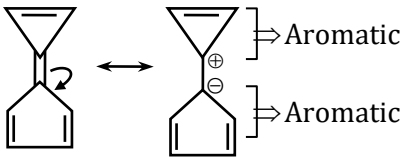
12. **Ans. (3)**

(1) 

$\Rightarrow$ Aromatic

(2) 

$\Rightarrow$ Aromatic

(3) 

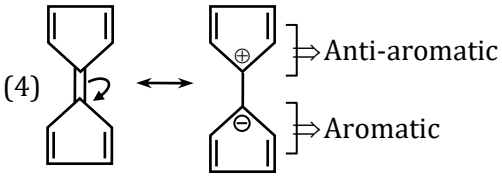
$\Rightarrow$ Aromatic

$\Rightarrow$ Aromatic

$\Rightarrow$ Both ring aromatic

$\Rightarrow$ Most charge separate.

$\Rightarrow$ Highest dipole moment

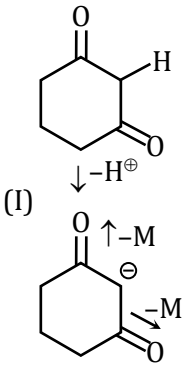
(4) 

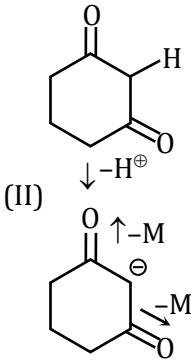
13. Ans. (1)

Acidic strength α stability of conjugate base

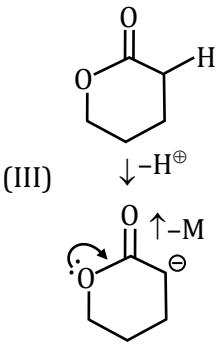
∴ Phenol is less acidic then H_2CO_3, but H_2CO_3 is less acidic then benzoic acid.

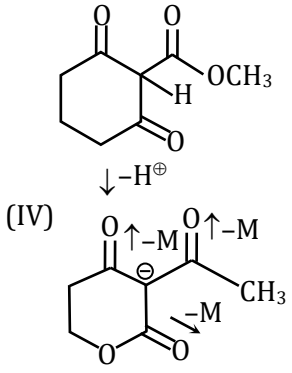
14. Ans. (4)

(I) 

(II) 

–M less than (III)

(III) 

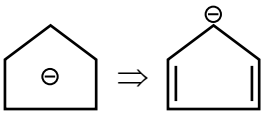
(IV) 

Maximum –M

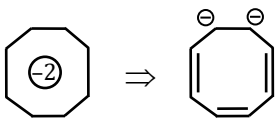
⇒Stability of $C^{\ominus} \propto -M$ ⇒ Acidic strength ∝ stability of $C^{\ominus}$

⇒ Acidic strength:- II < III < I < IV

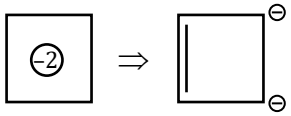
15. Ans. (4)

(1) 

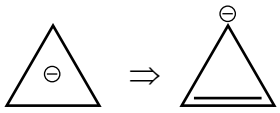
Aromatic

(2) 

Aromatic

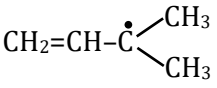
(3) 

Aromatic

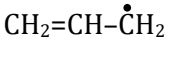
(4) 

Antiaromatic
Least stable

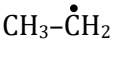
16. Ans. (4)



Resonance and 6αH

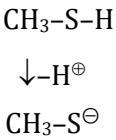


Resonance



3αH

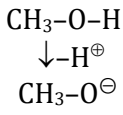
17. Ans. (1)



(I)

–ve on more size
Atom is more stable

Size : S > O



(II)

(III) H_2O $\downarrow -H^{\oplus}$ ^{-}OH

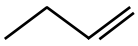
(IV) Et–OH $\downarrow -H^{\oplus}$ $CH_3-CH_2-O^{\ominus}$ $\xrightarrow{+I}$ Least acidic

$\Rightarrow$ Acidic strength α stability of conjugate base $\alpha \frac{1}{+I}$

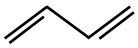
$\Rightarrow$ CH_3 – OH is slightly more acidic than H_2O

$\Rightarrow$ order :- I > II > III > IV

18. (3)



1-butene HOH = 30 Kcal/mol



1,3-butadiene HOH = 57 Kcal/mol , as some energy is utilized in form of resonance energy.

19. Ans. (2)

* $4\pi e^{\ominus}$ so anti aromatic
* less stable than aromatic and aromatic compounds
* shape is rectangular due to C–C bond length & C=C bond length are different

B.L (C–C) = 1.567 Å

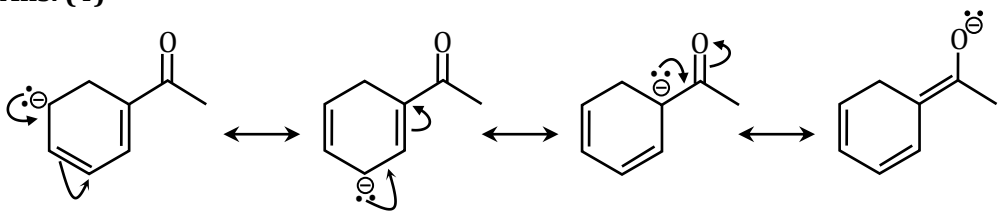
B.L (C=C) = 1.346 Å

20. Ans. (1)

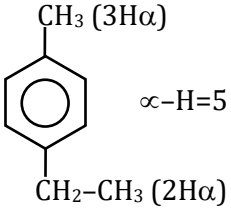
Basic strength $\propto K_b \propto \frac{1}{pK_b}$

SECTION-B

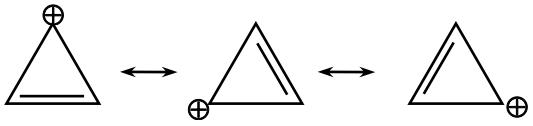
1. Ans. (4)



2. Ans. (5)



3. Ans. (3)



4. Ans. (6)

–I group : $-\overset{\oplus}{N}H_3$, – OH, $-N(CH_3)_2$, $-SO_3H$, –CHO, –Cl

(ii) (iii) (v) (vi) (vii) (viii)

5. Ans. (4)

(b, d, f, g)

Negatively charged group and alkyl group shows +I.

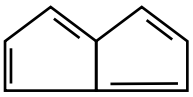
6. Ans. (7)

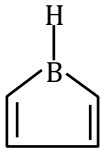
(a), (c), (d), (g), (j), (ℓ), (m) are correct statement about resonance.

7. Ans. (3)

Antiaromatic compounds are unstable at room temperature.

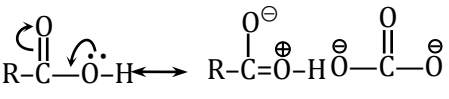
(i)  $4\pi e^{\ominus}$ Antiaromatic

(ii)  $8\pi e^{\ominus}$ Antiaromatic

(vii)  $4\pi e^{\ominus}$ Antiaromatic

8. Ans. (3)

(I) $R-\overset{O}{\overset{\|}{C}}-O^{\ominus} \longleftrightarrow R-\overset{O^{\ominus}}{\overset{|}{C}}=O$ $\Rightarrow$ equivalent R.S. $\Rightarrow$ All C–O B.L. are equal

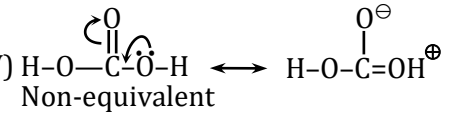
(II) 

Non- equivalent R.S $\Rightarrow$ All C–O B.L. not equal

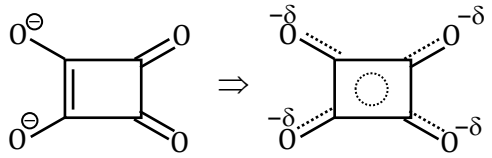
(III) $O^{\ominus}-\overset{O}{\overset{\|}{C}}-O^{\ominus} \leftrightarrow O=\overset{O^{\ominus}}{\overset{|}{C}}-O^{\ominus} \leftrightarrow {}^{-}O=\overset{O^{\ominus}}{\overset{|}{C}}-O$

$\Rightarrow$ Equivalent R.S.

$\Rightarrow$ All C–O B.L. equal

(IV)  $\Rightarrow$ All C–O B.L. not equal

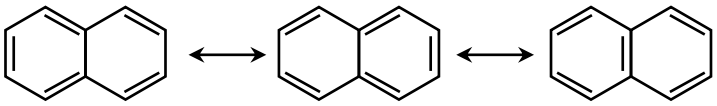
Non-equivalent

(V) 

squaring acid All C–O B.L. are equal

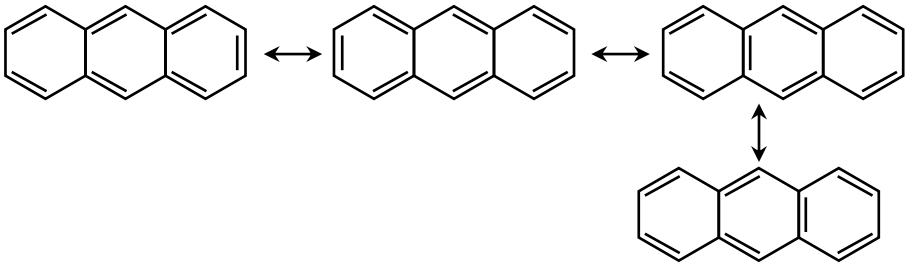
9. **Ans. (7)**

(I) Naphthalene :



$\Rightarrow$ 3 R.S.

(II) Anthracene :

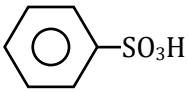


$\Rightarrow$ 4 R.S.

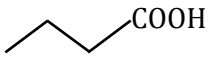
$\Rightarrow$ Total R.S. = 4 + 3 = 7

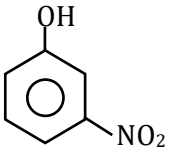
10. **Ans. (4)**

Compounds more acidic compare to water.

(a) 

(b) HCl

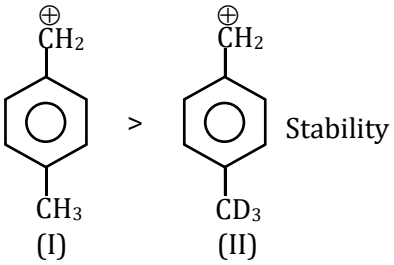
(d) 

(e) 

are more acidic compare to H_2O

JEE (Advanced) Practice Paper

1. Ans. (C)



(I) (II)

$-CH_3 > -CD_3$ (+ H effect) due to weak –C–H bond strength.

2. Ans. (C)

$R-NH_2$ $Ph-NH_2$ $R-\overset{\overset{O}{\|}}{C}-NH_2$

Non-conjugated conjugated conjugated

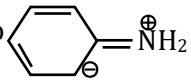
Basic strength Non-conjugated > conjugated

$R-NH_2 > Ph-NH_2 > R-\overset{\overset{O}{\|}}{C}-NH_2$

$Ph-NH_2 > R-\overset{\overset{O}{\|}}{C}-NH_2$

Because $R-\overset{\overset{O}{\|}}{C}-NH_2 \longleftrightarrow R-\overset{\overset{\oplus}{O^{\ominus}}}{C}=\overset{\oplus}{N}H_2$

More stable conjugated structure

compare to 

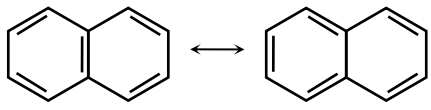
a > b > c

3. Ans. (B)

(A) $\overset{\oplus}{C}H_2 - O - CH_3 < CH_2 = \overset{\oplus}{O} - CH_3$ stability

(I) II (complete octet)

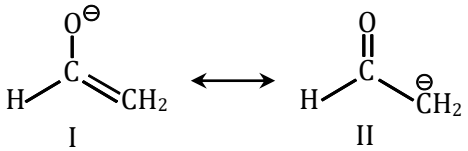
(Incomplete octet)

(B) 

I II

* I > II (stability)

* I has both ring cyclic conjugation, in which both are aromatic, so become more stable.

(C) 

I II

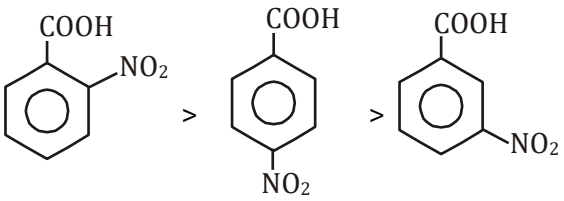
* I > II

* I is more stable resonating structure as –ve change is present on more electronegative atom 'O' as compared to less electronegative atom.

II, I, I are less stable structure.

a –II, b-I, c-I

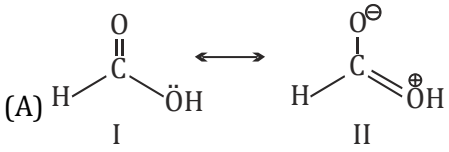
4. Ans. (A)



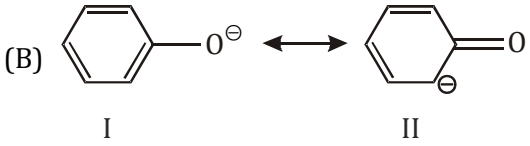
Ortho effect –M –I

c > a > b

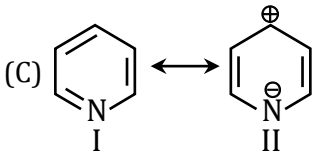
5. Ans. (C)



I > II (due to neutrality of 1st structure)



I > II (Aromaticity is maintained in (stability) 1st structure)

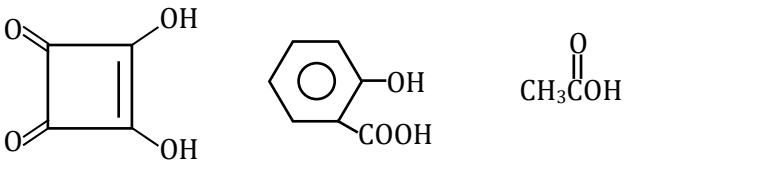


* Neutral structure is more stable compared to charged structure

I > II

I, I, I more stable

6. Ans. (A)



Squaric acid Salicaylic acid Carboxylic acid group.

Option (a) is correct all are more acidic than H_2CO_3.

7. **Ans. (A,D)**

(A) $\overset{\ominus}{C}H_3 > \overset{\ominus}{N}H_2 > \overset{\ominus}{O}H$

Along the period, basic strength $\alpha \frac{1}{\text{Electronegative}}$

So, the given order is correct

(B) $\overset{\ominus}{O}H > Et-O^{\ominus} > Et-\overset{\ominus}{N}H$

also, $Et-\overset{\ominus}{N}H$ has more basic strength due to less electronegativity of nitrogen than oxygen

So, given order is incorrect

(C) $CH_3-\overset{\ominus}{O} > CH_3-\overset{\ominus}{N}H > CH_3\overset{\ominus}{C}H_2$

as, along the period, basic strength $\alpha \frac{1}{\text{Electronegative}}$

So, given order is incorrect

(D) $H_3C-\overset{\ominus}{C}H_2$ $\quad$ $H_2C=\overset{\ominus}{C}H$ $\quad$ $HC\equiv\overset{\ominus}{C}$

sp^3 $\quad$ sp^2 $\quad$ sp

Electronegativity order : $sp > sp^2 > sp_3$

so, basic strength order : $sp^3 > sp^2 > sp$

Hence, given order is correct.

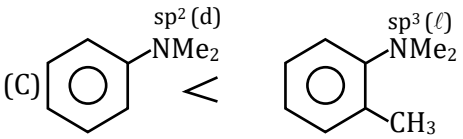
8. **Ans. (A,B,C,D)**

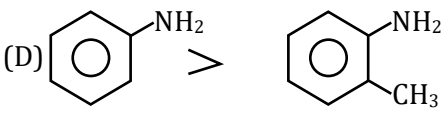
–COOH group is bulkier group, so the groups –OH, $-NO_2$, –COOH and $-CH_3$ shows SIR effect when attached at ortho. Due to SIR effect, the acidic strength of carboxylic acid increases.

9. **Ans. (A,B,C)**

(A) Correct because $CH_3-O-\overset{\oplus}{C}H_2$ is stabilised by lone pair-empty p-orbital resonance (back bonding)

(B) Correct, SIR effect due to presence of $-CH_3$ group at ortho, increase acidic strength of given carboxylic acid.

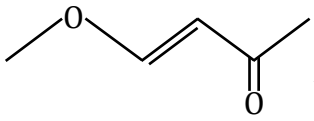
(C) 

(D) 

(SIP) due to ortho

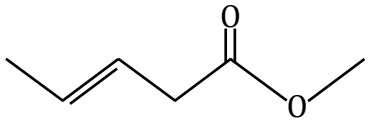
effect basicity decreases

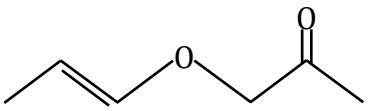
10. Ans. (A,B,C,D)

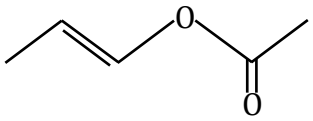
In  , there is extended conugation.

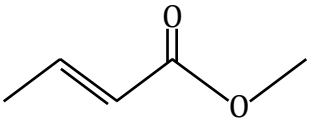
$\Rightarrow$ Bond rotation energy barrier order :

no conjugation > cross conjugation > extended conjugation

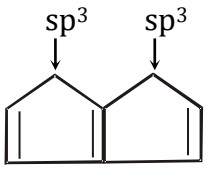
(A)  $\Rightarrow$ no conjugation with C = C $\rightarrow$ higher

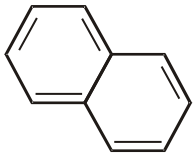
(B)  $\Rightarrow$ cross conjugation $\rightarrow$ higher

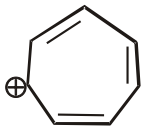
(C)  $\Rightarrow$ cross conjugation $\rightarrow$ higher

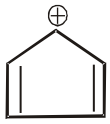
(D)  $\Rightarrow$ cross conjugation $\rightarrow$ higher

11. Ans. (A)

(A)  Non- Aromatic, cyclic structure

(B)  $(4n + 2)\pi = 10\pi e^{\ominus}$ Aromatic , cyclic structure, cyclic conjugation, planar

(C)  $(4n + 2)\ \pi = 6\pi e^{\ominus}$ Aromatic, cyclic structure, cyclic conjugation, planar

(D)  $4\pi e^{\ominus}$ Anti Aromatic structure, cyclic structure

(A) $\rightarrow$ Q,S ; (B) $\rightarrow$ P,S ; (C) $\rightarrow$ P,S ; (D) $\rightarrow$ R,S

12. Ans. (C)

more resonance $\rightarrow$ more resonance energy In III, resonance is maximum, so resonance energy is maximum.

13. Ans. (C)

Bond length of C=C bond α single bond character.

In II and III, resonance involved increases the single bond character in C=C bond. So, C=C bond in II and III is longer than I.

$\Rightarrow$ Among II and III : In III, the resonance present is more than II.

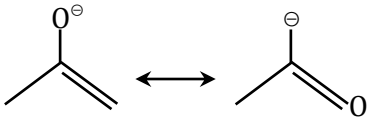
more resonance $\Rightarrow$ more single bond character in C=C bond.

So, III will have highest bond length of C=C bond.

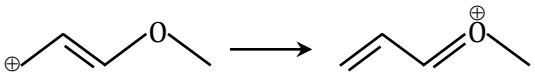
14. Ans. (4.0)

(a) $H_3C-\overset{\oplus}{C}=O \longleftrightarrow H_3C-C\equiv\overset{\oplus}{O}$

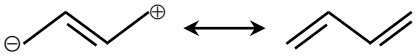
Incomplete octet, less stable — complete octet, more stable

(b) 

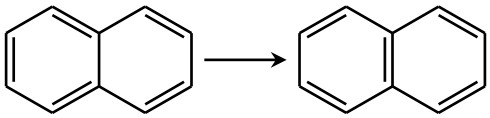
as negative charge is on more electronegative oxygen — less stable

(c) 

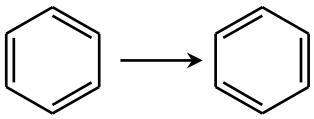
less stable, incomplete octet — more stable, complete octet

(d) 

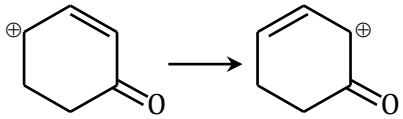
natural more stable

(e) 

1 Benzenoid, less stable — 2 Benzenoid ring, less stable

(f) 

Equal stability

(g) 

more –I, less stable

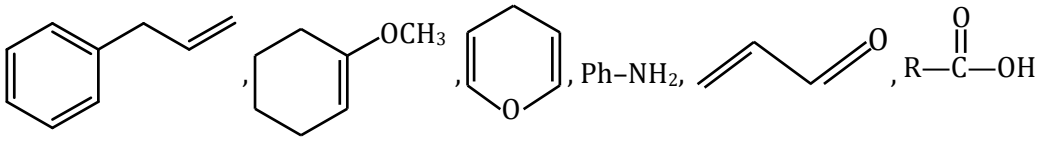
$\Rightarrow$ Total number of pairs in which second is more stable than first = 4

15. Ans. (5.00)

CF_3-CH_2-OH, CH_3-CF_2-OH, $CH_3-\overset{\overset{O}{\|}}{C}-OH$, $CCl_3-\overset{\overset{O}{\|}}{C}-OH$, O_2N-CH_2-OH , are more acidic than CH_3-CH_2-OH.

Total = 5

16. Ans. (6.00)



will show resonance .

Total = 6

17. Ans. (3.00)

Given :

Heat of hydrogenation for $H_2C=CH-CH=CH_2$ = 57 kcal

Heat of hydrogenation for $H_2C=CH-CH_2-CH_3$

= 30 kcal = heat of hydrogenation for one double bond

Theoretical, heat of hydrogenation for two double bonds = 30 × 2 = 60 kcal

Actual value found = 57 kcal

So, resonance energy = Theoretical – actual = 60 – 57 = 3 kcal

18. Ans. (5.00)

$\overset{\ominus}{C}H_3$, $\overset{\ominus}{C}F_3$, $\overset{\ominus}{C}Cl_3$, $\overset{\ominus}{C}H_2-CCl_3$, $\overset{\ominus}{C}H_2-\overset{\oplus}{N}(CH_3)_3$ are more stable than $\overset{\ominus}{C}H_2-CH_3$