

# **ORGANIC CHEMISTRY**

## **TARGET IIT-JEE**

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## **ELECTRONIC DISPLACEMENT EFFECTS**

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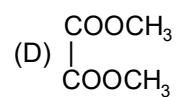
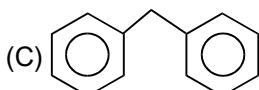
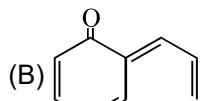
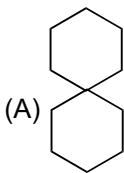


## **EXERCISE - I**

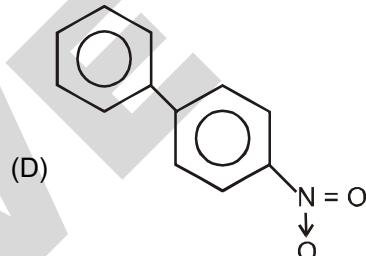
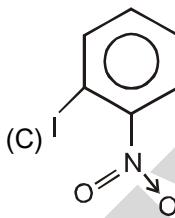
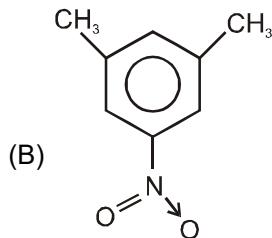
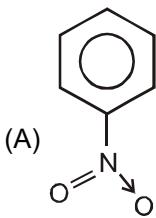
# INDUCTIVE EFFECT

## RESONANCE

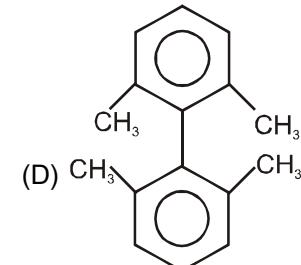
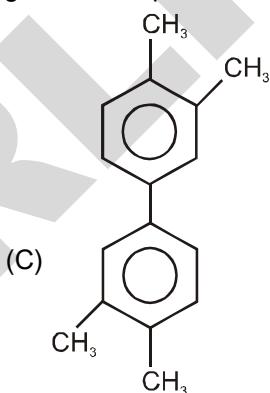
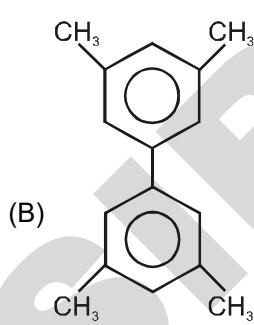
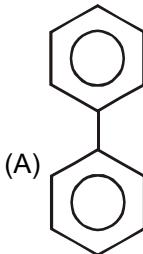
9. In which of the following molecules resonance takes place through out the entire system.



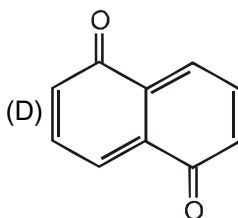
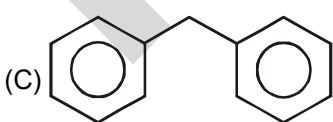
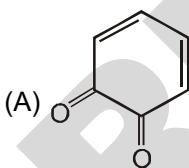
10. In which of the following molecules,  $\text{--NO}_2$  group is not coplanar with phenyl ring?



11. In which of the following molecules both phenyl rings are not coplanar?



12. In which of the following molecules, all atoms are not coplanar?



13. (I)  $\text{CH}_3 - \text{CH} = \text{O}$       (II)  $\text{CH}_2 = \text{CH} - \text{OH}$       (III)  $\text{CH}_3 - \overset{\oplus}{\text{CH}} - \overset{\ominus}{\text{O}}$

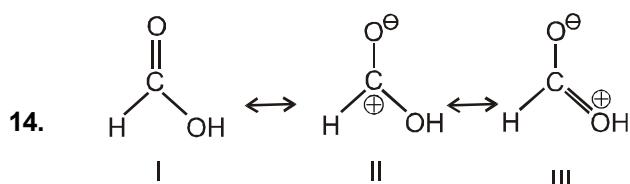
Among, these, which are canonical structures?

(A) I and II

(B) I and III

(C) II and III

(D) all



Among these canonical structures, the correct order of stability is

(A) I > II > III

(B) III > II > I

(C) I > III > II

(D) II > I > III

15. I     $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH} - \text{OCH}_3$

↑  
↓

II     $\Theta - \text{CH}_2 - \text{CH} = \text{CH} - \text{CH} = \text{OCH}_3^+$

↑  
↓

III     $\text{CH}_2 = \text{CH} - \text{CH} - \text{CH} - \text{OCH}_3$

↑  
↓

IV     $\text{CH}_2 = \text{CH} - \text{CH} - \text{CH} - \text{OCH}_3$

Among these canonical structures which one is least stable?

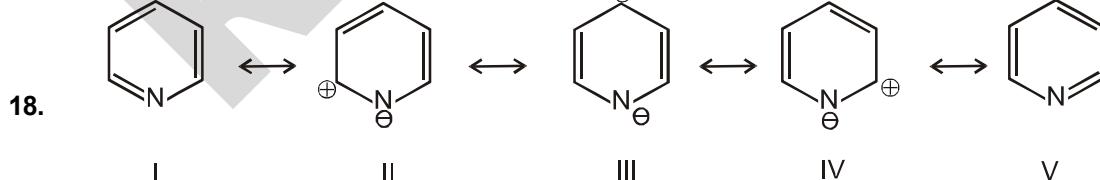
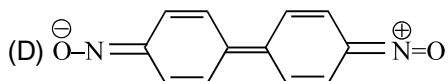
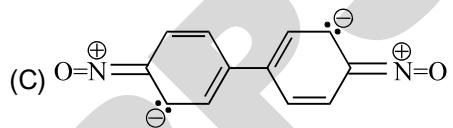
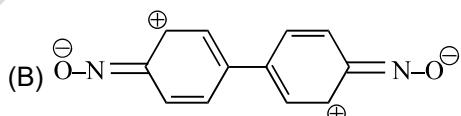
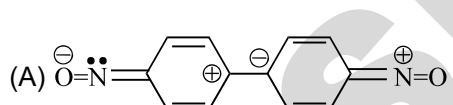





Among these three canonical structures (though more are possible) what would be their relative contribution in the hybrid :

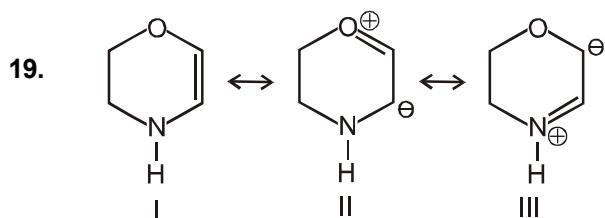
- (A) I > II > III      (B) III > II > I      (C) I > III > II      (D) III > I > II

17. The most stable resonating structure of following compound is

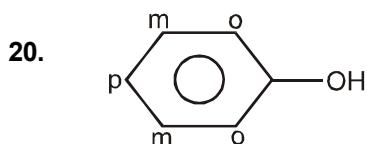


Among these canonical structures of pyridine, the correct order of stability is

- (A)  $|I| = |V| > |II| = |IV| > |III|$       (B)  $|II| = |IV| > |I| = |V| > |III|$   
 (C)  $|I| = |V| > |III| > |II| = |IV|$       (D)  $|III| > |II| = |IV| > |I| = |V|$



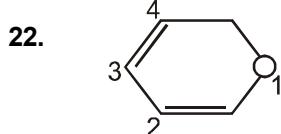
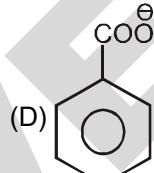
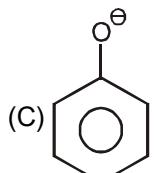
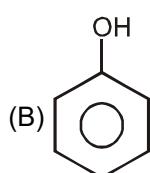
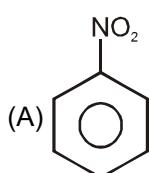
The least stable canonical structure among these is



In phenol,  $\pi$ -electron-density is maximum on

- (A) ortho & meta positions (B) ortho & para positions (C) meta & para positions (D) none of these

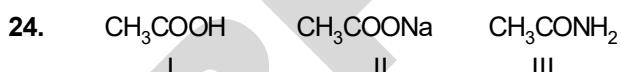
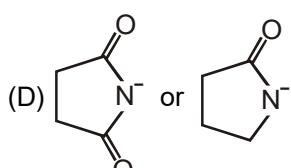
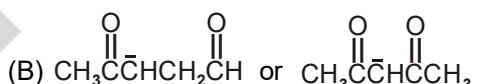
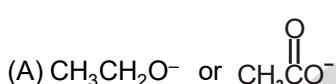
21. Which of the following compounds has maximum electron density in ring?



In this molecule,  $\pi$ -electron-density is more on

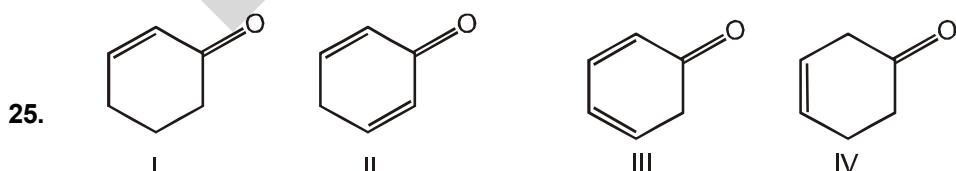
- (A) C1 and C3 (B) C2 and C4 (C) C2 and C3 (D) C1 and C4

23. In which of the following pairs, first species is more stable than second?



Among these compounds, the correct order of resonance energy is

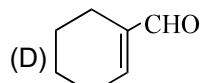
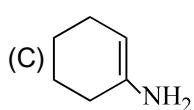
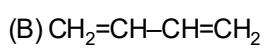
- (A) I > II > III (B) III > II > I (C) II > III > I (D) II > I > III



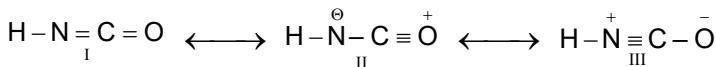
Among these compounds, which one has maximum resonance energy?

- (A) I (B) II (C) III (D) IV

26. In which of the following molecules resonance structures are equivalent :



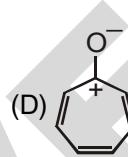
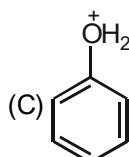
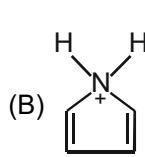
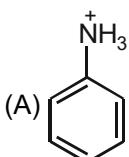
27. HCNO (isocyanic acid) has following resonating structures :



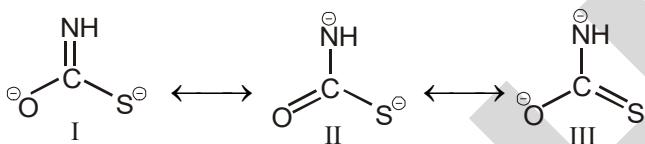
The order of stability is :

- (A) I > III > II      (B) I > II > III      (C) II > III > I      (D) II > I > III

28. In which delocalisation of positive charge is possible

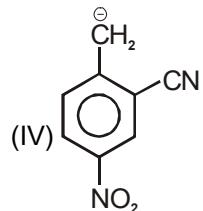
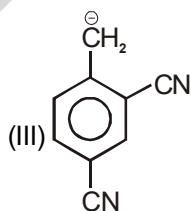
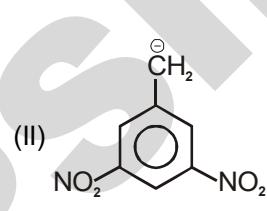
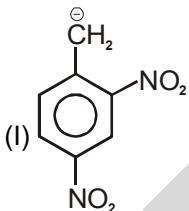


29. Stability order of the following species?



- (A) I > II > III      (B) III > I > II      (C) III > II > I      (D) I > III > II

30. Arrange the following carbanions in increasing order of stability :



- (A) III > IV > I > II      (B) I > III > IV > II      (C) I > II > III > IV      (D) I > IV > III > II

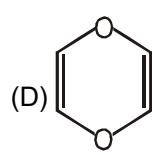
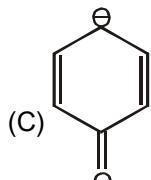
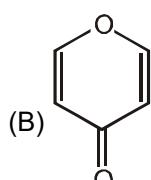
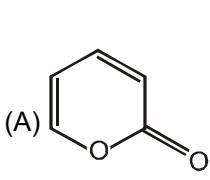
### AROMATIC

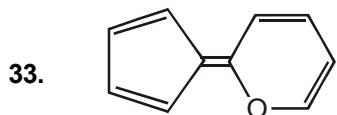
- 31.

Which of these cyclopropene systems is aromatic?

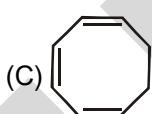
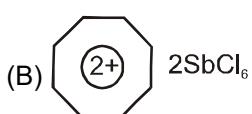
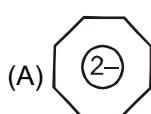
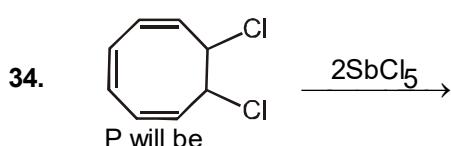
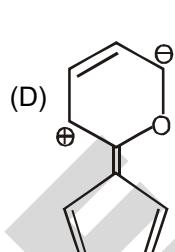
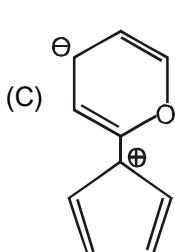
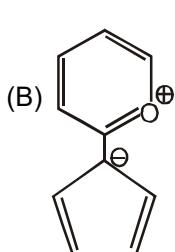
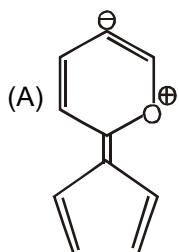
- (A) I      (B) II      (C) III      (D) all of these

32. Which of the following compounds is not aromatic?

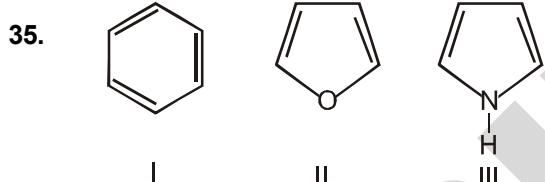




The most stable canonical structure of this molecule is



(D) mixture of (a) and (b)



The aromatic character is maximum in which of these three compounds?

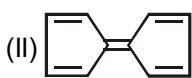
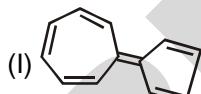
(A) I

(B) II

(C) III

(D) same in all

36. Select the correct statement regarding the following compounds :



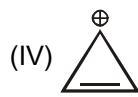
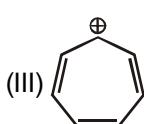
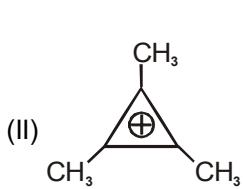
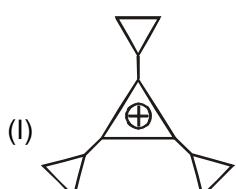
(A) II has greater dipole moment than I

(B) Covalent characters of II is less than I

(C) I is more soluble in polar solvent than II

(D) None of these

37. Arrange the following carbocations in decreasing order their stability?



(A) I, II, III, IV

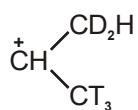
(B) I, II, IV, III

(C) I, III, II, IV

(D) IV, III, II, I

## HYPERCONJUGATION

38. How many hyper conjugative structures are possible in the following carbocation?



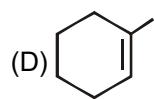
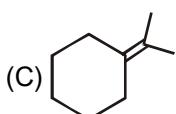
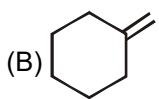
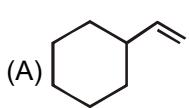
(A) 1

(B) 3

(C) 5

(D) 6

39. Which of the following has most negative heat of hydrogenation?



40. The hyperconjugative stabilities of tert-butyl cation and 2-butene respectively are due to :

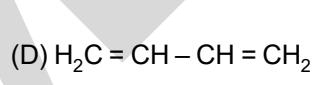
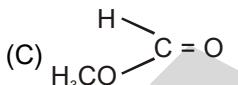
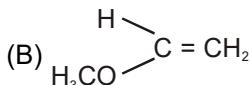
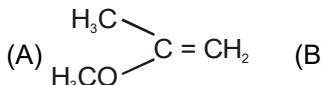
(A)  $\sigma$ (filled)  $\rightarrow$  p(empty) and  $\sigma$ (filled)  $\rightarrow$   $\pi^*$  (empty) electron delocalisation

(B)  $\sigma$ (filled)  $\rightarrow$  p(empty) and  $\sigma$ (filled)  $\rightarrow$   $\pi$ (empty) electron delocalisation

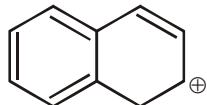
(C)  $\sigma$ (filled)  $\rightarrow$  p(filled) and  $\sigma$ (filled)  $\rightarrow$   $\pi^*$  (empty) electron delocalisation

(D) p (filled)  $\rightarrow$   $\pi^*$ (empty) and  $\sigma$ (filled)  $\rightarrow$   $\pi$ (empty) electron delocalisation

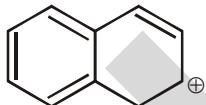
41. The compound having all resonance, inductive and hyper-conjugation effect is :



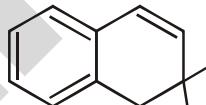
42. Arrange the following carbocations in the increasing order of their stability.



(I)



(II)



(III)

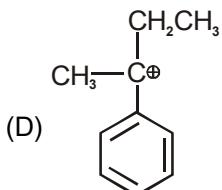
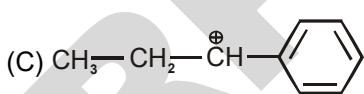
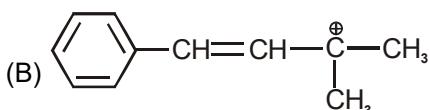
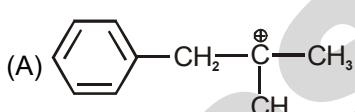
(A) I > II > III

(B) II > I > III

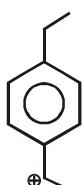
(C) I > III > II

(D) III > I > II

43. Which of the following is most stable carbocation :



44. How many hyper conjugative hydrogen atoms are in



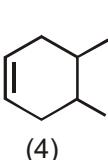
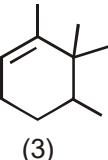
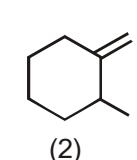
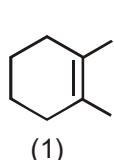
(A) 3

(B) 4

(C) 0

(D) 5

45. Correct order of heat of combustion is

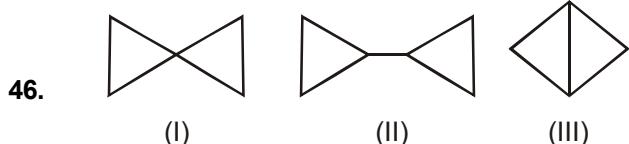


(A) 3 > 2 > 4 > 1

(B) 2 > 1 > 3 > 4

(C) 4 > 3 > 2 > 1

(D) 1 > 2 > 3 > 4



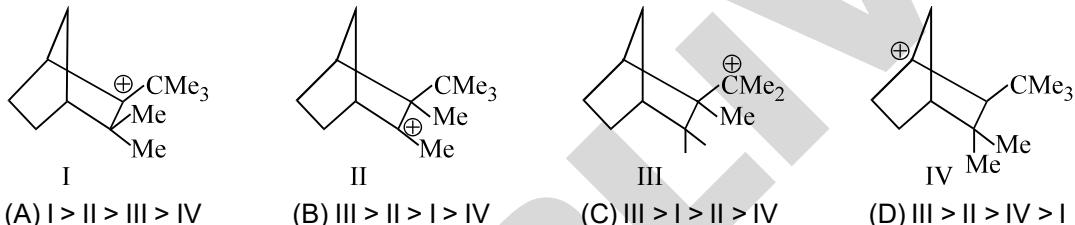
HOC order is

- (A) II > I > III      (B) III > I > II      (C) III > II > I      (D) None of these

47. Which of the following alkenes will show maximum number of hyperconjugation forms?

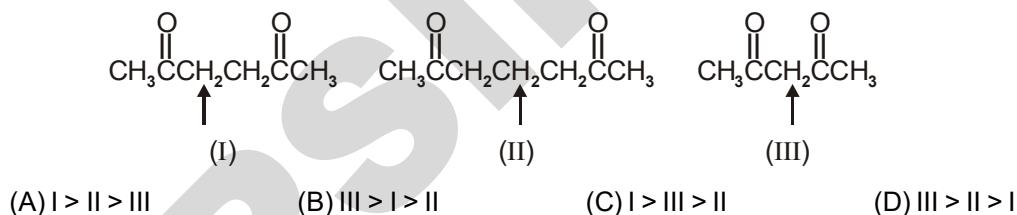
- (A)  $\text{CH}_2 = \text{CH}_2$       (B)  $\text{CH}_3 - \text{CH} = \text{CH}_2$       (C)  $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$       (D)  $\text{CH}_3 - \begin{array}{c} \text{CH}_3 \\ | \\ \text{CH} \end{array} - \text{CH} = \text{CH}_2$

48. Write correct order of stability of following carbocations:



### ACID :

49. Rank the following compounds in order of decreasing acidity of the indicated hydrogen :

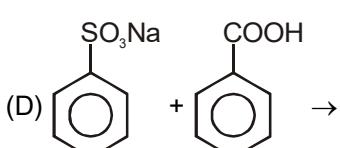
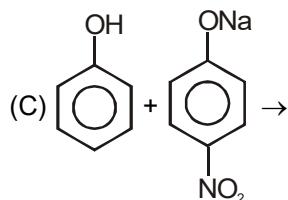
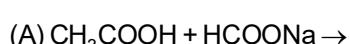


(Cyanic acid)      (Isocyanic acid)

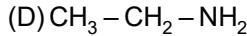
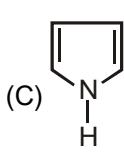
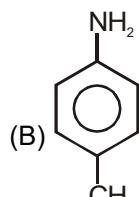
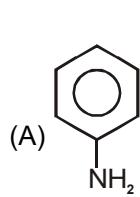
Loss of proton from these two acids produces

- (A) same anion      (B) different anions      (C) same cation      (D) different cations

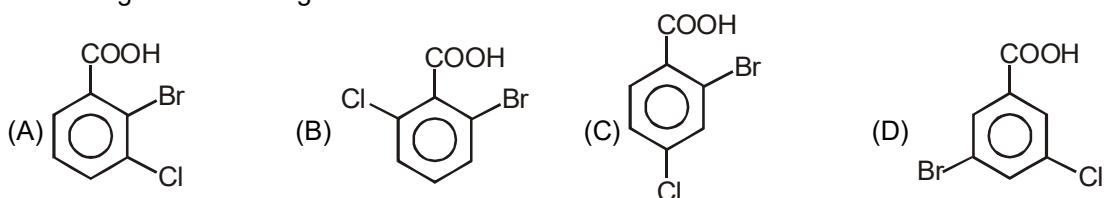
51. Which of the following reaction is/are feasible?



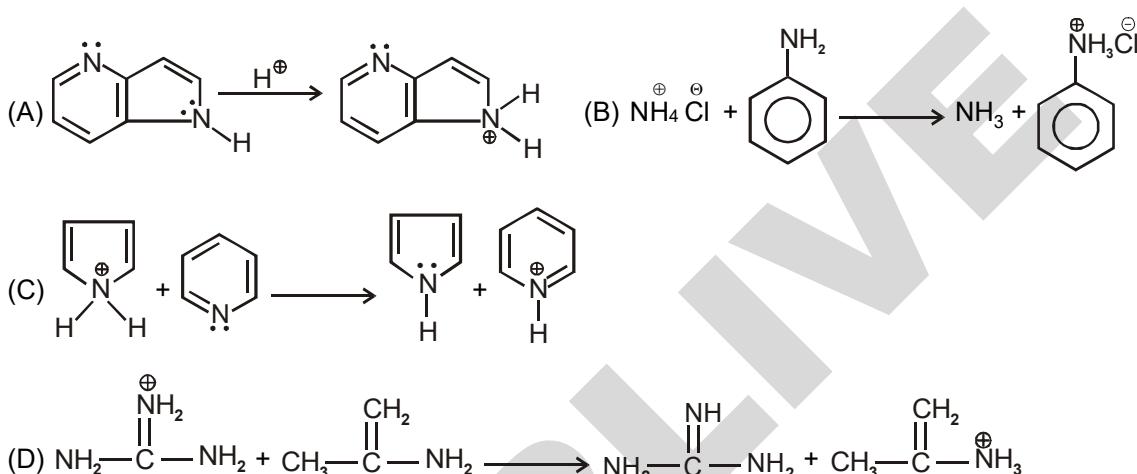
52. Which of the following will accept  $\text{H}^+$  from  $\text{NH}_4^+$  ion ?



53. The strongest acid among all isomers is



54. Which of the following reaction is feasible?



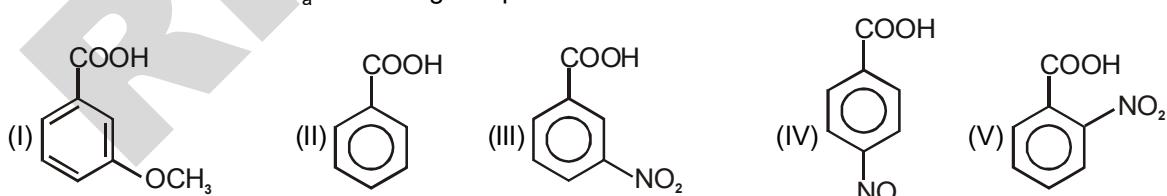
55. Which of the following is not correct decreasing  $k_a$  order

- (A)  $\text{CH}_4 > \text{NH}_3 > \text{H}_2\text{O} > \text{HF}$   
 (B)  $\text{CH}_3\text{OH} > \text{CH}_3\text{NH}_2 > \text{CH}_3\text{F} > \text{CH}_3\text{CH}_3$   
 (C)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$   
 (D)  $\text{PhOH} > \text{H}_2\text{O} > \text{C}_2\text{H}_5\text{OH} > \text{CH}_3\text{C}\equiv\text{CH}$

56. Find the strongest acid among the following compounds is :

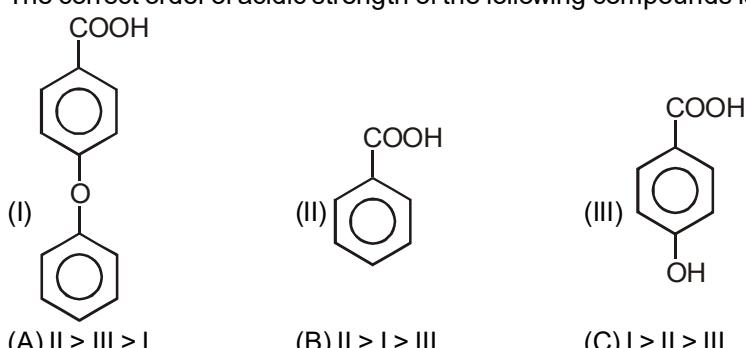
- (A)  $\text{HOOC}-(\text{CH}_2)_2-\text{COOH}$       (B)  $\text{H}_3\text{N}^+-(\text{CH}_2)_2-\text{COOH}$   
 (C)  $\text{F}-(\text{CH}_2)_2-\text{COOH}$       (D)  $\text{CH}_3-(\text{CH}_2)_2-\text{COOH}$

57. Find the correct order of  $k_a$  of following compounds



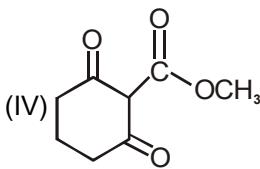
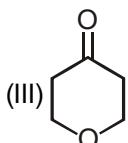
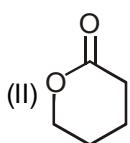
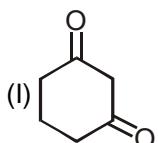
- (A) I < II < III < IV < V      (B) IV < I < III < II < V      (C) III < II < I < IV < V      (D) II < I < III < IV < V

58. The correct order of acidic strength of the following compounds is



- (A) II > III > I      (B) II > I > III      (C) I > II > III      (D) II > I = III

59. Arrange the following in increasing order of their acidic strength



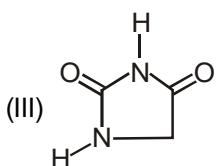
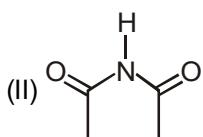
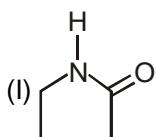
(A) III < I < IV < II

(B) II < I < IV < III

(C) I < III < IV < II

(D) II < III < I < IV

60. Identify correct acidic strength order in the following compounds



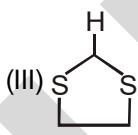
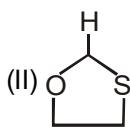
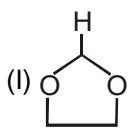
(A) I > II > III

(B) II > III > I

(C) I > III > II

(D) III > I > II

61. Identify correct acidic strength order in the following compounds



(A) I > II > III

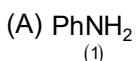
(B) III > II > I

(C) I > III > II

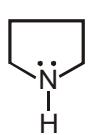
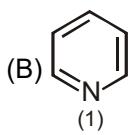
(D) III > I > II

## BASE

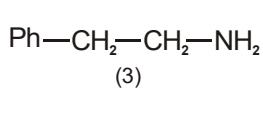
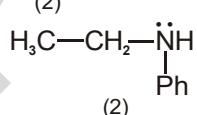
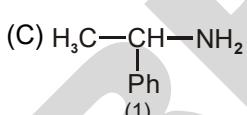
62. Which is the correct order of the basic strength of the following compounds:



Correct order : 1 > 2 > 3



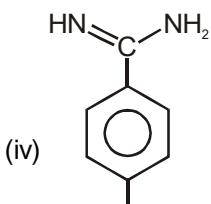
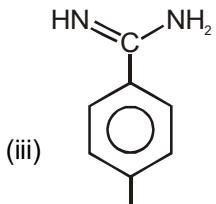
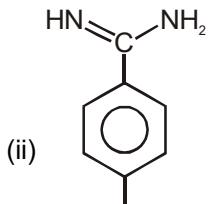
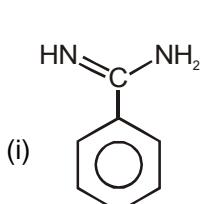
Correct order : 1 > 2 > 3



Correct order: 3 > 2 > 1

(D) None of these

63. Select the decreasing order of relative basic strengths of the following species :



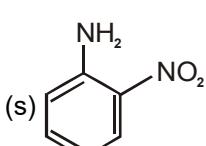
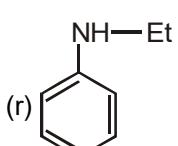
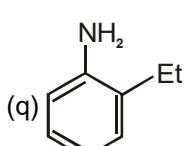
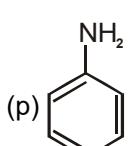
(A) ii > iv > i > iii

(B) iii > i > iv > ii

(C) iii > iv > i > ii

(D) ii > i > iv > iii

64. Correct basic strength order is :



(A) r > q > p > s

(B) r > p > q > s

(C) q > r > p > s

(D) r > q > s > p

65. Find the order of basic strength. (if R = Me)?  
 (A)  $\text{R}_4\text{N}^+$       (B)  $\text{R}_3\text{N}$       (C)  $\text{R}_2\text{NH}$       (D)  $\text{RNH}_2$
66. In the labelled N-atoms which is correct basic strength order :
- (A) 2 > 1 > 3      (B) 3 > 1 > 2      (C) 2 > 3 > 1      (D) All are equally basic

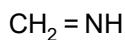
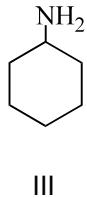
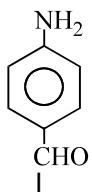
67. Which is the weakest base among the following?  
 (A)      (B)      (C)      (D)

68. The correct orders are :  
 (A) > Acidic strength  
 (B) > Acidic strength  
 (C) > Basic strength  
 (D) > Boiling point

### MIXED QUESTIONS

69. Which of the following has longest C – O bond :  
 (A)      (\*B)      (C)      (D)

70.



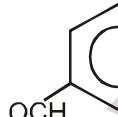
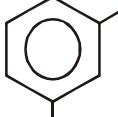
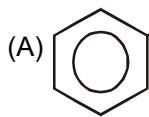
IV

Among these compounds, the correct order of C – N bond lengths is :

- (A) IV > I > II > III      (B) III > I > II > IV      (C) III > II > I > IV      (D) III > I > IV > II

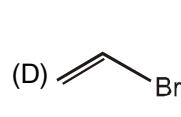
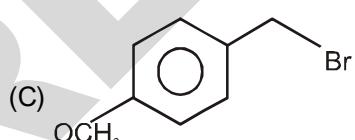
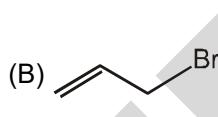
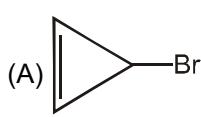
71.

Ease of ionization to produce carbocation and bromide ion under the treatment of  $\text{Ag}^+$  will be maximum in which of the following compounds?



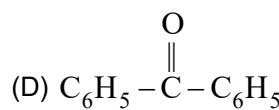
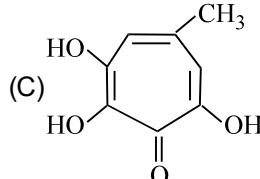
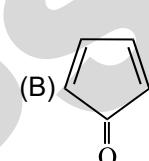
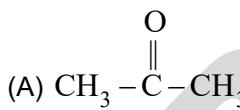
72.

Ease of ionization to produce carbocation and bromide ion under the treatment of  $\text{Ag}^+$  will be maximum in which of the following compounds?



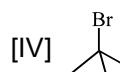
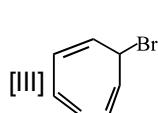
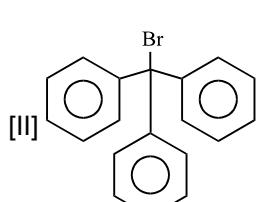
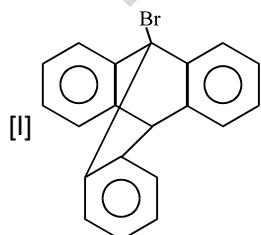
73.

Which one of the following carbonyl compound when treated with dilute acid forms the more stable carbocation?



74.

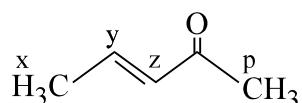
Correct order of rate of hydrolysis or rate of reaction toward  $\text{AgNO}_3$  for following compounds is



- (A) III > II > IV > I      (B) I > II > III > IV      (C) III > I > II > IV      (D) III > II > I > IV

75.

The abstraction of proton will be fastest, in which carbon in the following compound



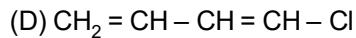
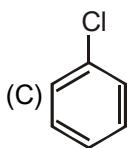
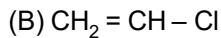
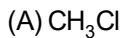
- (A) x

- (B) y

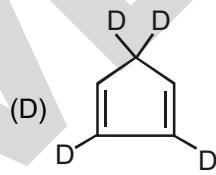
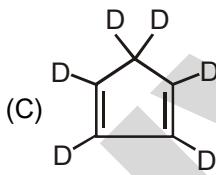
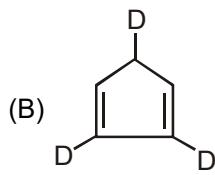
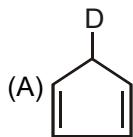
- (C) z

- (D) p

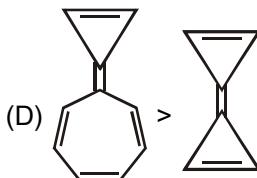
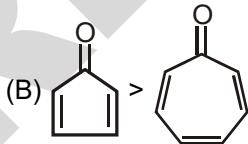
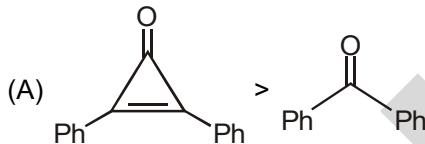
76. Which of the following has shortest C–Cl bond?



77. The possible product of the reaction :  $\xrightarrow[\text{D}_2\text{O}(\text{Solvent})]{\text{Na(excess)}}$  P



78. Identify the incorrect order of dipole moment

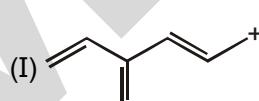
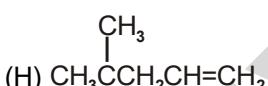
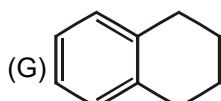
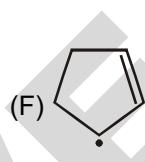
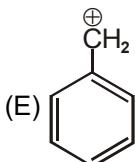
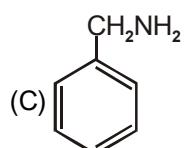
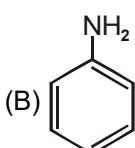


## ANSWER KEY

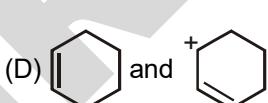
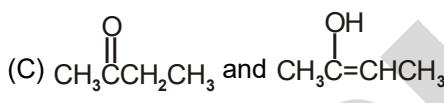
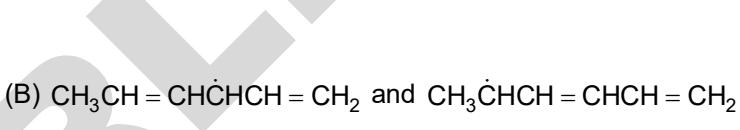
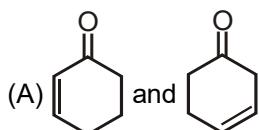
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8.	C	9.	B	10.	C	11.	D	12.	C	13.	B	14.	C
15.	D	16.	C	17.	D	18.	A	19.	B	20.	B	21.	C
22.	B	23.	D	24.	C	25.	C	26.	A	27.	A	28.	D
29.	A	30.	D	31.	C	32.	D	33.	B	34.	B	35.	A
36.	C	37.	C	38.	D	39.	A	40.	A	41.	A	42.	A
43.	B	44.	D	45.	A	46.	A	47.	B	48.	B	49.	B
50.	A	51.	B	52.	D	53.	B	54.	C	55.	A	56.	B
57.	D	58.	B	59.	D	60.	B	61.	B	62.	A	63.	D
64.	B	65.	C	66.	A	67.	D	68.	A	69.	B	70.	C
71.	C	72.	A	73.	C	74.	A	75.	A	76.	C	77.	C
78.	B												

## EXERCISE - II

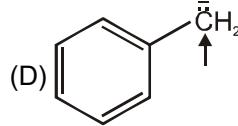
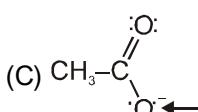
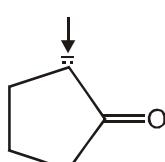
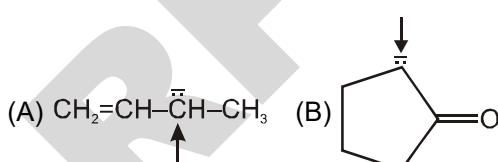
1. In which of the following molecules resonance takes place through out the entire system.



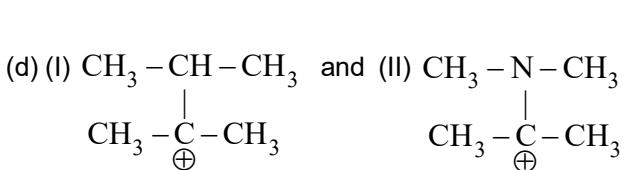
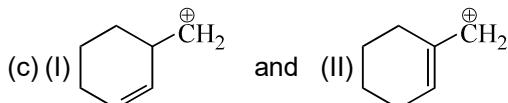
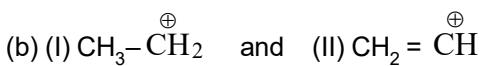
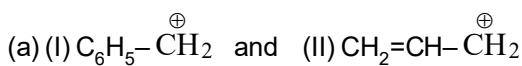
2. Which of the following pairs of structures are resonance contributors?



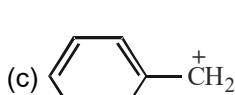
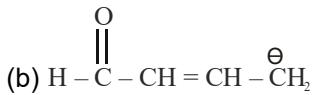
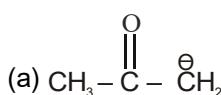
3. Determine the hybridization around the indicated atom in the following anion.

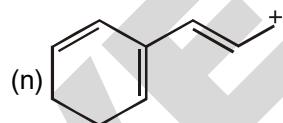
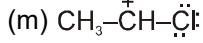
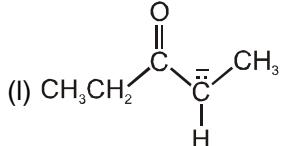
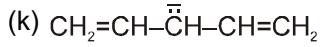
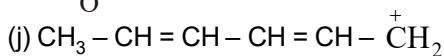
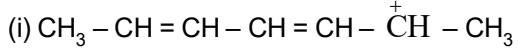
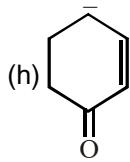
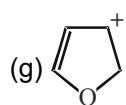
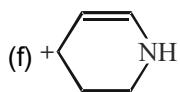
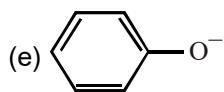
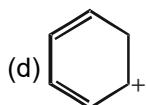


4. In each of the following pairs of ions which ion is more stable:

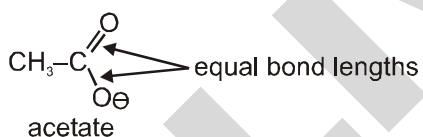


5. Draw the resonance forms to show the delocalization of charges in the following ions

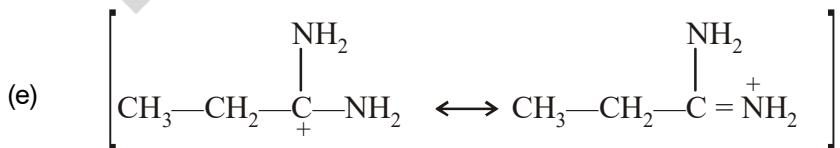
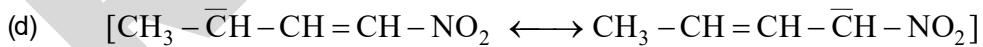
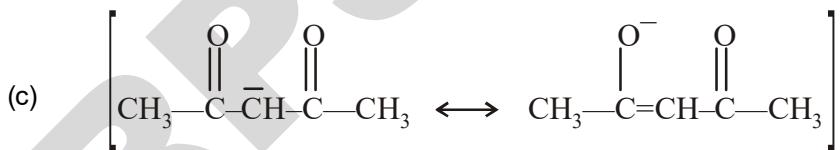
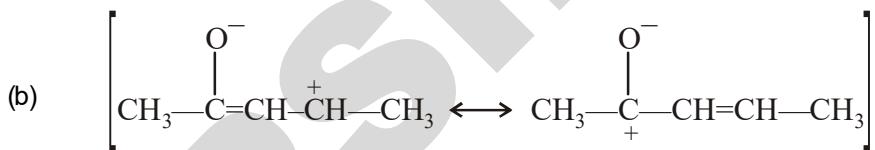
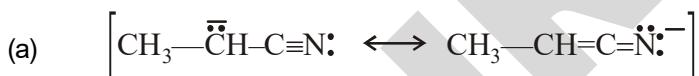




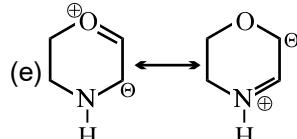
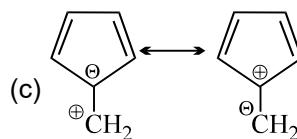
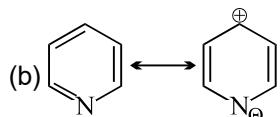
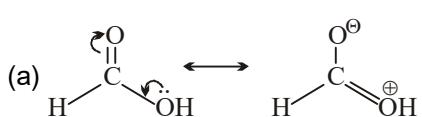
6. Use resonance theory to explain why both C – O bond lengths are equal in the acetate anion.



7. In the following sets of resonance forms, label the major and minor contributors and state which structures would be of equal energy. Add any missing resonance forms.



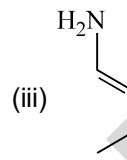
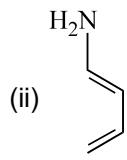
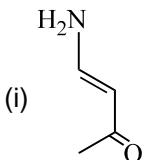
8. Identify more stable canonical structure in each of the following pairs :



9. A canonical structure will be more stable if

- (a) it has more number of  $\pi$  bonds than if it has less number of  $\pi$  bonds.
- (b) the octets of all atoms are complete than if octets of all atoms are not complete.
- (c) it involves cyclic delocalization of  $(4n + 2)$   $\pi$  – electrons than if it involves acyclic delocalization of  $(4n + 2)$   $\pi$  – electrons.
- (d) it involves cyclic delocalization  $(4n)$   $\pi$  – electrons than if it involves acyclic delocalization of  $(4n)$   $\pi$  – electrons.
- (e) +ve charge is on more electronegative atom than if +ve charge is on less electronegative atoms.
- (f) -ve charge is on more electronegative atom than if -ve charge is on less electronegative atom.

10. Compare the C–N bond-length in the following species:



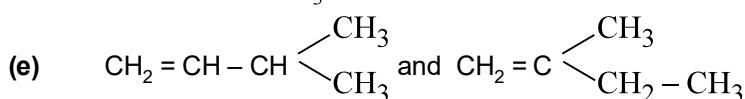
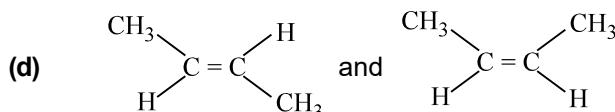
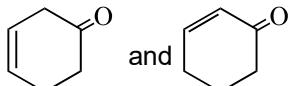
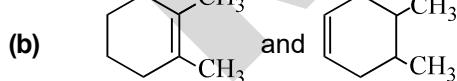
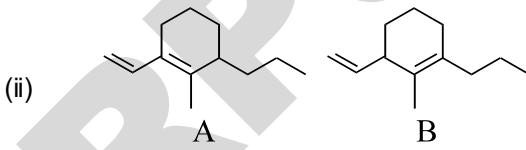
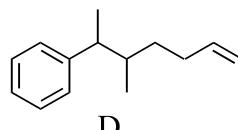
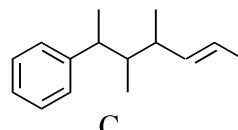
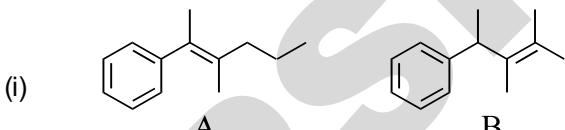
11. Match each alkene with the appropriate heat of combustion:

Heats of combustion (kJ/mol) : 5293 ; 4658; 4650; 4638; 4632

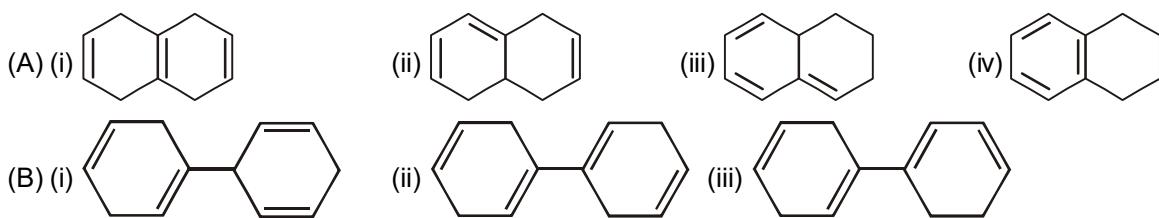
- |                               |                            |
|-------------------------------|----------------------------|
| (a) 1-Heptene                 | (b) 2,4-Dimethyl-1-pentene |
| (c) 2,4-Dimethyl-2-pentene    | (d) 4,4-Dimethyl-2-pentene |
| (e) 2,4,4-Trimethyl-2-pentene |                            |

12. Compare heat of hydrogenation (Decreasing order)

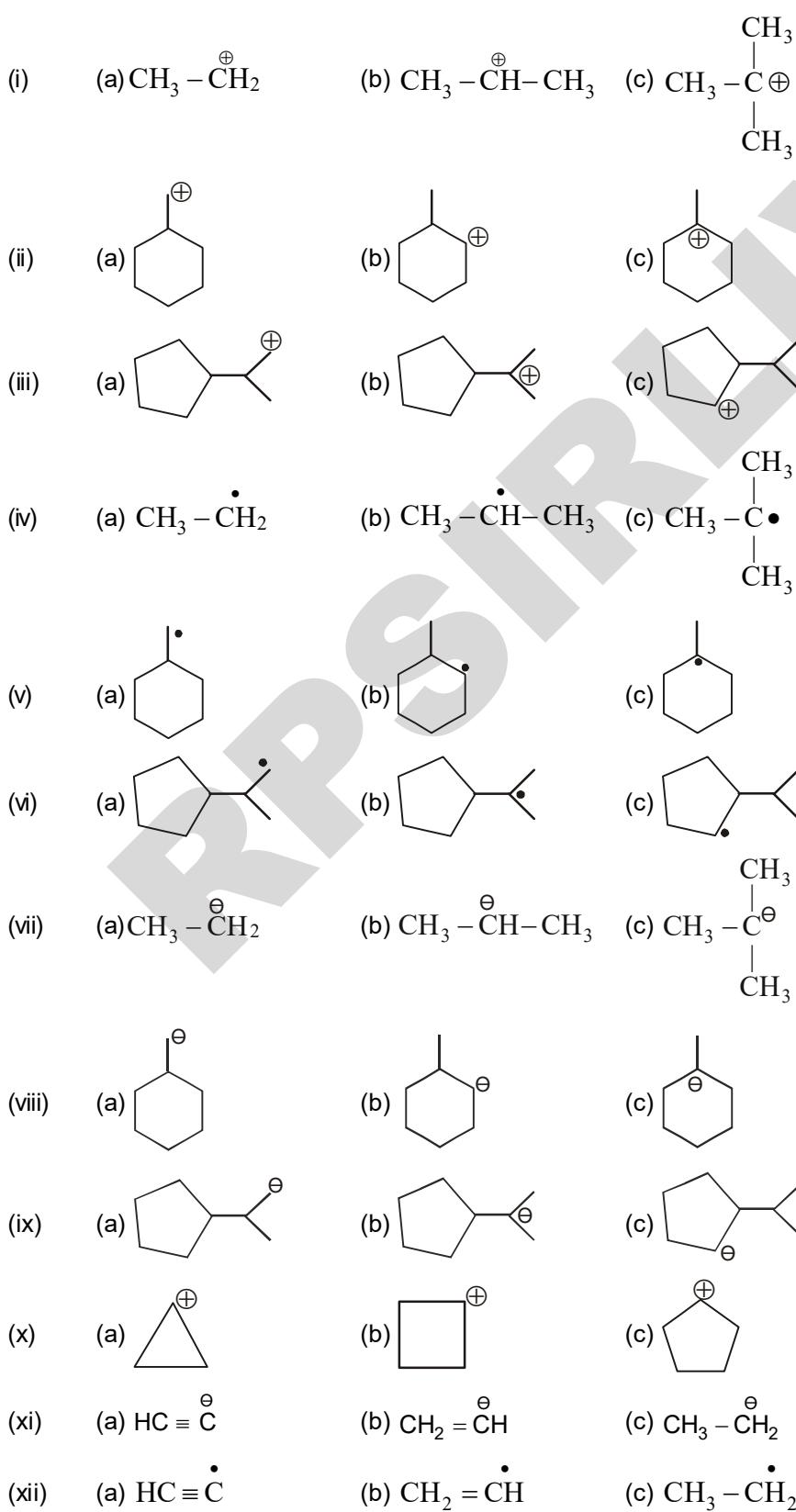
(a) heat of hydrogenation



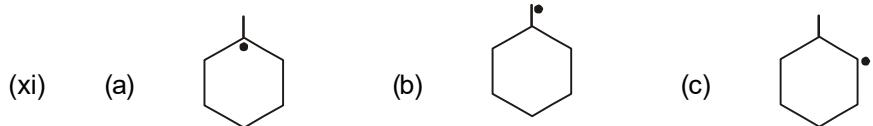
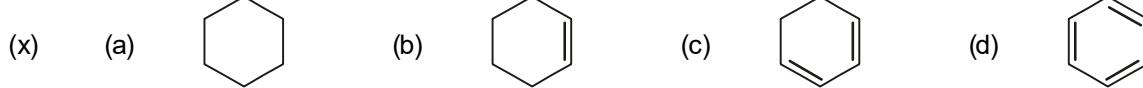
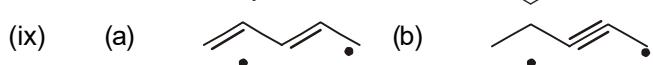
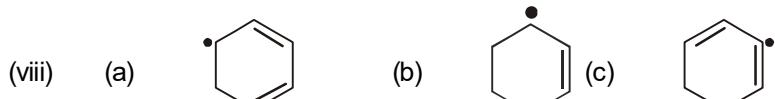
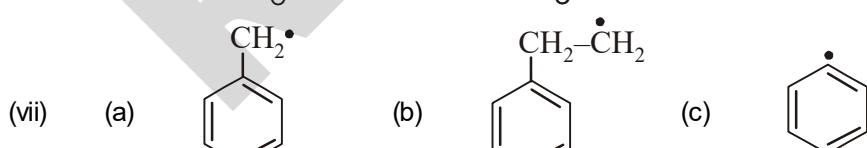
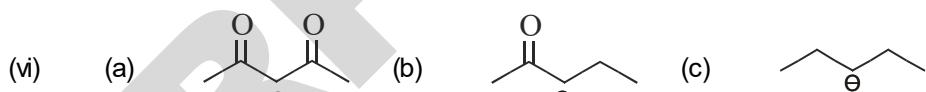
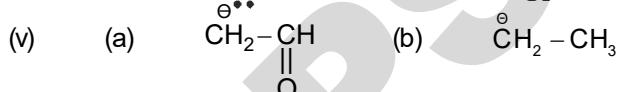
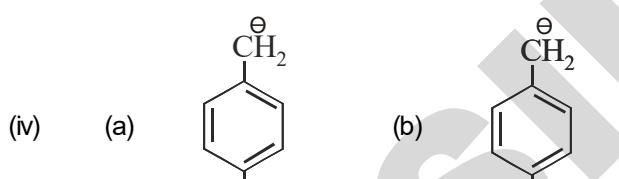
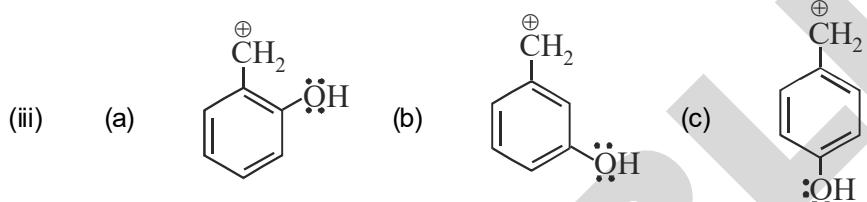
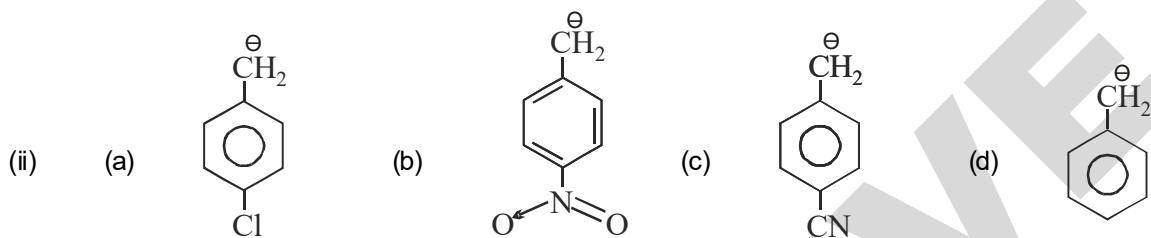
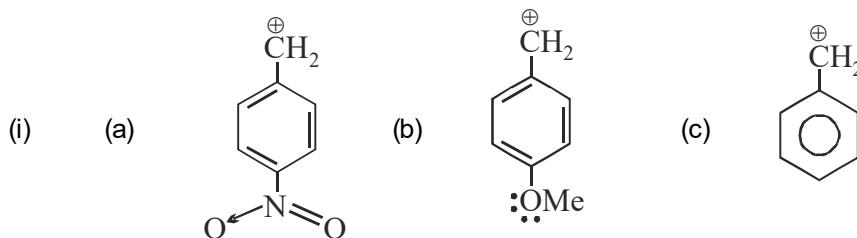
13. (I) Stability order and (II) heat of hydrogenation orders.

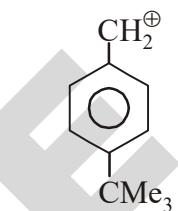
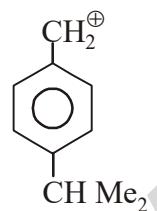
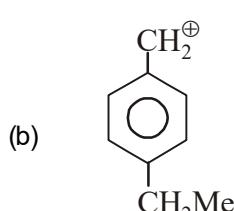
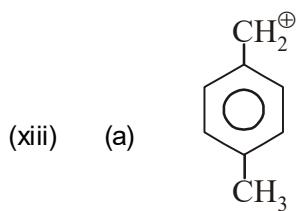
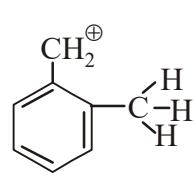
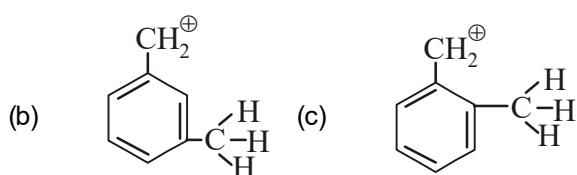
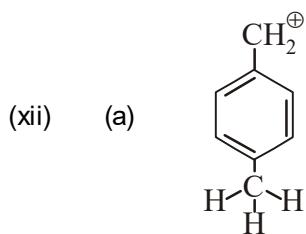


14. Write stability order of following intermediates:

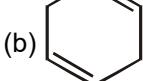
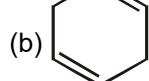
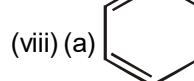
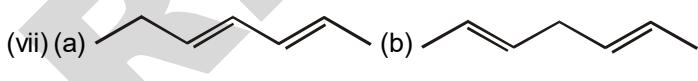
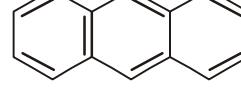
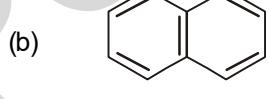
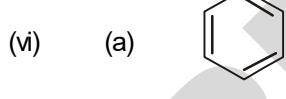
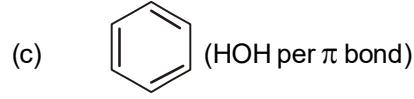
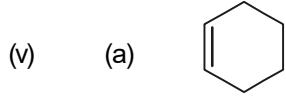
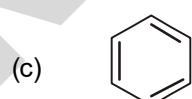
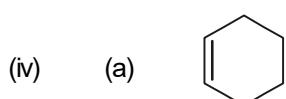
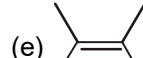
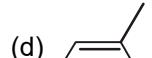
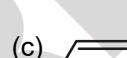
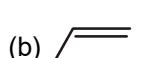
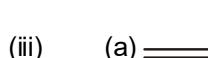
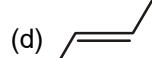
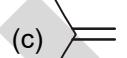
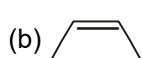
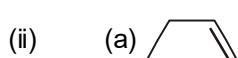
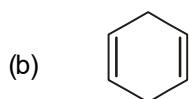
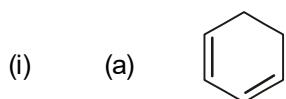


15. Write stability order of following intermediates:

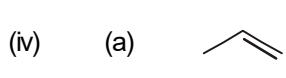
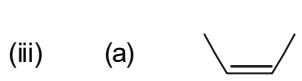
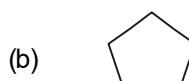
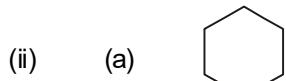
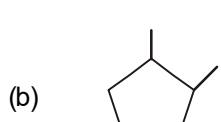
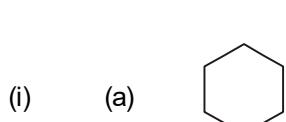




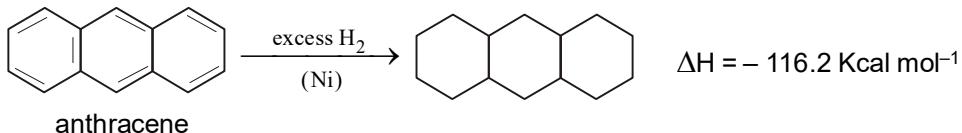
16. Write increasing order of heat of hydrogenation :



17. Give decreasing order of heat of combustion (HOC):



- 18.** Use the following data to answer the questions below:



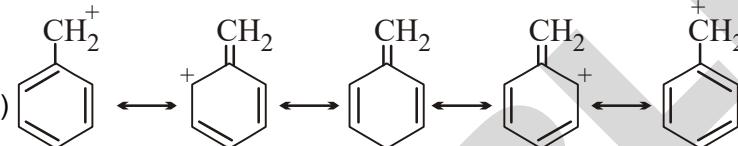
Calculate the resonance energy of anthracene in kcal/mol.

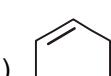
# ANSWER KEY

- 1.** B, E, I      **2.** B, D      **3.** (A)  $\text{sp}^2$ , (B)  $\text{sp}^2$ , (C)  $\text{sp}^2$ , (D)  $\text{sp}^2$       **4.** (a) I, (b) I, (c) II, (d) II

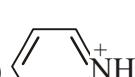
**5.**

(a)  $\text{CH}_3 - \overset{\text{O}^-}{\underset{\text{C}}{\text{||}}} \text{CH}_2$       (b)  $\text{H} - \overset{\text{O}^-}{\underset{\text{C}}{\text{||}}} \text{CH} - \text{CH} = \text{CH}_2$

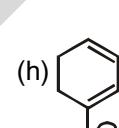
(c) 

(d) 

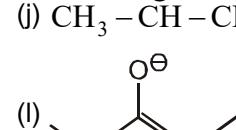
(e) 

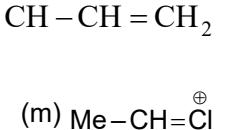
(f) 

(g) 

(h) 

(i)  $\text{CH}_3 - \overset{\oplus}{\underset{\text{C}}{\text{||}}} \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_3$       (j)  $\text{CH}_3 - \overset{\oplus}{\underset{\text{C}}{\text{||}}} \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$

(k)  $\text{H}_2 \overset{\ominus}{\underset{\text{C}}{\text{||}}} - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$       (l) 

(m)  $\text{Me} - \overset{\oplus}{\underset{\text{C}}{\text{||}}} \text{CH} = \text{Cl}$       (n) 

6. Equivalent R.S. ∴ in hybrid both bond lengths are equal.

7. (a) II, (b) II, (c) II,  $\text{CH}_3 - \overset{\overset{\text{O}}{\parallel}}{\underset{\underset{\text{NH}_2}{\parallel}}{\text{C}}} - \text{CH} = \overset{\overset{\text{O}^-}{\mid}}{\text{C}} - \text{CH}_3$  (d) II,  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \overset{+}{\text{N}} \begin{cases} \text{O}^- \\ \text{O}^- \end{cases}$   
 (e) II,  $\text{CH}_3 - \text{CH}_2 - \overset{\overset{\text{O}}{\parallel}}{\underset{\underset{\text{NH}_2}{\parallel}}{\text{C}}} - \text{NH}_2$

8. (a) I, (b) I, (c) I, (d) II, (e) III

- 9. (a), (b), (c), (f)**

10. iii > ii > i

- 11.** (a) 4658, (b) 4638, (c) 4632, (d) 4650, (e) 5293

- 12.** (a) (i) D > C > B > A (ii) E > C > D > B > A (b) 2 > 1 (c) 2 < 1 (d) 1 < 2 (e) 1 > 2

- 13.** (A) (I) iv > iii > ii > i; (II) i > ii > iii > iv (B) (I) iii > ii > i (II) i > ii > iii



- (v)  $c > b > a$       (vi)  $b > c > a$       (vii)  $a > b > c$       (viii)  $a > b > c$   
 (ix)  $a > c > b$       (x)  $d > c > b > a$       (xi)  $a > b > c$       (xii)  $c > b > a$

15. (i)  $b > c > a$       (ii)  $b > c > a > d$       (iii)  $c > a > b$       (iv)  $a < b$   
(v)  $a > b$       (vi)  $a > b > c$       (vii)  $a > b > c$       (viii)  $a > b > c$   
(ix)  $a > b$       (x)  $c > b > a > d$       (xi)  $a > c > b$       (xii)  $c > a > b$   
(xiii)  $a > b > c > d$

16. (i)  $b > a$       (ii)  $a > b > d > c$       (iii)  $a > b > c > d > e$       (iv)  $b > c > a$   
(v)  $a > b > c$       (vi)  $a > b > c$       (vii)  $b > a$       (viii)  $b > a$

17. (i)  $c > b > a$       (ii)  $a > b > c > d$       (iii)  $a > b$       (iv)  $c > b > a$

18. Anthracene is  $14 \pi$  e's system

i.e. there are  $7 \pi$  bonds

Expected (theoretical) heat of hydrogen =  $- 28.6 \times 7 = - 200.2$  kcal/mol

Observed (experimental) heat of hydrogen =  $- 116.2$

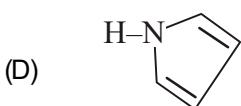
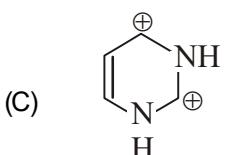
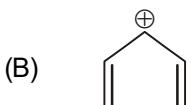
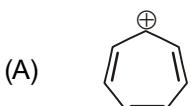
$$\therefore \text{R.E.} = - 116.2 - (-200.2)$$

$$= 84 \text{ kcal / mol}]$$

## EXERCISE - III

1. Match the Column :

**Column I**



**Column II**

(P) Six  $\pi$  electrons

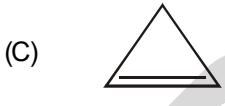
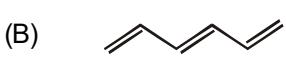
(Q) Four  $\pi$  electrons

(R) Aromatic compound

(S) Anti-aromatic compound

2. Match the Column :

**Column I**



**Column II**

(P) Hybrid state of each atom  $sp^2$

(Q) Anti aromatic

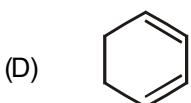
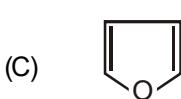
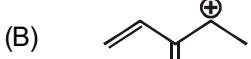
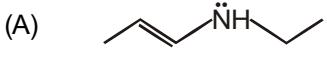
(R) Delocalisation of  $\pi$  bond

(S) Non aromatic

(T) Obeys Huckel's Rule for aromaticity

3. Match the Column :

**Column I**



**Column II**

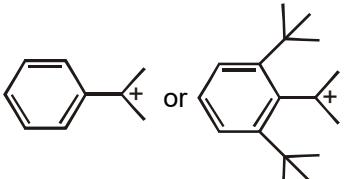
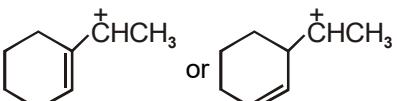
(P) Non aromatic

(Q) Anti aromatic

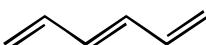
(R) Resonance

(S) Aromatic

4. Match the Column :

Column I	Column II
(A) $\text{CH}_3\text{OCH}_2^+$ or $\text{CH}_3\text{NHCH}_2^+$	(P) First is more stable than second
(B) $\text{CH}_3\text{OCH}_2^+\text{CH}_2$ or $\text{CH}_3\text{OCH}_2^+$	(Q) Second is more stable than first
(C) 	(R) Not resonating structure of each other
(D) 	(S) Resonance is present in both carbocations

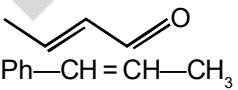
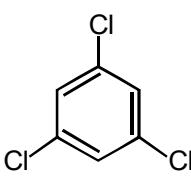
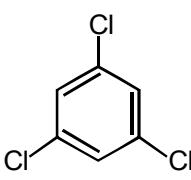
5.

Column-I	Column-II
(P) 	(1) Aliphatic Hydrocarbon
(Q) 	(2) Anti aromatic
(R) 	(3) Aromatic
(S) 	(4) Alicyclic Compound

Code :

	P	Q	R	S	P	Q	R	S
(A)	3	1	4	2	(B)	1	2	4
(C)	2	1	3	4	(D)	3	2	1

6.

Column-I (Compounds)	Column-II (Characteristics)
(A) 	(p) Mesomeric effect / resonance
(B) 	(q) Inductive effect
(C) 	(r) Hyperconjugative effect
(D) 	(s) Nonpolar
	(t) Polar

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## **ANSWER KEY**

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**1.** (A) P, R; (B) Q,S; (C) P,R; (D) P,R

**3.** (A) P, R; (B) P,R; (C) R,S; (D) P,R

**5.**      A

**6.**       $(A \rightarrow PQRT), (B \rightarrow PQRT), (C \rightarrow PQRT), (D \rightarrow PQS)$

**2.** (A) P, R, T; (B) P,R,S ; (C) S; (D) P,Q,R

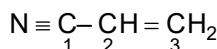
**4.** (A) Q, R, S; (B) Q,R; (C) P,R; (D) P,R

RPSIRLIVE

## EXERCISE - IV

**Single Choice Questions :**

1. The bond between carbon atom (1) and carbon atom (2) in compound



involves the hybridisation as

[JEE-1987]

- (A)  $sp^2$  and  $sp^2$       (B)  $sp^3$  and  $sp$       (C)  $sp$  and  $sp^2$       (D)  $sp$  and  $sp$

2. The compound in which C uses its  $sp^3$ -hybrid orbital for bond formation is

[JEE-1989]

- (A)  $HCOOH$       (B)  $(H_2N)_2CO$       (C)  $(CH_3)_3COH$       (D)  $CH_3CHO$

3. The number of sigma and pi-bonds in 1-butene 3-yne are

[JEE-1989]

- (A) 5 sigma and 5 pi      (B) 7 sigma and 3 pi      (C) 8 sigma and 2 pi      (D) 6 sigma and 4 pi

4. The hybridisation of carbon atoms in C — C single bond of  $H — C \equiv C — CH = CH_2$  is

[JEE-1991]

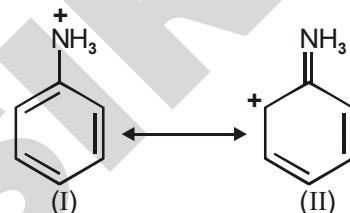
- (A)  $sp^3 - sp^3$       (B)  $sp^2 - sp^3$       (C)  $sp - sp^2$       (D)  $sp^3 - sp$

5. Which is the decreasing order of strength of the bases  $\overset{\ominus}{OH}$ ,  $\overset{\ominus}{NH_2}$ ,  $H — C \equiv \overset{\ominus}{C}$  and  $CH_3 — \overset{\ominus}{CH}_2$ ? [JEE-1993]

- (A)  $CH_3 — CH_2^- > NH_2^- > H — C \equiv C^- > OH^-$       (B)  $H — C \equiv C^- > CH_3 — CH_2^- > NH_2^- > OH^-$   
 (C)  $OH^- > NH_2^- > H — C \equiv C^- > CH_3 — CH_2^-$       (D)  $NH_2^- > H — C \equiv C^- > OH^- > CH_3 — CH_2^-$

6. Choose the correct statement from the ones given below for anilinium ion

[JEE-1993]



- (A) II is not an acceptable canonical structure because carbonium ions are less stable than ammonium ions  
 (B) II is not an acceptable canonical structure because it is non aromatic  
 (C) II is not an acceptable canonical structure because the nitrogen has 10 valence electrons  
 (D) II is an acceptable canonical structure

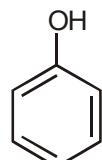
7. Most stable carbonium ion is

[JEE-1995]

- (A)  $p-NO_2 — C_6H_4 — {}^+CH_2$   
 (C)  $p-Cl — C_6H_4 — {}^+CH_2$       (B)  $C_6H_5{}^+CH_2$   
 (D)  $p-CH_3O — C_6H_4 — {}^+CH_2$

8. In the following compounds

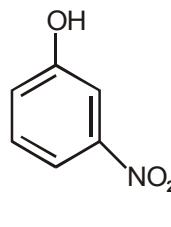
[JEE-1996]



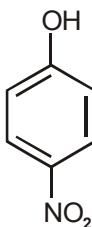
(I)



(II)



(III)



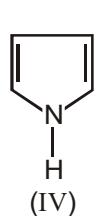
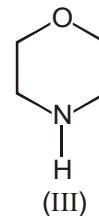
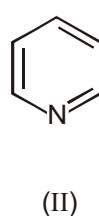
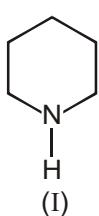
(IV)

The order of acidity is

- (A) III > IV > I > II      (B) I > IV > III > II      (C) II > I > III > IV      (D) IV > III > I > II

9. In the following compounds, the order of basicity is

[JEE-1997]



- (A) IV > I > III > II      (B) III > I > IV > II      (C) II > I > III > IV      (D) I > III > II > IV

10. Among the following compounds, the strongest acid is

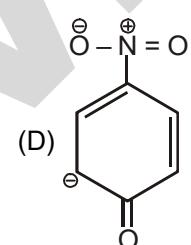
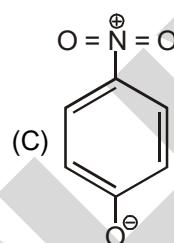
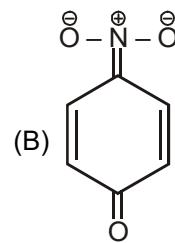
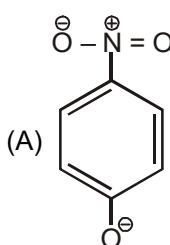
[JEE-1998]

- (A)  $\text{HC}\equiv\text{CH}$       (B)  $\text{C}_6\text{H}_6$       (C)  $\text{C}_2\text{H}_6$



11. The most unlikely representation of resonance structure of p-nitrophenoxide ion is

[JEE-1999]



12. Which of the following has the most acidic hydrogen :

[JEE-2000]

- (A) 3-hexanone      (B) 2, 4-hexanedione  
(C) 2, 5-hexanedione      (D) 2, 3-hexanedione

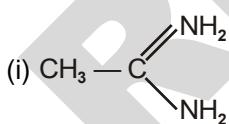
13. Amongst the following, the most basic compound is

[JEE-2000]

- (A)  $\text{C}_6\text{H}_5\text{NH}_2$       (B)  $\text{p-NO}_2-\text{C}_6\text{H}_4\text{NH}_2$   
(C)  $\text{m-NO}_2-\text{C}_6\text{H}_4\text{NH}_2$       (D)  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$

14. The correct order of basicities of the following compounds is

[JEE-2001]



- (A) ii > i > iii > iv      (B) i > iii > ii > iv      (C) iii > i > ii > iv      (D) i > ii > iii > iv

15. Which of the following hydrocarbons has the lowest dipole moment?

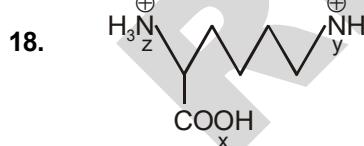
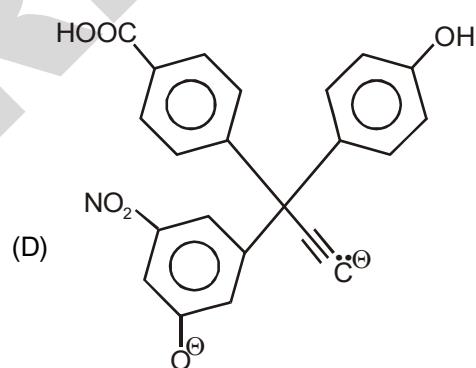
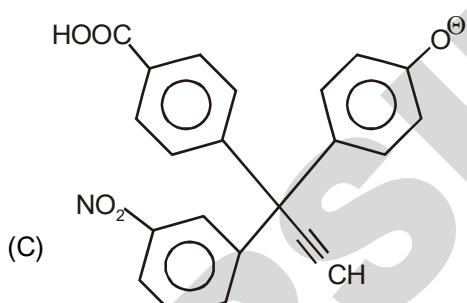
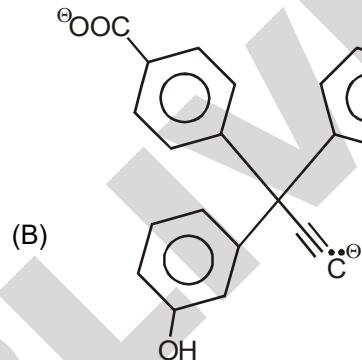
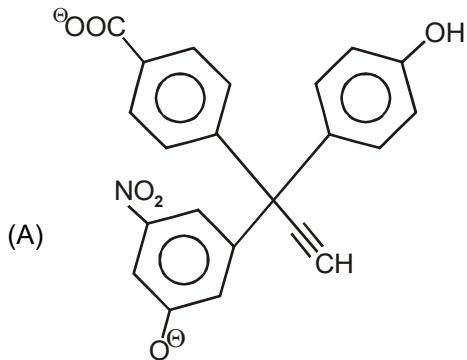
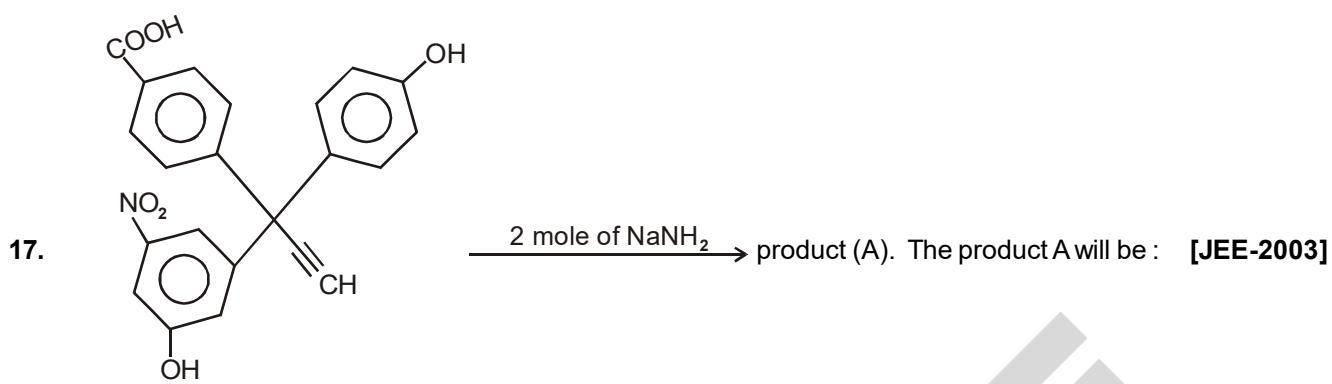
[JEE-2002]

- (A) cis-2-butene      (B) 2-butyne      (C) 1-butyne      (D)  $\text{H}_2\text{C}=\text{CH}-\text{C}\equiv\text{CH}$

16. Which of the following acids has the smallest dissociation constant?

[JEE-2002]

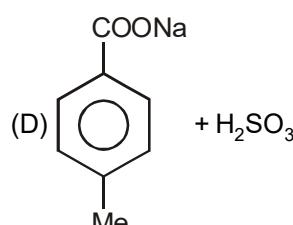
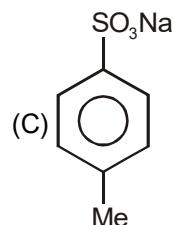
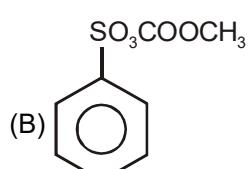
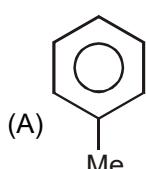
- (A)  $\text{CH}_3\text{CHFCOOH}$       (B)  $\text{FCH}_2\text{CH}_2\text{COOH}$   
(C)  $\text{BrCH}_2\text{CH}_2\text{COOH}$       (D)  $\text{CH}_3\text{CHBrCOOH}$



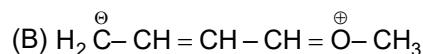
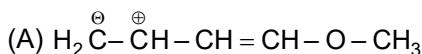
Correct order of acidic strength is

- (A)  $x > y > z$       (B)  $z > y > x$       (C)  $y > z > x$       (D)  $x > z > y$

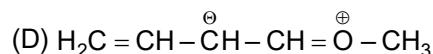
[JEE-2004]



20. For 1-methoxy-1,3-butadiene, which of the following resonating structure is the least stable ?

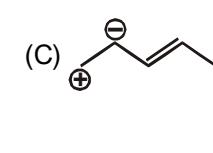
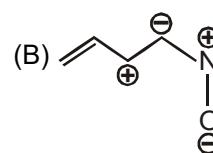
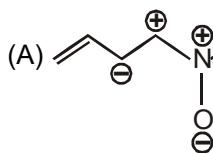


[JEE-2005]

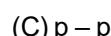
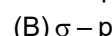
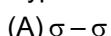


21. Among the following, the least stable resonance structure is

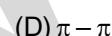
[JEE-2007]



22. Hyperconjugation involves overlap of the following orbitals

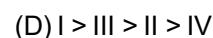
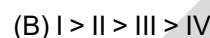
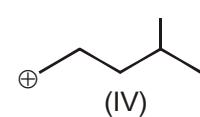
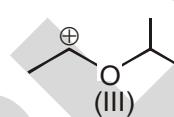
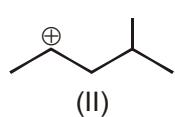
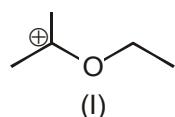


[JEE-2008]



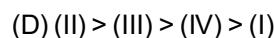
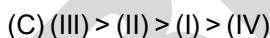
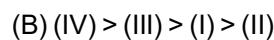
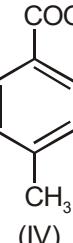
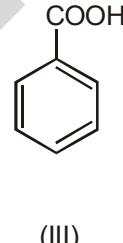
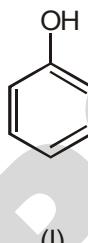
23. The correct stability order for the following species is

[JEE-2008]



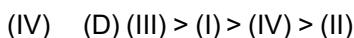
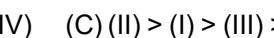
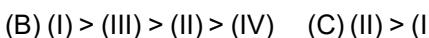
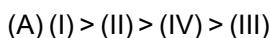
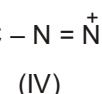
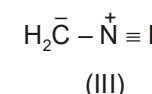
24. The correct acidity order of the following is

[JEE-2009]



25. The correct stability order of the following resonance structures is

[JEE-2009]



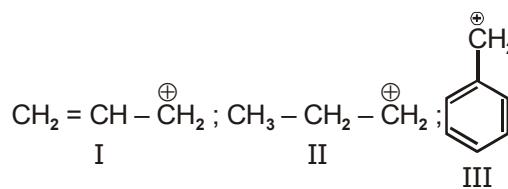
26. Among the following compounds, the most acidic is :

[JEE-2011]

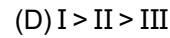
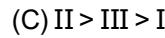
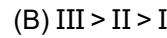
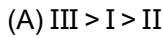


27. The order of stability of the following carbocations

[JEE-Mains-2013]

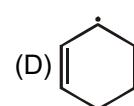
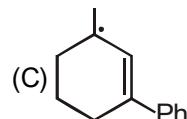
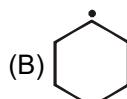
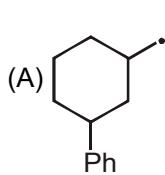


is



28. Which one of the following is most stable ?

[JEE-Mains-Online : 2013]



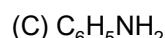
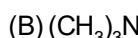
29. The order of basicity of amines in gaseous state is :

[JEE-Mains-Online : 2013]

- (A)  $3^\circ > 2^\circ > \text{NH}_3 > 1^\circ$  (B)  $1^\circ > 2^\circ > 3^\circ > \text{NH}_3$  (C)  $3^\circ > 2^\circ > 1^\circ > \text{NH}_3$  (D)  $\text{NH}_3 > 1^\circ > 2^\circ > 3^\circ$

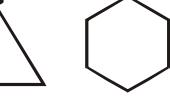
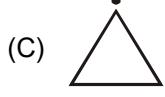
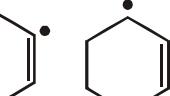
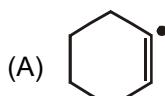
30. Considering the basic strength of amines in aqueous solution, which one has the smallest  $pK_b$  value?

[JEE Mains 2014]



31. In which of the following pairs A is more stable than B ?

[JEE Mains Online 2014]

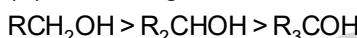


32. Which one of the following statements is **not** correct ?

[JEE Mains Online 2014]

- (A) Alcohols are weaker acids than water.

- (B) Acid strength of alcohol decreases in the following order.

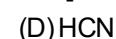
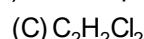
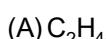


- (C) Carbon-oxygen bond length in methanol,  $\text{CH}_3\text{OH}$  is shorter than that of C – O bond length in phenol.

- (D) The bond angle in methanol is  $108.9^\circ$ .

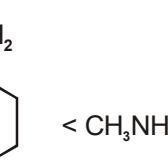
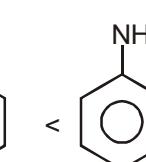
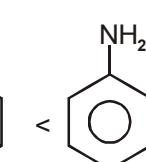
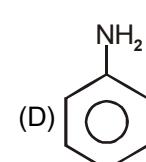
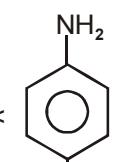
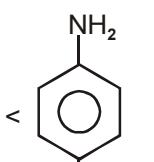
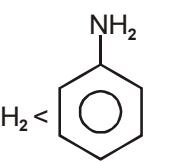
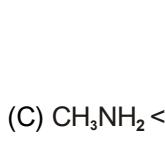
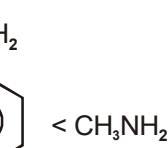
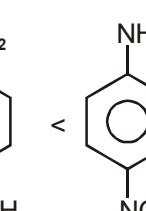
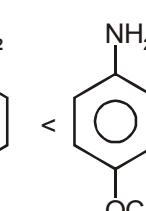
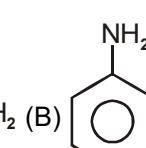
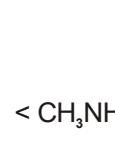
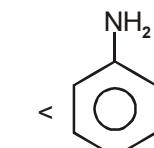
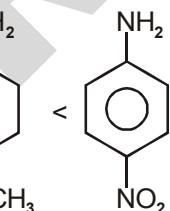
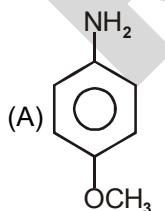
33. Which of the following molecules has two sigma( $\sigma$ ) and two pi( $\pi$ ) bonds ?

[JEE Mains Online 2014]



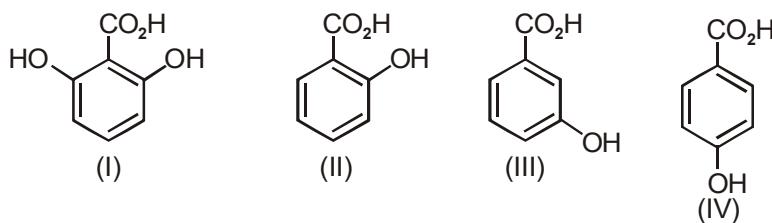
34. Arrange the following amines in the order of increasing basicity

(JEE MAIN 2015)



35. The correct order of acidity for the following compounds is :

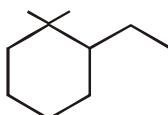
[IIT-JEE Advance 2016]



- (A) I > II > III > IV      (B) III > I > II > IV      (C) III > IV > II > I      (D) I > III > IV > II

36. The IUPAC name of the following compound is :

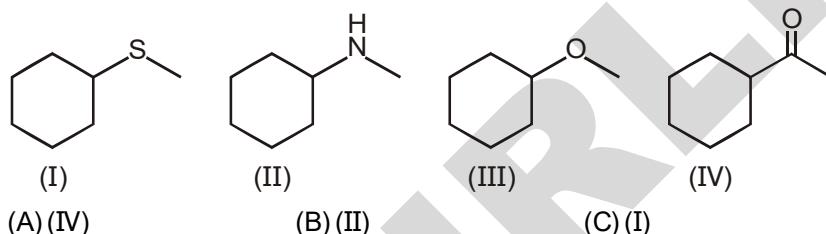
[JEE-Mains Online -2017]



- (A) 2-Ethyl-1,1-dimethylcyclohexane      (B) 1-Ethyl-2,2-dimethylcyclohexane  
 (C) 1,1-Dimethyl-2-ethylcyclohexane      (D) 2,2-Dimethyl-1-ethylcyclohexane

37. A mixture containing the following four compounds is extracted with 1M HCl. The compound that goes to aqueous layer is :

[JEE-Mains Online -2017]



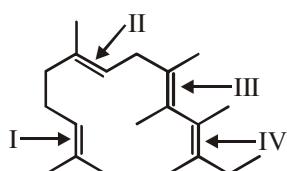
- (A) (IV)      (B) (II)      (C) (I)      (D) (III)

38. Which of the following compounds is most reactive to an aqueous solution of sodium carbonate?

[JEE-Mains Online -2017]



39. In the following structure, the double bonds are marked as I, II, III and IV

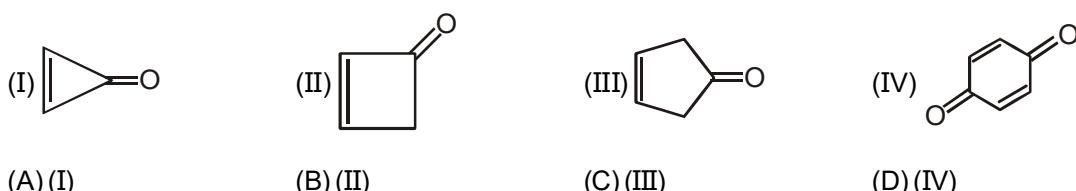


Geometrical isomerism is not possible at site (s) :      [JEE-Mains Online -2017]

- (A) III      (B) I      (C) I and III      (D) III and IV

40. Which of the following compounds will show highest dipole moment?

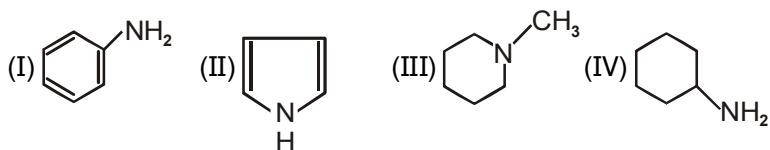
[JEE-Mains Online -2017]



- (A) (I)      (B) (II)      (C) (III)      (D) (IV)

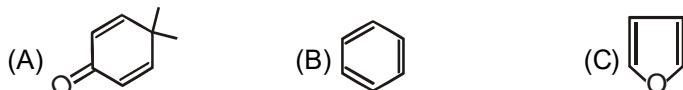
41. Among the following compounds, the increasing order of their basic strength is :

[JEE-Mains Online -2017]

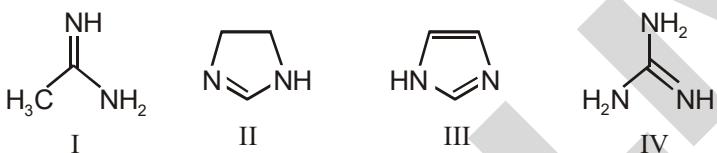


- (A) (I) < (II) < (IV) < (III)  
 (C) (II) < (I) < (IV) < (III)
- (B) (I) < (II) < (III) < (IV)  
 (D) (II) < (I) < (III) < (IV)

42. Which of the following molecules is least resonance stabilized?



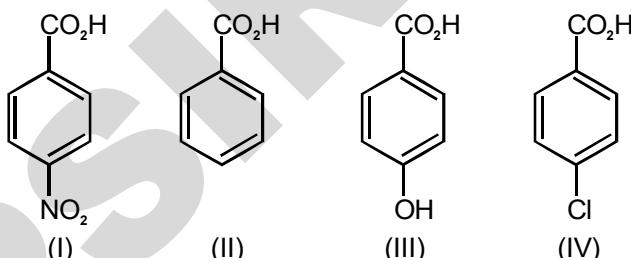
43. The order of basicity among the following compound is :



- (A) II > I > IV > III  
 (B) IV > II > III > I  
 (C) I > IV > III > II  
 (D) IV > I > II > III

44. The increasing order of the acidity of the following carboxylic acids is :

[IIT Main Online-2018]



- (A) I < III < II < IV  
 (B) IV < II < III < I  
 (C) II < IV < III < I  
 (D) III < II < IV < I

#### Multiple Choice Questions :

45. Phenol is less acidic than

- (A) acetic acid      (B) p-methoxy phenol      (C) p-nitrophenol      (D) ethanol

[JEE 1986]

46. The molecule(s) that will have dipole moment is/are

- (A) 2, 2 dimethyl propane      (B) trans 2-pentene  
 (C) cis 3-hexene      (D) 2, 2, 3, 3-tetramethyl butane

[JEE-1992]

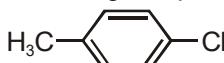
47. An aromatic molecule will :

- (A) have  $4n \pi$  electrons      (B) have  $(4n + 2) \pi$  electrons  
 (C) be planar      (D) be cyclic

[JEE-1999]

48. The IUPAC name(s) of the following compound is(are)

[IIT Advance - 2017]

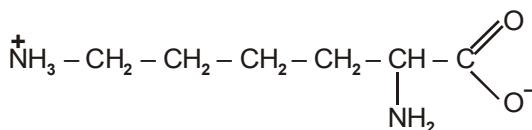


- (A) 1-chloro-4-methylbenzene      (B) 4-chlorotoluene  
 (C) 4-methylchlorobenzene      (D) 1-methyl-4-chlorobenzene

**Subjective :**

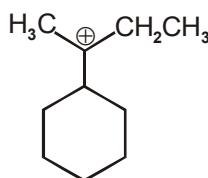
49. The total number of basic groups in the following form of lysine is

[JEE-2010]



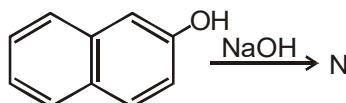
50. The total number of contributing structure showing hyperconjugation (involving C–H bonds) for the following carbocation is

[JEE-2011]



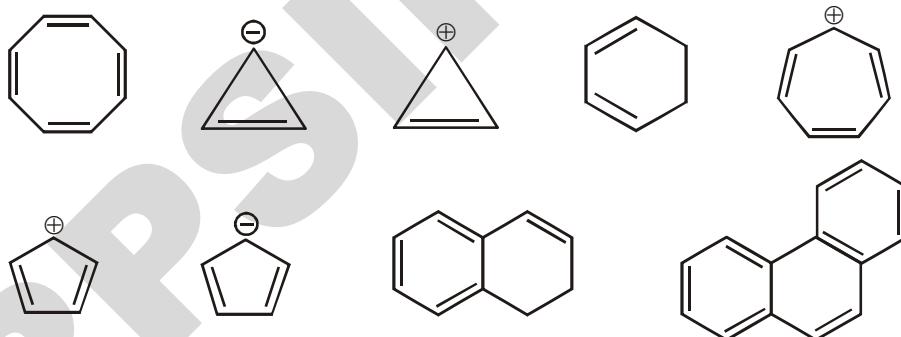
51. The number of resonance structures for N is

[IIT-JEE Advance 2015]



52. Among the following, the number of aromatic compound(s) is :

[IIT Advance - 2017]

**ANSWER KEY**

1.	C	2.	C	3.	B	4.	C	5.	A	6.	C	7.	D
8.	D	9.	D	10.	D	11.	C	12.	B	13.	D	14.	B
15.	B	16.	C	17.	A	18.	D	19.	C	20.	C	21.	A
22.	B	23.	D	24.	A	25.	B	26.	C	27.	A	28.	C
29.	C	30.	D	31.	D	32.	C	33.	D	34.	D	35.	A
36.	A	37.	B	38.	C	39.	B	40.	A	41.	D	42.	A
43.	D	44.	D	45.	AC	46.	BC	47.	BCD	48.	AB	49.	2
50.	6	51.	9	52.	5								