JEE - 2025

CHEMISTRY - MODULES

THEORY

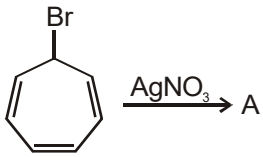
EXERCISE

SOLUTIONS

- Useful for JEE MAINS and ADVANCED Exams
- Each topic contains Detailed Theory with images
- Every topic contains Exercises and Detailed solutions

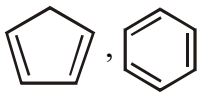
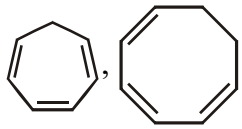
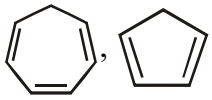
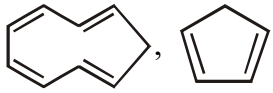
Exercise # 1 [Single Correct Choice Type Questions]

1. Which statement is incorrect for the given reaction ?

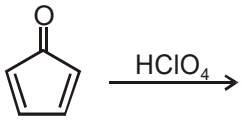


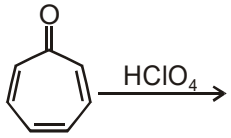
(a) A is resonance stablised
(b) A is a charged ion
(c) A is aromatic
(d) A has low resonance energy (magnitude)

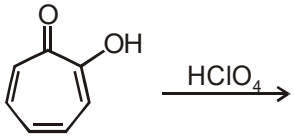
2. In which of the following pairs can both the members be readily deprotonated ?

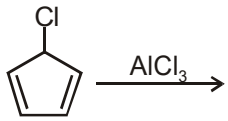
(a) 
(b) 
(c) 
(d) 

3. Which of the following can form carbocation most readily ?

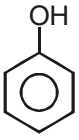
(a) 

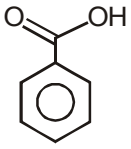
(b) 

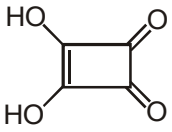
(c) 

(d) 

4. Which of the following compound will produce the fastest effervescence with aqueous $NaHCO_3$?

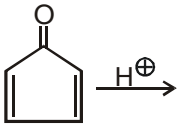
(a) 

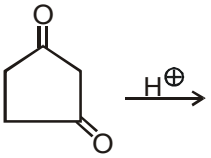
(b) 

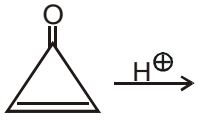
(c) 

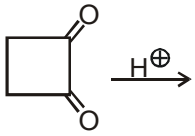
(d) HCOOH

5. Which reaction will give aromatic product ?

(a) 

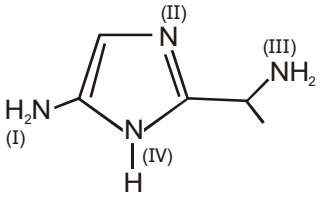
(b) 

(c) 

(d) 

6. Which compound will not release CO_2 gas water $NaHCO_3$?
(a) Lactic acid (b) Tartaric acid (c) Carbolic acid (d) Picric acid

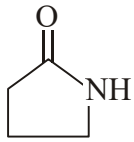
7. Find the most favourable site for protonation in the following compound :



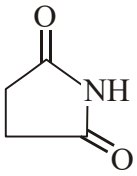
(a) I (b) II (c) III (d) IV

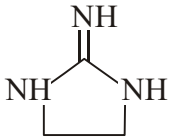
8. Identify the compound which is neither insoluble in acid (aq–HCl) nor in base (aq NaOH)?
(a) Amine (b) Alcohol (c) Carboxylic acid (d) Phenol

9. Identify the most basic compound amongst the following.

(a) 

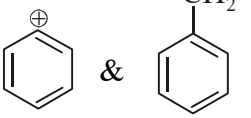
(b) 

(c) 

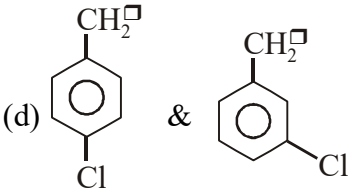
(d) 

10. In which of the following the first intermediate is less stable ?

(a) $CF_3 - H_2C^{\square}$ & $CH_3 - CH_2^{\square}$

(b) 

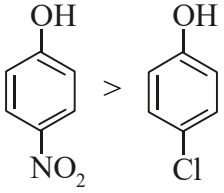
(c) 

(d) 

11. Choose the incorrect option :

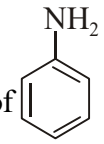
(a) $(CH_3)_2\dot{C}H < (CH_3)_3\dot{C} < (C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C}$ (Stability)

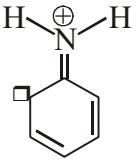
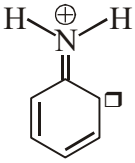
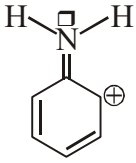
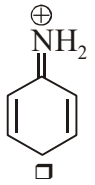
(b) $CH_3CO_2H < MeOCH_2CO_2H < CF_3CO_2H < (Me)_2\overset{H}{\overset{|}{C}} - CO_2H$ (Acidic strength)

(c) 

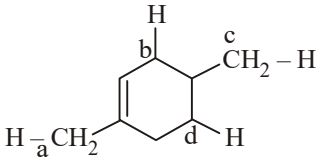
(Acidic strength)

(d) $(CH_3)_2NH$ (I) & CH_3NH_2 (II) (In aqueous solution pK_b value of I is smaller than II)

12. Which of the following is/are not resonating structure(s) of  ?

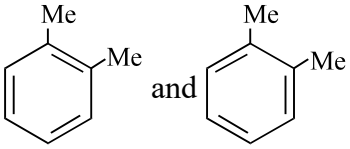
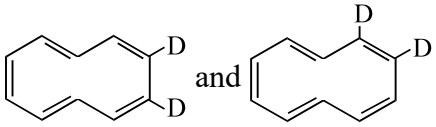
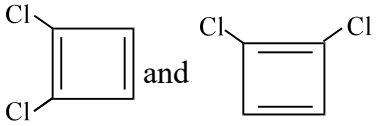
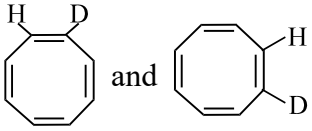
(a) 
(b) 
(c) 
(d) 

13. Compare the bond energy of different C – H bonds shown in the following molecule :



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

14. Which one of following represents different molecules?

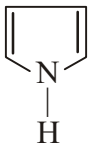
(a) 
(b) 
(c) 
(d) 

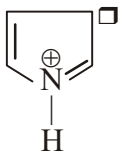
15. Which is the decreasing order of stability of the ions?

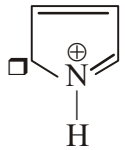
1. $CH_3-\overset{+}{C}H-OCH_3$ 2. $CH_3-\overset{+}{C}H-CH_3$ 3. $CH_3-\overset{+}{C}H-COCH_3$

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

16.


(I)

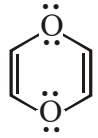
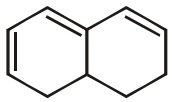
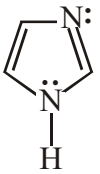

(II)


(III)

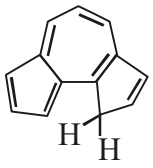
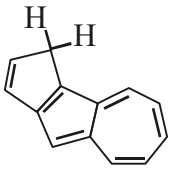
Among these three canonical structures, what is the relative contribution into the hybrid ?

(a) I > III > II (b) I > II > III (c) III > I > II (d) None

17. Which of the following is aromatic?

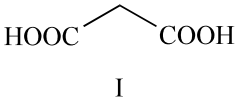
(a)  (b)  (c)  (d) 

18. Two hydrocarbons are given, compare their acidic strength.

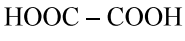
(I)  (II) 

(a) I > II (b) II > I
(c) I = II (d) Both (a) and (b) can be possible

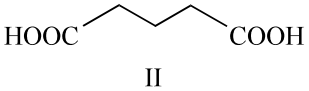
19. Indicate the correct order of acidic strength (first ionization) in the following dicarboxylic acids:



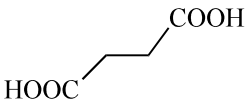
I



III



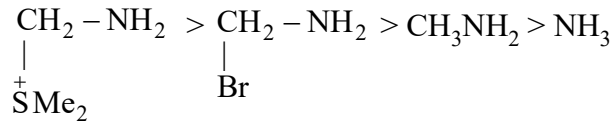
II



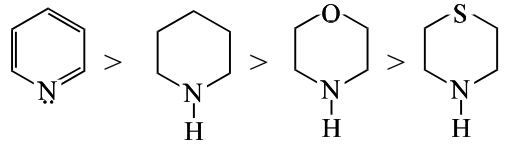
IV

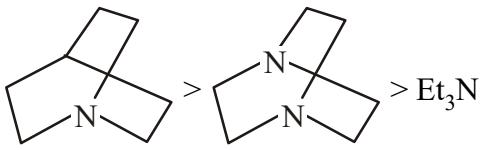
(a) I > II > III > IV (b) II > IV > I > III (c) III > I > IV > II (d) IV > II > I > III

20. What is the correct order of basicity values of the following compounds?

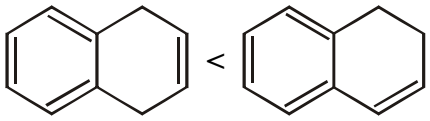
(a) 

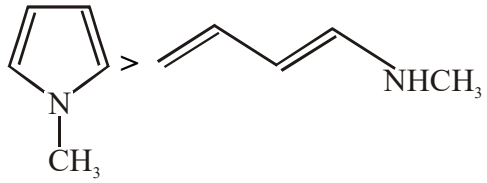
(b) $NH_3 > CH_3NH_2 > CH_2{=}CH\text{-}NH_2 > NH_2\text{-}CH_2\text{-}CH_2\text{-}N^+R_3$

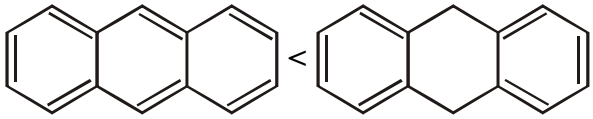
(c) 

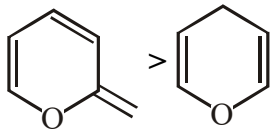
(d) 

21. Which order is **incorrect** for resonance energy?

(a) 

(b) 

(c) 

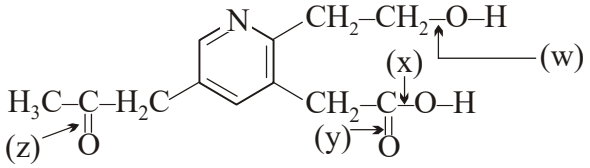
(d) 

22. Select the correct statement about the following compounds.

(I) (II)

(a) II has a greater dipole moment than I
(b) Covalent character of II is less than I
(c) I is more soluble in polar solvent than II
(d) None of these

23. Which one is correct order for Bond length in given compound?



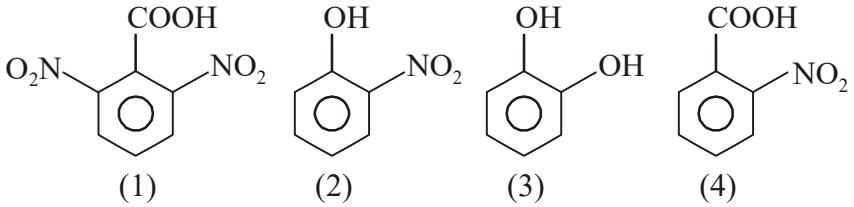
(a) w > y > x > z (b) z > y > x > w (c) w > x > y > z (d) z > x > y > w

24. Four Alkenes are given for molecular formula C_4H_8 :

Select a pair in which Ist compound has maximum stability and IInd compound has maximum heat of hydrogenation -

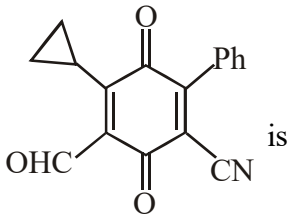
(a) b, c (b) d, c (c) d, a (d) b, a

25. Arrange in increasing order of acidic strength.



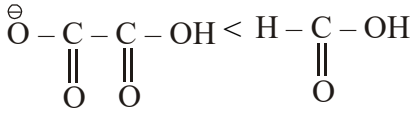
(1) (2) (3) (4)

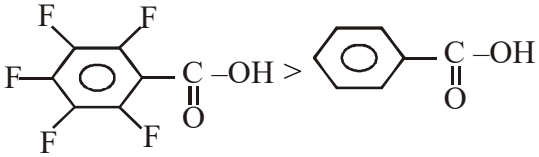
(a) 3 > 2 > 1 > 4 (b) 1 > 4 > 2 > 3 (c) 1 > 4 > 3 > 2 (d) 1 > 2 > 3 > 4

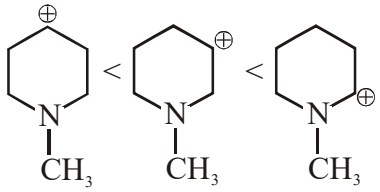
26. Degree of unsaturation for  is

(a) 12 (b) 13 (c) 14 (d) 15

27. Which of the order is incorrect?

(a) Acidic strength : 

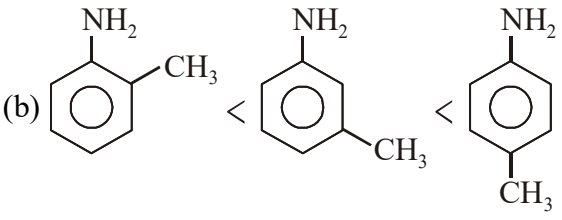
(b) Acidic strength : 

(c) Stability order : 

(d) Basic Strength order : $Et_2NH > Et_3N > Et–NH_2 > NH_3$ (In H_2O)

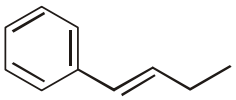
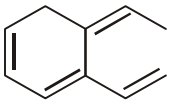
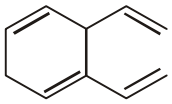
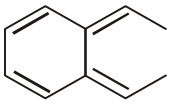
28. The correct order of basic strength for the following bases is / are :

(a) $\overline{C}H_3 > \overline{N}H_2 > \overline{O}H > \overline{F}$

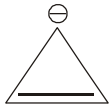
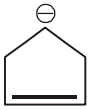
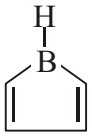
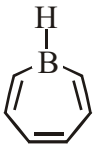
(b) 

(c) Both are correct (d) Both are incorrect

29. Which of the following have highest heat of hydrogenation?

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

30. Which of the following is aromatic ?

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

31. Which of the following statement is incorrect?

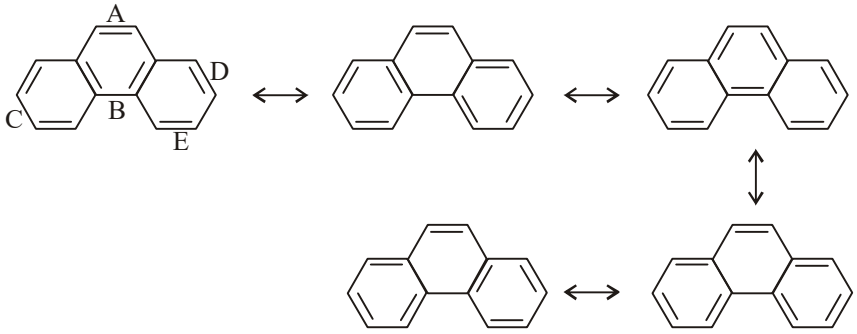
(a) p-nitro phenol is more acidic than p-flouro phenol.

(b) $-\overset{\oplus}{N}Me_3$ is stronger – I group than $-\overset{\oplus}{N}H_3$

(c) Acidity order : o-nitrobenzoic acid > p-nitrobenzoic acid > m-nitrobenzoic acid

(d) Acidity order : $H_3C-COOH > H-\overset{\overset{O}{\|}}{C}-OH$

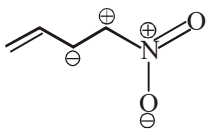
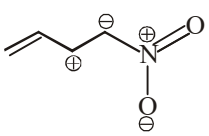
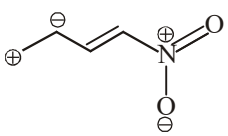
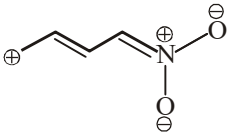
32. Assuming that each resonance structure contributes equally to the final resonance hybrid of phenanthrene, identify the longest bond and shortest bond in phenanthrene.



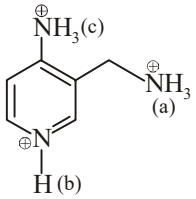
(a) A shortest and B longest (b) C longest and D shortest

(c) E shortest and A longest (d) B longest and C shortest

33. Among the following, the least stable canonical structure is :

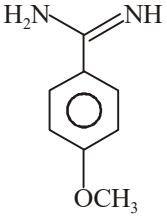
(a)  (b)  (c)  (d) 

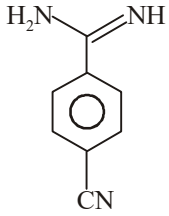
34. Find the correct acidic strength order :

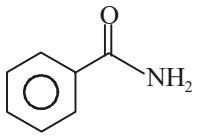


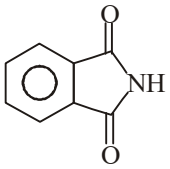
(a) a > b > c (b) c > b > a (c) b > c > a (d) c > a > b

35. The correct order of basic strength of the following compounds is

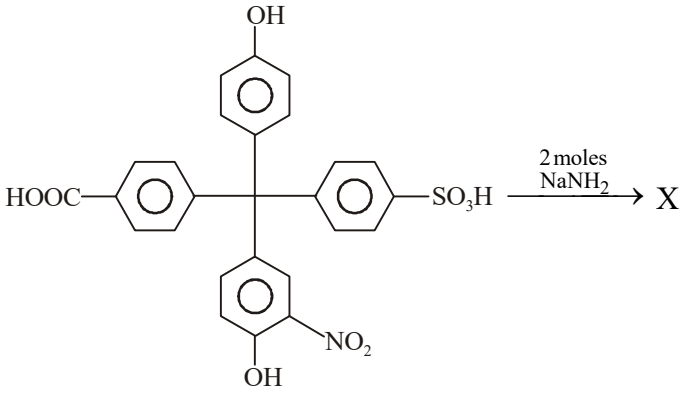
(1) 

(2) 

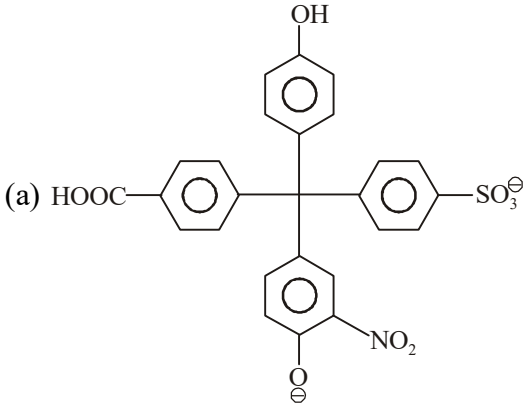
(3) 

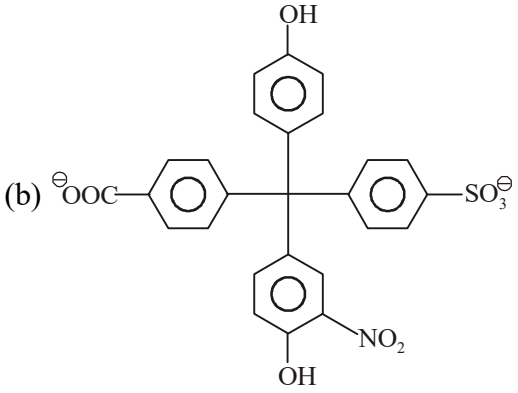
(4) 

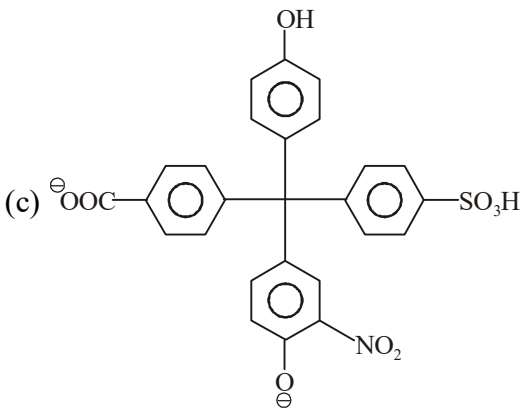
(a) 1 > 2 > 3 > 4 (b) 2 > 1 >3 > 4 (c) 3 > 4 > 1 > 2 (d) 1 > 3 > 2 > 4

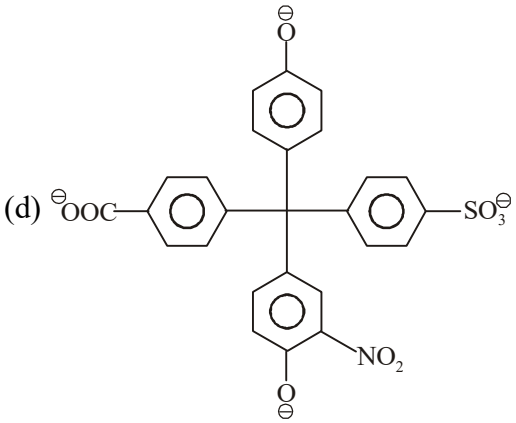
36. 

The product X will be :

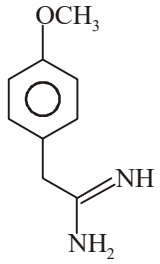
(a) 

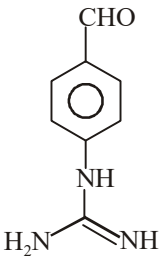
(b) 

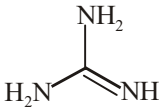
(c) 

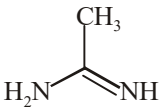
(d) 

37. Identify the compound having highest basic strength.

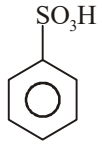
(a) 

(b) 

(c) 

(d) 

38. Which of the following compounds will have highest thermodynamic acidic strength?

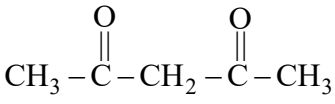
(a) 

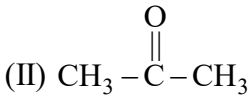
(b) p-nitro phenol

(c) p-Sulpho Benzoic acid

(d) 2,4-Dinitro phenol

39. Arrange acidity of given four compounds in decreasing order:

(I) 

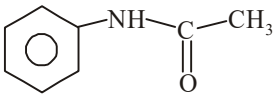
(II) 

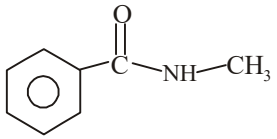
(III) CH≡CH

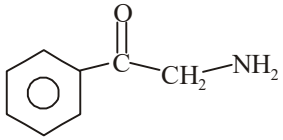
(IV) CH_3–CHO

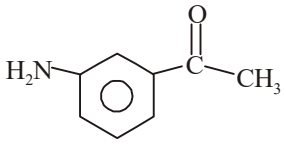
(a) I > IV> III > II (b) I > IV > II >III (c) III > I > IV > II (d) II > IV > I > III

40. The correct basic strength order of the following bases is:

(I) 

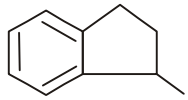
(II) 

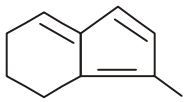
(III) 

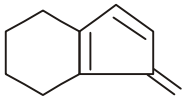
(IV) 

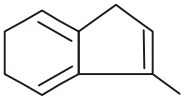
(a) I > II > IV > III (b) IV > III > II > I
(c) III > II > IV > I (d) III > IV > II > I

41. Which of the following hydrocarbon is most acidic ?

(a) 

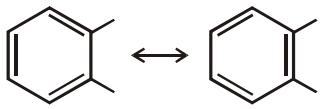
(b) 

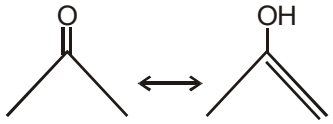
(c) 

(d) 

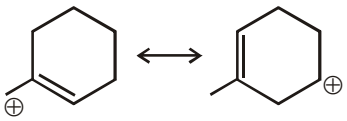
Exercise # 2 Part # I [Multiple Correct Choice Type Questions]

1. Which of the following are resonance structures of each other?

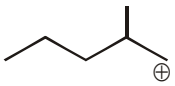
(I) 

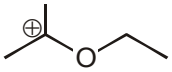
(II) 

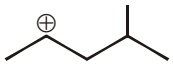
(III) 

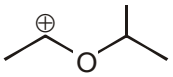
(IV) 

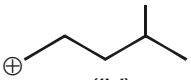
(a) I (b) II (c) III (d) IV

2. Which of the following cations are more stable than 


(I)

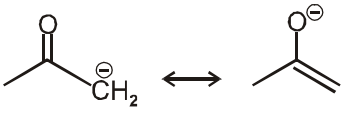

(II)

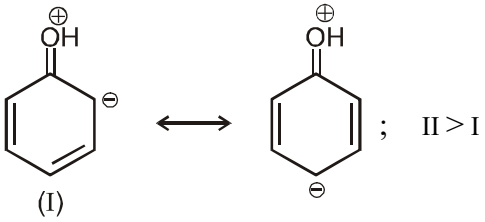

(III)

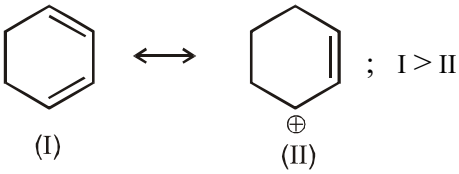

(IV)

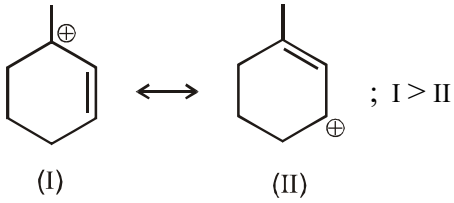
(a) I (b) II (c) III (d) IV

3. Select the options indicating correct order of stability

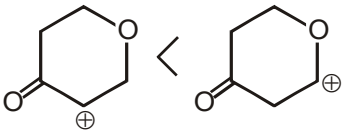
(a)  ; II > I

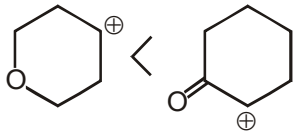
(b)  ; II > I

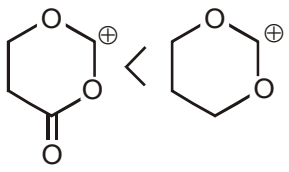
(c)  ; I > II

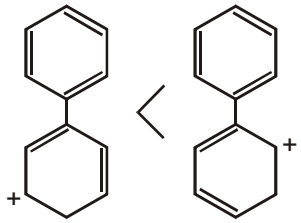
(d)  ; I > II

4. Which carbonium ion stability order is correct ?

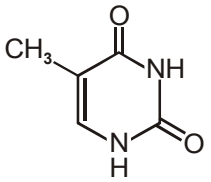
(a) 

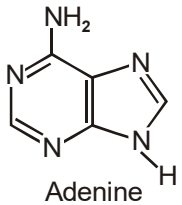
(b) 

(c) 

(d) 

5. Which compound(s) is (are) aromatic ?

(a) 
Thymine

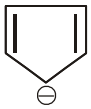
(b) 
Adenine

(c) 
Tropolium ion

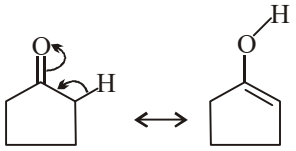
(d) 
Cyclooctatetraene

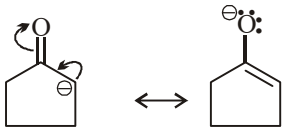
6. Succinic acid is less acidic than which of the following acids?
(a) oxalic acid (b) malonic acid (c) Butanoic acid (d) Adipic acid

7. Which compound(s) has / have identical C – C bond length ?

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

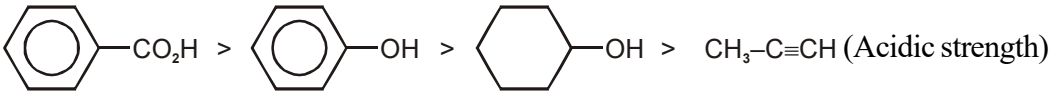
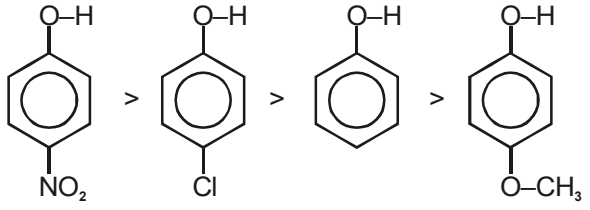
8. Which pair represents resonating structures ?

(a) 

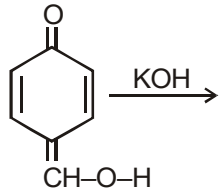
(b) 

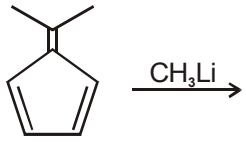
(c) 

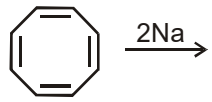
(d) 

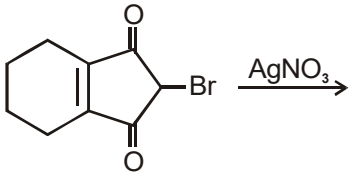
9. Select the correct statement(s) :
(a) $CH_3–NH–CH_3 > CH_3–NH_2 > CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{N}}–CH_3 > NH_3$ (Order of K_b in Aqueous solution)
(b) $CH_3 – CH_2 – NH_2 > C_2H_5 – NH – C_2H_5 > Ph – NH_2$ (Basic strength)
(c)  (Acidic strength)
(d)  (Order of Ka)

10. Which of the following reaction(s) will give aromatic product ?

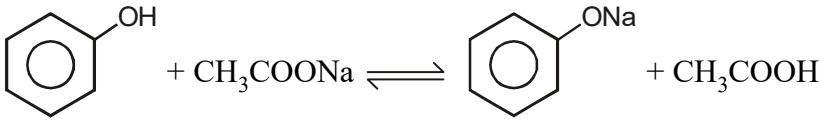
(a) 

(b) 

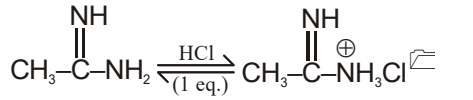
(c) 

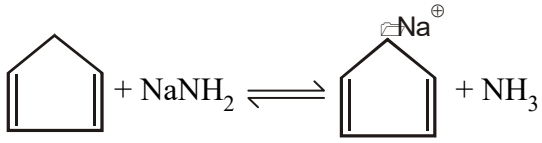
(d) 

11. Which of the following reaction(s) will be in forward direction ?

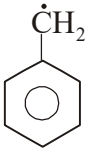
(a) 

(b) $CH_3COOH + NaHCO_3 \rightleftharpoons CH_3COONa + H_2CO_3$

(c) 

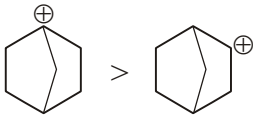
(d) 

12. Select the correct option(s).

(a) Stability of free radical 

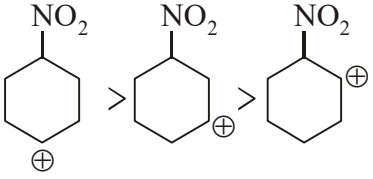
$> CH_3 - CH_2 - \dot{C}H_2$

(b) Stability of carbanion $HC \equiv \overset{\ominus}{C} > CH_2 = \overset{\ominus}{C}H > CH_3 - \overset{\ominus}{C}H_2$

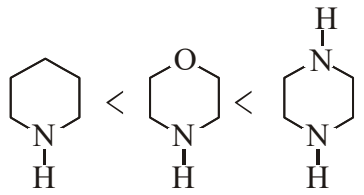
(c) Stability order of carbocation 

(d) Stability of resonating structures $\overset{\ominus}{C}H_2 - \overset{O}{\overset{\|}{C}} - H < CH_2 = \overset{O^{\ominus}}{\overset{|}{C}} - H$

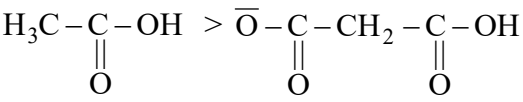
13. Which of the following order is/are correct?

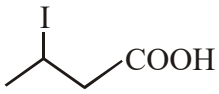
(a) 

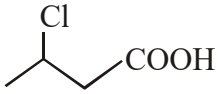
Stability order

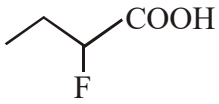
(b)  Basic strength order

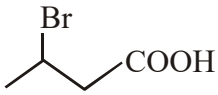
(c) $HC \equiv \overset{\ominus}{C} > H_2C = \overset{\ominus}{C}H > H_3C - \overset{\ominus}{C}H_2$ Stability order

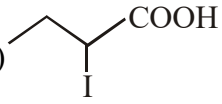
(d)  Acidic strength order

14. Which of the followings is/are more acidic than 

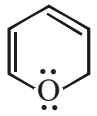
(a) 

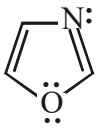
(b) 

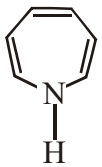
(c) 

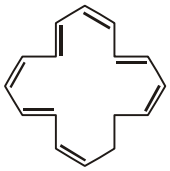
(d) 

15. Which of the followings is / are aromatic?

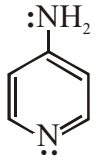
(a) 

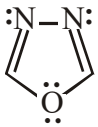
(b) 

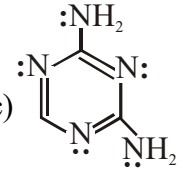
(c) 

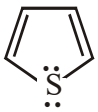
(d) 

16. Which of the following compound(s) has/have two delocalised lone pair?

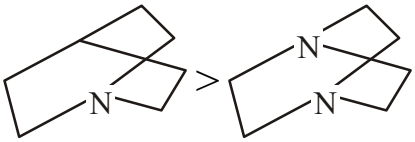
(a) 

(b) 

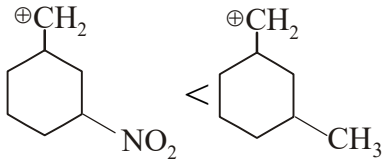
(c) 

(d) 

17. Which of the following orders are correct?

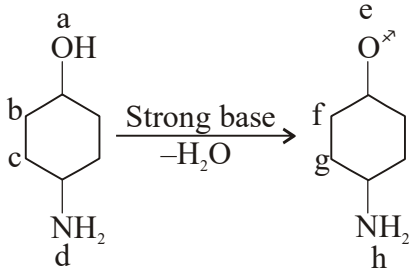
(a) Basic strength 

(b) Acidic strength $CH_3-\underset{\underset{Cl}{|}}{CH}-COOH > \underset{\underset{Cl}{|}}{CH_2}-CH_2-COOH$

(c) Stability of carbocation 

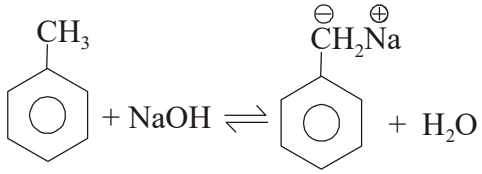
(d) Diprotic acid , first dissociation constant (Ka_1) $\underset{\underset{COOH}{|}}{\overset{\overset{COOH}{|}}{(CH_2)_3}} > \underset{\underset{COOH}{|}}{\overset{\overset{COOH}{|}}{}}$

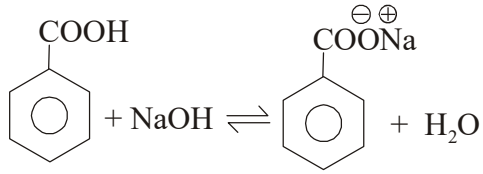
18. Select the correct statement about the following :

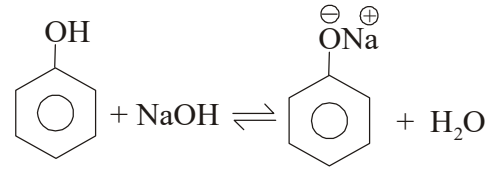


(a) b is more acidic than f
(b) a is less basic than e
(c) a is more basic than d
(d) f is less acidic than g

19. Which of the following reaction equilibrium is favoured in forward direction?

(a) 

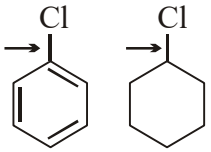
(b) 

(c) 

(d) $EtOH + NaOH \rightleftharpoons \overset{\ominus}{E}t\overset{\ominus}{O}\overset{\oplus}{Na} + H_2O$

20. Correct statement about acidic strength of three substituted benzoic acids is / are :
(I) 2, 6 di - Methyl - benzoic acid
(II) 2 - terebutyl-benzoic acid
(III) 2 - Methyl - benzoic acid
(a) (II) is more acidic than (I)
(b) (II) is more acidic than (I), (III)
(c) Acidic strength order is (I) > (II) > (III)
(d) All show SIR effect

21. In which pair(s) first compound has greater bond strength than second compound for the indicated bond ?

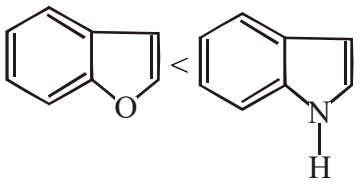
(a) 

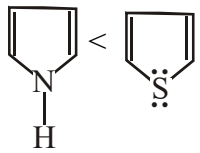
(b) $H_2C = \underset{\uparrow}{CH} - O - CH_3$ $O_2N - \underset{\uparrow}{CH} = CH - OCH_3$

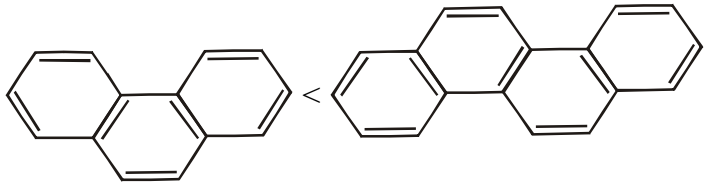
(c) $H_3C - \underset{\uparrow}{CH_2} - Br$ $H_3C - \underset{\uparrow}{CH_2} - I$

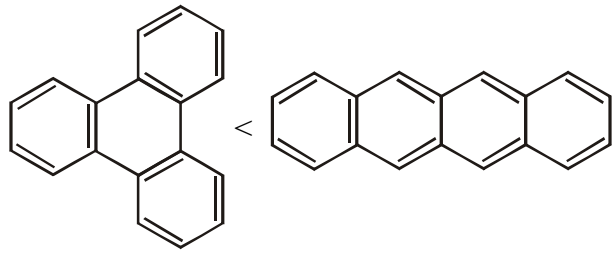
(d) $\underset{\uparrow}{HC} \equiv CH$ $H_2\underset{\uparrow}{C} = CH_2$

22. Which is correct order of resonance energy ?

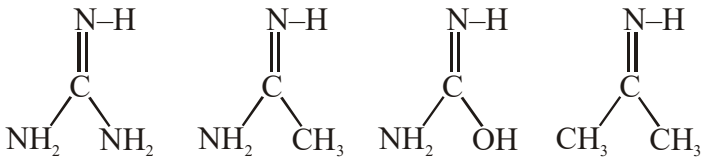
(a) 

(b) 

(c) 

(d)  <

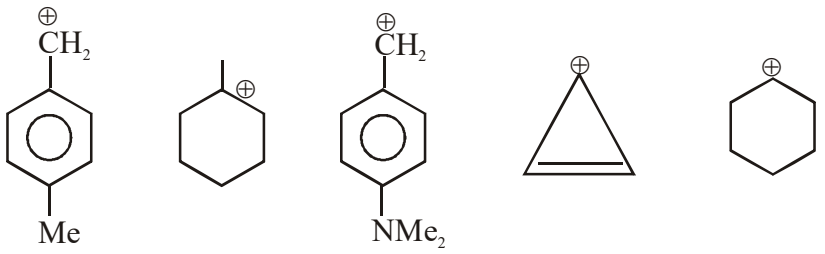
23. Which statement is/are correct for given compounds?



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

(a) All molecules have atleast one localised lone pair.
(b) Compound II is more basic than III
(c) Compound I is most basic
(d) Conjugate acid of compound II has 2 equivalent resonating structures

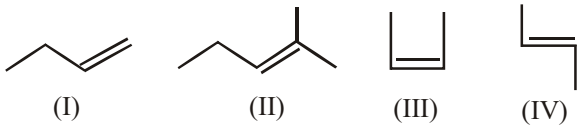
24. Compare stability of intermediates and select correct order of stability.



(I) **(II)** **(III)** **(IV)** **(V)**

(a) III > I > II (b) II > IV (c) IV > I > II (d) IV > II >V

25. Four different alkenes are given. Compare their characteristics and choose the correct statement(s)



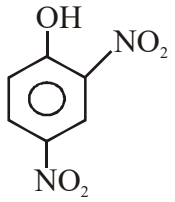
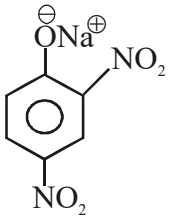
(I) (II) (III) (IV)

(a) Alkene II has most number of α H
(b) Alkene III is more stable than I, IV
(c) Alkene I has highest HOC/CH_2 unit
(d) Alkene III has more HOH/mol than alkene IV

26. Which reaction equilibrium is favoured forward reaction ?

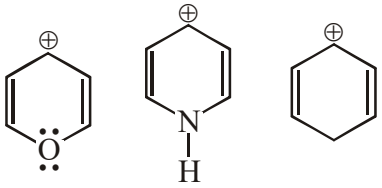
(a) $Me_3C–OH + NaOH \rightleftharpoons Me_3C–\overset{\ominus}{O}\,\overset{\oplus}{Na} + H_2O$

(b) $NaSH + C_6H_5OH \rightleftharpoons H_2S + C_6H_5ONa$

(c) $NaHCO_3$ +  $\rightleftharpoons H_2O + CO_2 +$ 

(d) $Me–OH + Na \rightleftharpoons Me–O^{\ominus}Na^{\oplus} + \frac{1}{2}H_2(\uparrow)$

27. Which statement(s) is (are) correct?



(I) **(II)** **(III)**

(a) Stability order is I > II > III (b) Resonance energy order is II > I > III
(c) I is more aromatic than II (d) III is non-aromatic in nature.

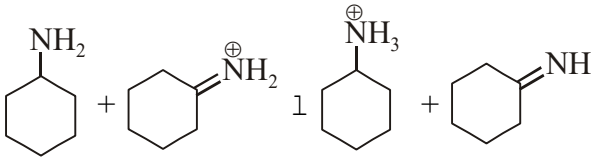
28. Three resonating structures of a compound are given, select the correct statement(s) for them.

(I) $Me–O–CH=CH–NO_2$ **(II)** $Me-\overset{\oplus}{O}=CH-\overset{\ominus}{C}H-NO_2$

(III) $Me-\overset{\oplus}{O}=CH-CH=N(\rightarrow O)-O^{\ominus}$

(a) Their stability order is I > III > II.
(b) Structure I has highest contribution in its resonance hybrid.
(c) Structure III has least number of electron pairs.
(d) All resonating structure have zero unpaired electrons.

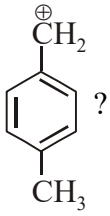
29. Which reaction should have $K_{eq} > 1$?

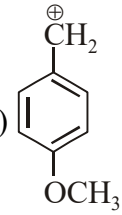
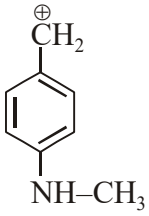
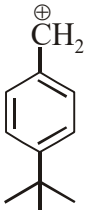
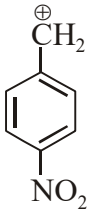
(a) 

(b) $\overline{C}H_3Li^+ + CH_3-OH \rightleftharpoons CH_3\overline{O}Li^+ + CH_4$

(c) $CH_3-\underset{\underset{O}{\|}}{C}-\overline{O}Na^+ + CH_3-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH \rightleftharpoons H_3C-\underset{\underset{O}{\|}}{C}-OH + H_3C-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-\overline{O}Na^+$

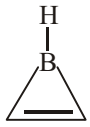
(d) $HCl + CH_3-\overset{\overset{O}{\|}}{C}-\overline{O}Na \;\; l \;\; H_3C-\overset{\overset{O}{\|}}{C}-OH + NaCl$

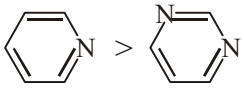
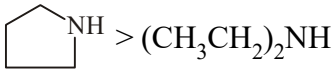
30. Which of the following carbocation(s) is / are more stable than  ?

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

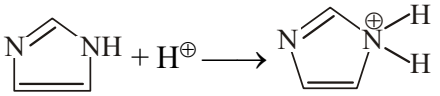
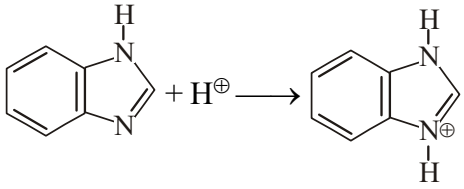
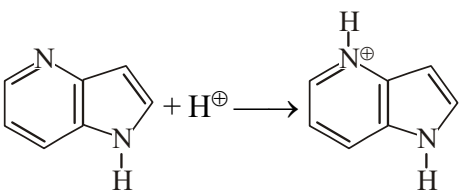
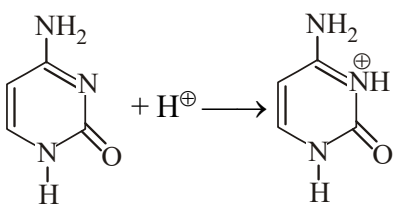
31. The molecules in which all the atoms are in same plane is (are) :
(a) Butadiene
(b) Tricarbon dioxide
(c) Cyclooctatetraene
(d) Cyclopentadienyl anion

32. The molecules in which all the atoms are in same plane is (are) :

(a) Annulene (4)
(b) Annulene (10)
(c) Tropylium cation
(d) 

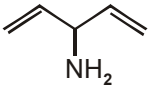
33. Which of the following is correct order of basic strength:
(a) $PrNH_2 < Pr_2NH < Pr_3N$ in chloro benzene
(b) m-$MeOC_6H_4NH_2$ < p-$MeOC_6H_4NH_2$ in gaseous phase
(c) 
(d) 

34. In which of the acid base reaction is the most basic N atom protonated ?

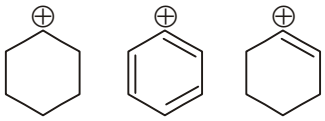
(a) 
(b) 
(c) 
(d) 

Exercise # 3 Part # I [Matrix Match Type Questions]

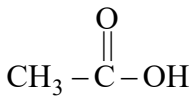
1.

	Column-I		**Column-II**
(a)		(p)	Non aromatic
(b)		(q)	Aromatic
(c)		(r)	No resonance
(d)		(s)	Anti aromatic
		(t)	Lone pair undergoes resonance

2.

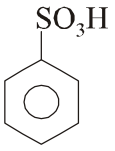
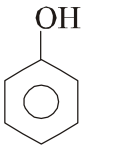
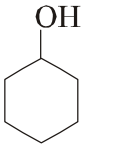
	Column I (Intermediate species)		**Column II (Select the correct decreasing order of stability of the species given in column I)**
	(I) (II) (III)		
(a)	$MeCH_2^{\bullet}$ $Me_3C^{\bullet}$ $Me_2CH^{\bullet}$	(p)	I > III > II
(b)	$MeCH_2^{\square}$ $Me_2CH^{\square}$ $Me_3C^{\square}$	(q)	II > III > I
(c)		(r)	I > II > III
		(s)	III > I > II

3.

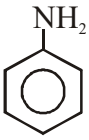
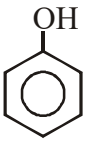
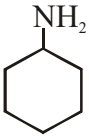
	Column I ***(Compound)***		**Column II** ***(Effect which operates in given compound)***
(a)		(p)	Inductive effect
(b)	$CH_3–CH=CH–OCH_3$	(q)	Resonance
(c)		(r)	Hyperconjugation
		(d)	Reverse Hyperconjugation

4.

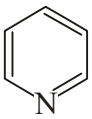
	Column-I		**Column-II**

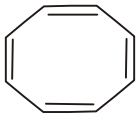
(a)		(p)	React with Na
(b)		(q)	React with NaOH
(c)		(r)	React with $NaNH_2$
		(s)	React with $NaHCO_3$
(d)	$CH \equiv CH$	(t)	Most acidic compound

5.

	Column - I		**Column - II**
(a)		(p)	Aromatic compound
(b)		(q)	DBE ≥ 2
(c)		(r)	Highest C–N bond order
(d)		(s)	Highest resonance energy
		(t)	Compound has at least one lone pair.

6.

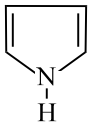
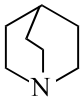
	Column I		**Column II**
(a)		(p)	Homocyclic compound
(b)		(q)	Anti-aromatic compound
(c)		(r)	Aromatic compound

(d) 

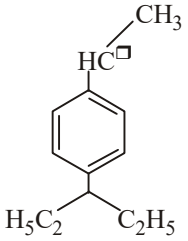
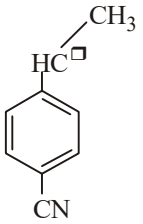
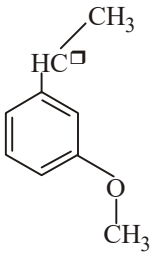
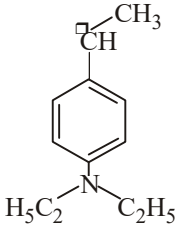
(s) Heterocyclic compound

(t) Degree of unsaturation is odd

7.

	Column -I (Compound)		**Column- II (pK_b)**
(a)		(p)	13.60
(b)	Me_3N	(q)	3.35
(c)	NH_3	(r)	4.75
(d)		(s)	4.22

8.

	Column-I (Carbanions)		**Column -II (Half lives)**
(a)		(p)	4.3×10^{-8} s
(b)		(q)	2.5×10^{-5} s
(c)		(r)	8.7×10^{-7} s
(d)		(s)	1.4×10^{-4} s

Part # II [Comprehension Type Questions]

Comprehension # 1

We've now learned that benzene is unusually stable, and that this stability seems to be correlated with the overlap of its carbon 2p orbitals to form π molecular orbitals. In 1931, Erich Huckel (1896 – 1980), a German chemist physicist, elucidated with molecular orbital arguments the criteria for this sort of stability, which has come to be called aromaticity.

Criteria for aromaticity :

– Aromatic compounds contain one or more rings that have a cyclic arrangement of p-orbitals. Thus, aromaticity is a property of certain cyclic compounds

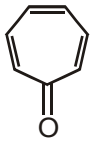
– Every atom of an aromatic ring has a p-orbital.

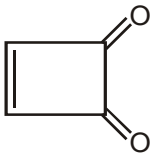
– Aromatic rings are planar.

– The cyclic arrangements of p-orbitals in an aromatic compound must contain $4n + 2\pi$ electrons, where n is any positive integer (0, 1, 2,.....). In other words, an aromatic ring must contain 2, 6, 10, ... π electrons.

1. Which of the following compound is Non Aromatic ?

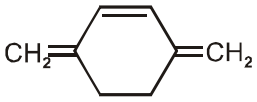
(a) 

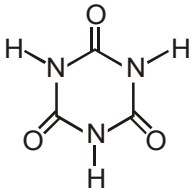
(b) 

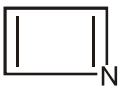
(c) 

(d) 

2. Which of the following compound is Aromatic?

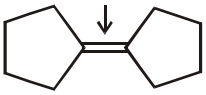
(a) 

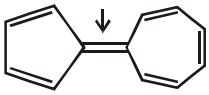
(b) 

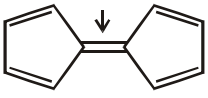
(c) 

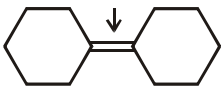
(d) 

3. Which amongst the indicated bonds has the highest bond length ?

(a) 

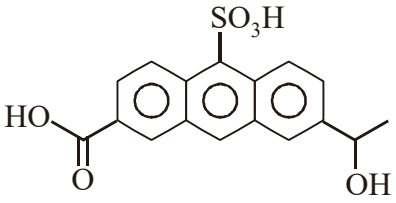
(b) 

(c) 

(d) 

Comprehension # 2

Consider following compound:



1. How many moles of $NaHCO_3$ will consume on reaction of one mole of above compound?
(a) 3 (b) 2 (c) 1 (d) 0

2. How many moles of $NaNH_2$ will consume on reaction of 1 mole of above compound ?
(a) 2 (b) 0 (c) 3 (d) 1

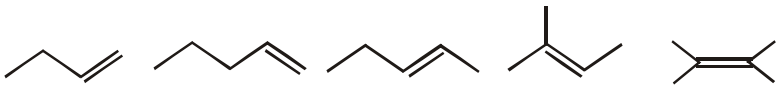
Comprehension # 3

Heat of combustion is a method to define the stability of compound. By this method we compare HOC/mol and HOC/CH_2 unit of compound.

$$\text{HOC/mol} \alpha \text{ Number of } CH_2 \text{ unit}$$

$$\text{HOC/}CH_2 \text{ unit} \alpha \frac{1}{\text{stability}}$$

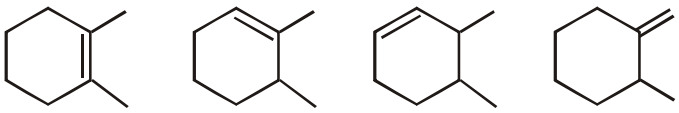
1. Arrange given compounds in decreasing order of their HOC/mol.



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

(a) a > b > c > d > e (b) e > d > c > b > a
(c) e > b > c > d > a (d) b > a > c > d > e

2. Correct order of HOC / CH_2 unit in given compounds :

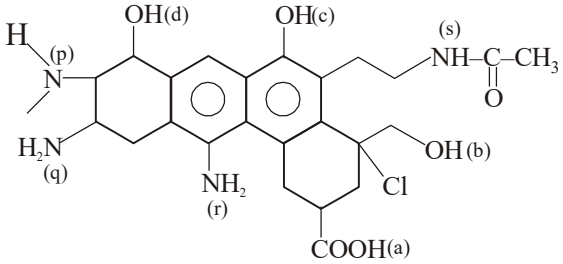


(I) **(II)** **(III)** **(IV)**

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

Comprehension # 4

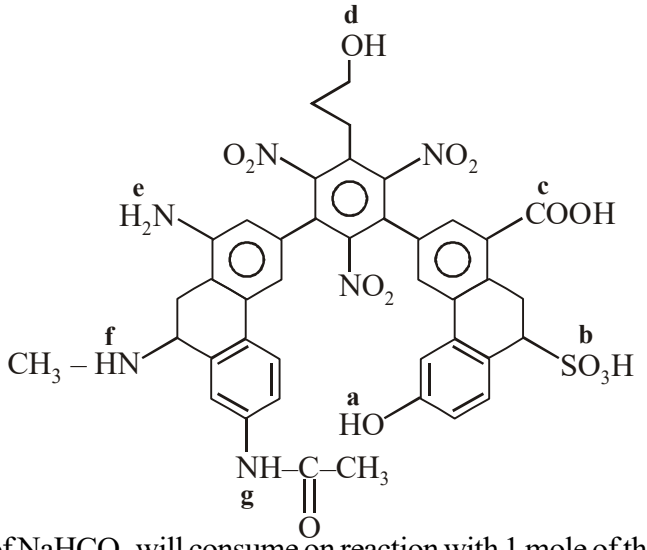
In the following compound -



1. Which of the following is correct order of acidic strength?
(a) c > b > a > d (b) c > a > b > d (c) a > c > b > d (d) a > b > c > d

2. The degree of unsaturation (DBE) in the compound is :
(a) 9 (b) 10 (c) 11 (d) 12

Comprehension # 5

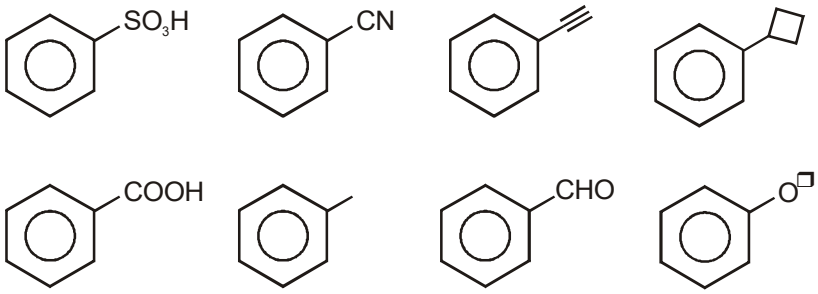


1. How many moles of $NaHCO_3$ will consume on reaction with 1 mole of this compound?
(a) 2 (b) 3 (c) 4 (d) 1

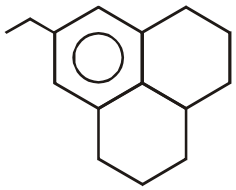
2. What is the correct order of basic strength of the following?
(a) e > f > g (b) f > e > g (c) g > e > f (d) e > g > f

Exercise # 4 [Subjective Type Questions]

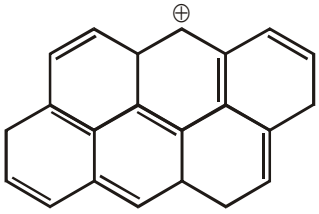
1. How many compounds have (–I) group directly attached to benzene?



2. Determine the total number of α-H in the given compound.

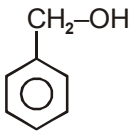


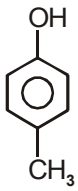
3. Determine the number of carbon atoms where ⊕ charge is delocalised in the resonance hybrid.

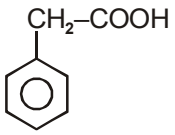


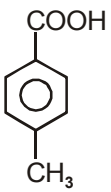
4. Find the number of resonating structure of carbolic acid.

5. How many of the given organic compounds are soluble in alkali/NaOH(aq)?

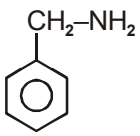
(a) 

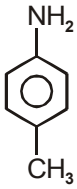
(b) 

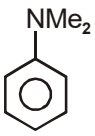
(c) 

(d) 

(e) $CH \equiv CH$ (f) $CH_2 = CH_2$ (g) $CH_3–CH_2–OH$

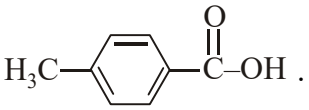
(h) 

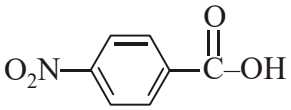
(i) 

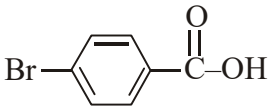
(j) 

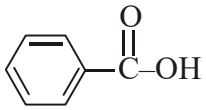
6. If benzene π electron are localized, then find the number of possible isomer for Bromo-chloro Benzene.

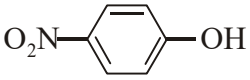
7. Consider following compounds and write number of compound having pK_a less than pK_a of

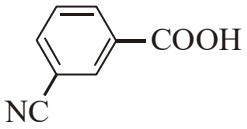


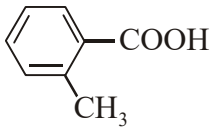




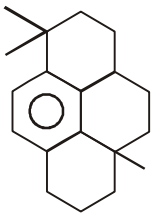


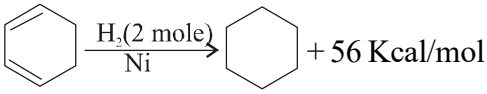


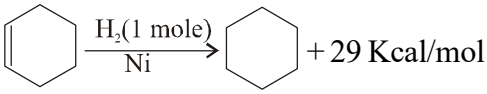




8. Total number of α-hydrogen in the given compound is:

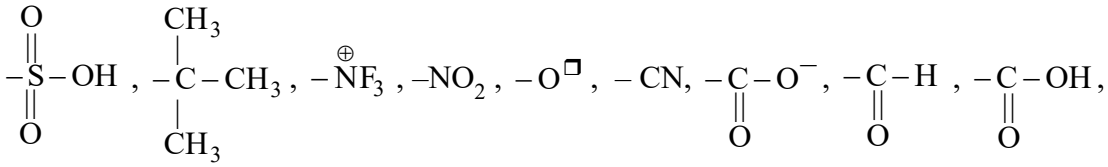


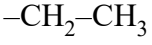
9. (a) 

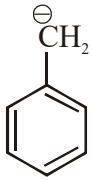
(b) 

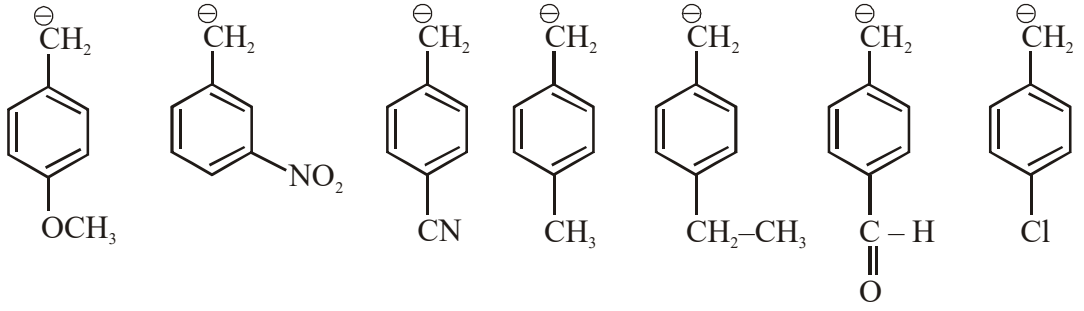
Give the value of resonance energy for  using these data :

10. Consider following groups and write number of groups which have –I effect .

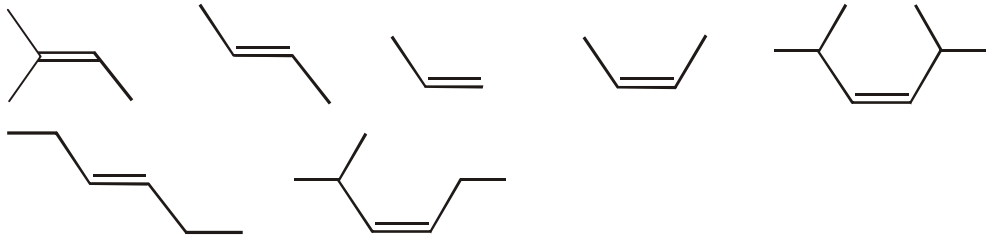


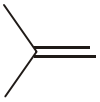


11. Consider following carbanions and find number of carbanions which are more stable than  .



12. Consider the following compounds :



How many compounds have higher value of heat of combustion than HOC of  ?

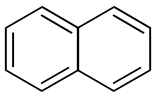
13. Consider the following compounds :

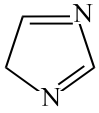
$H_3C-\overset{\ominus}{C}H_2\ \overset{\oplus}{Na}$, $H_3C-CH_2-\overset{\ominus}{O}\ \overset{\oplus}{Na}$, $\overset{\oplus}{Na}\overset{\ominus}{N}H_2$, NaOH , $H_3C\overset{\ominus}{O}\overset{\oplus}{Na}$, NH_4OH ,

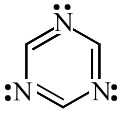
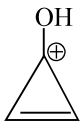
$H-\underset{\underset{O}{\|}}{C}-\overset{\ominus}{O}\ \overset{\oplus}{Na}$, $H_2C=\overset{\ominus}{C}H\overset{\oplus}{Na}$

Number of compounds which are more basic than $HC\equiv\overset{\ominus}{C}\overset{\oplus}{Na}$ are _____

14. Among the following compounds:

(i)  (ii) $C_8H_8^{-2}$ (Mono cyclic) (iii) 

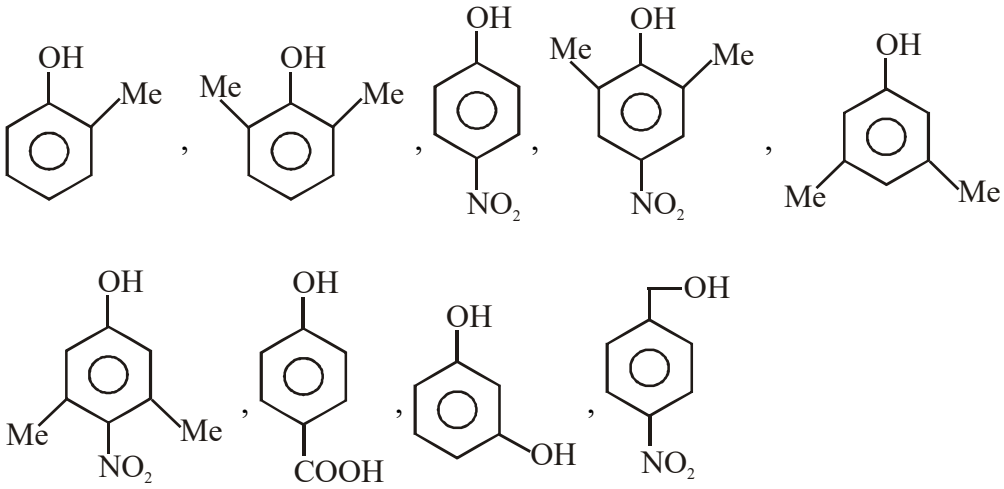
(iv)  (v)  (vi)  (vii) 

(viii)  (ix) $C_3H_3^{+1}$ (Mono cyclic) (x) 

(xi) 

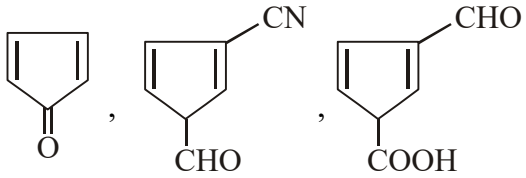
(a) Number of compounds which are non-aromatic = x
(b) Number of compounds which are anti-aromatic = y
What is the sum of x + y ?

15. Find the number of compounds which are more acidic than phenol.

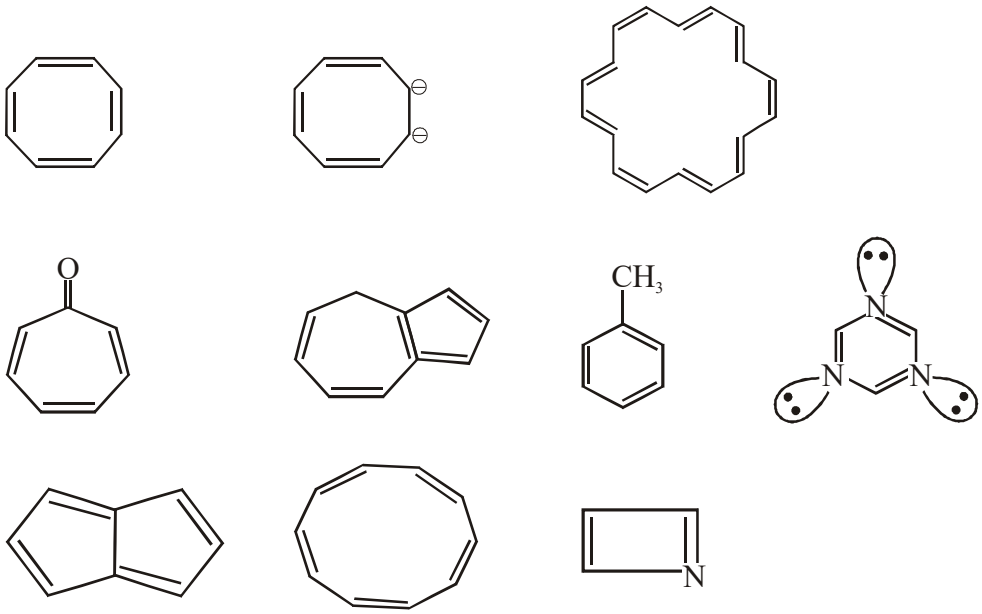


16. Which of the following compounds have degree of unsaturation = 4.

C_8H_8, C_7H_8O, C_9H_{12}, C_3H_9N,

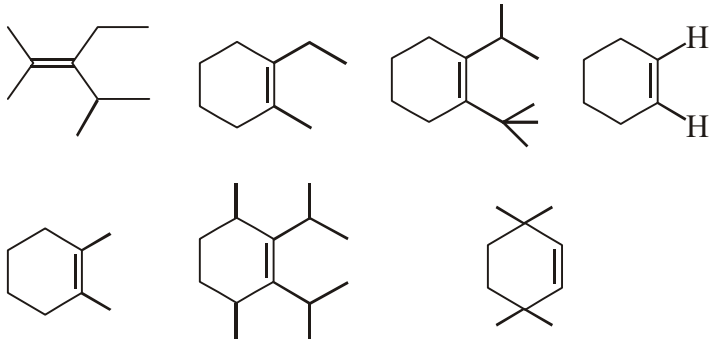


17. Number of compounds which are aromatic in nature.



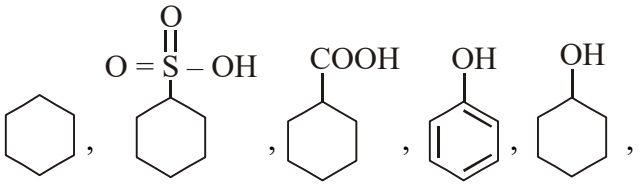
18. Consider monocyclic compounds.
$C_8H_8^{2-}$, $C_8H_2^{2+}$, $C_{16}H_{16}$, $C_4H_4^{2-}$, C_6H_6, $C_7H_7^{+}$, $C_7H_7^{-}$, C_8H_8
Number of compounds which can follow Huckel's rule.

19. Consider following alkenes.

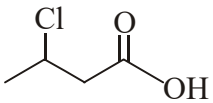


Find the number of compounds which have more than 5 α H .

20. Consider following compounds and identify compounds which can react with $NaNH_2$ to evolve NH_3.



$HC \equiv CH$, $H_2C = CH_2$, CH_4 , H_2O , $H_3C–OH$

21. Consider following compounds & identify compounds which should be more acidic than 

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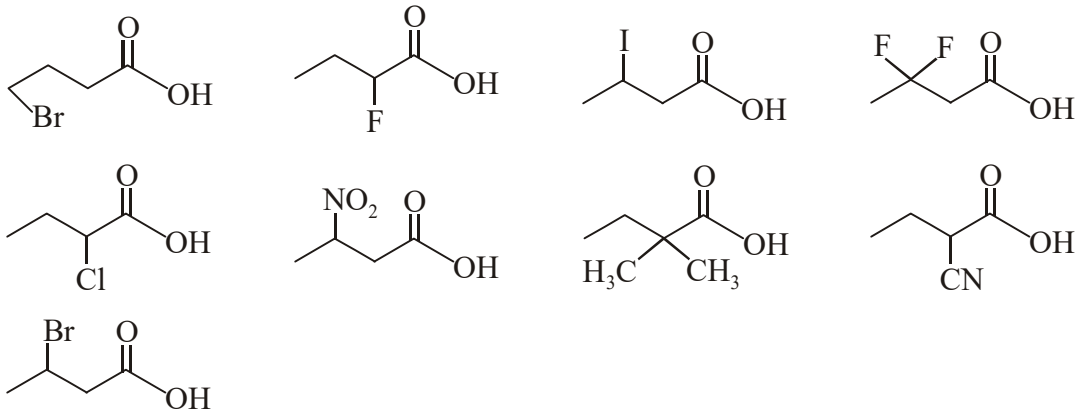
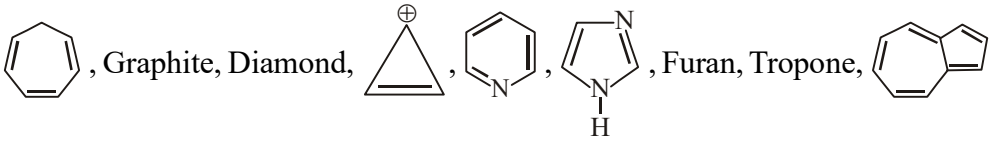


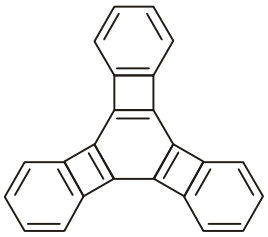
22. Find the number of aromatic compounds among the following :

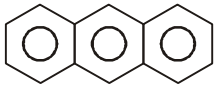

, Graphite, Diamond,

,

,

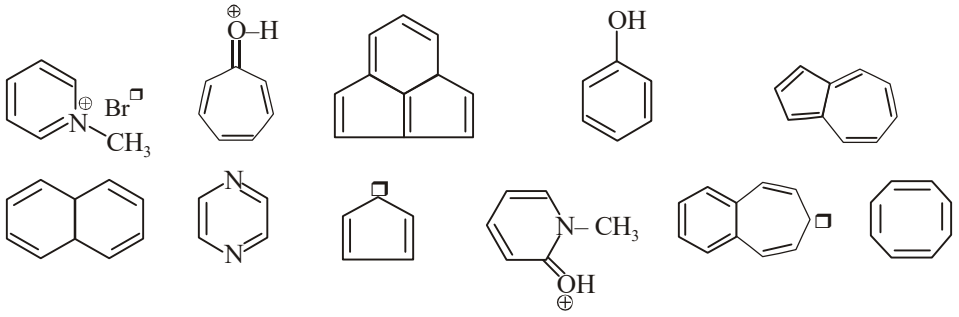
, Furan, Tropone,

23. (i)

$\xrightarrow{3H_2 / Ni}$ (x) number of product including stereoisomers

(ii)


When two hydrogen of anthracene is replaced by bromine then number of meso isomer (y) obtained is so, x + y = ?

24. Of the following compounds, how many would be considered aromatic by application of the Huckel rule ?



25. How many aromatic compounds having molecular formula $C_8H_8O_2$ will be readily extracted in aqueous $NaHCO_3$ solution?

ANSWER KEY

EXERCISE - 1

1. D **2.** D **3.** C **4.** C **5.** C **6.** C **7.** C **8.** B **9.** D **10.** B **11.** B **12.** C **13.** C
14. B **15.** B **16.** A **17.** D **18.** A **19.** C **20.** D **21.** C **22.** C **23.** C **24.** D **25.** B **26.** B
27. C **28.** C **29.** C **30.** D **31.** D **32.** A **33.** A **34.** B **35.** A **36.** B **37.** C **38.** C **39.** B
40. D **41.** B

EXERCISE - 2 : PART # I

1. A **2.** ABCD **3.** ACD **4.** AC **5.** ABC **6.** AB **7.** AC **8.** BCD **9.** ACD **10.** ABCD
11. BD **12.** ABD **13.** ACD **14.** ABCD **15.** B **16.** C **17.** ABC **18.** ABD **19.** BC **20.** ACD
21. ACD **22.** ABC **23.** ACD **24.** ACD **25.** ACD **26.** CD **27.** BD **28.** ABD **29.** ABCD
30. AB **31.** ABD **32.** ACD **33.** ABCD **34.** BCD

EXERCISE - 3 : PART # I

1. (a) – qt ; (b) – p ; (c) – q ; (d) – pr
2. (a) q, (b) r, (d) p
3. (a) pq (b) pqr (c) pr
4. (a) pqrst, (b) pqr (c) pr (d) pr
5. (a) pqrst (b) pqt, (c) qt (d) t
6. (a) pqt (b) rs (c) rst (d) pt
7. (a) p (b) s (c) r (d) q
8. (a) r (b) s (c) q (d) p

PART # II

Comprehension # 1 : **1.** D **2.** B **3.** B
Comprehension # 2 : **1.** B **2.** C
Comprehension # 3 : **1.** C **2.** B
Comprehension # 4 : **1.** C **2.** C
Comprehension # 5 : **1.** A **2.** B

EXERCISE - 4

1. 5 **2.** 7 **3.** 6 **4.** 5 **5.** 3 **6.** 5 **7.** 5 **8.** 3 **9.** 2 **10.** 6 **11.** 4 **12.** 6 **13.** 3 **14.** 5 **15.** 5 **16.** 3
17. 5 **18.** 5 **19.** 3 **20.** 7 **21.** 5 **22.** 7 **23.** 2 **24.** 7 **25.** 4