

QUESTION BANK
ACIDITY, BASICITY
H-BONDING
&
TAUTOMERISM




StudySteps.in

Students should solve this Question Bank by 17th Sept. 2006 positively

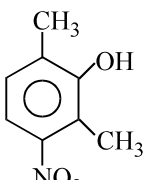
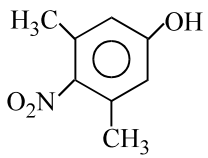
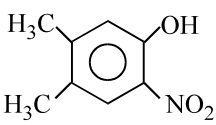
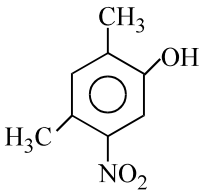
Questions No.1 to 6 (6 questions)

Acid strength is measured by the position of equilibrium of ionisation in water. In other words acid strength is the function of the stability of conjugate base of the acid. More is the stability of conjugate base of the acid, more is the acidity of acid.

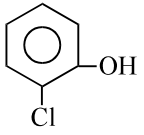
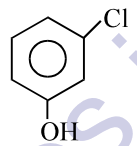
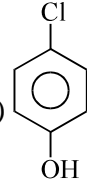
Q.1 Which one of the following is the most acidic?

- (A)  (B)  (C)  (D) $\text{CH}_2=\text{CH}-\text{CH}_3$

Q.2 Which one of the following phenols will show highest acidity?

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

Q.3 Arrange the following compounds in decreasing order of acidity?

- (I) $\text{C}_6\text{H}_5-\text{OH}$ (II)  (III)  (IV) 

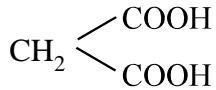
Select the correct answer from the codes given below:

- (A) $\text{III} > \text{II} > \text{IV} > \text{I}$ (B) $\text{III} > \text{II} > \text{I} > \text{IV}$ (C) $\text{II} > \text{III} > \text{I} > \text{IV}$ (D) $\text{II} > \text{III} > \text{IV} > \text{I}$

Q.4 Which one of the following is strongest acid?

- (A) $\text{Cl}-\text{CH}_2-\text{CH}_2-\text{COOH}$ (B) $\text{Cl}-\text{CH}_2-\text{COOH}$
 (C) $\text{Cl}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$ (D) CH_3-COOH

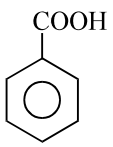
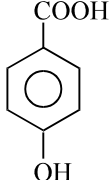
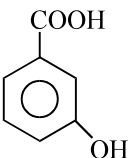
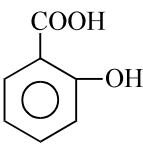
Q.5 The correct order of acidity of the given acids:

- (I) CH_3COOH (II) $\text{HOOC}-\text{COOH}$ (III)  (IV) $\text{HOOC}-(\text{CH}_2)_4-\text{COOH}$

will be:

- (A) $\text{II} > \text{IV} > \text{III} > \text{I}$ (B) $\text{I} > \text{II} > \text{III} > \text{IV}$ (C) $\text{II} > \text{III} > \text{IV} > \text{I}$ (D) $\text{II} > \text{I} > \text{IV} > \text{III}$

Q.6 Which of the following is weakest acid?

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

Question No. 7 to 9 (3 questions)

Basicity of nitrogen containing compounds are determined by the relative availability of the non-bonding electrons on nitrogen atom to a proton donor or Lewis acid and by the stabilisation of the positive charged nitrogen atom by solvation or, in some special cases by resonance.

Q.7 Consider the following bases:

- (I) o-nitroaniline (II) m-nitroaniline (III) p-nitroaniline

The decreasing order of basicity is:

- (A) $\text{II} > \text{III} > \text{I}$ (B) $\text{II} > \text{I} > \text{III}$ (C) $\text{I} > \text{II} > \text{III}$ (D) $\text{I} > \text{III} > \text{II}$

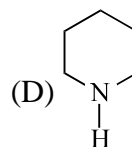
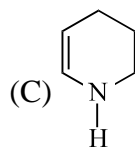
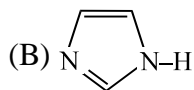
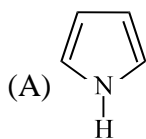
Q.8 Consider the basicity of the following aromatic amines:

(I) aniline (II) p-nitroaniline (III) p-methoxyaniline (IV) p-methylaniline

The correct order of decreasing basicity is:

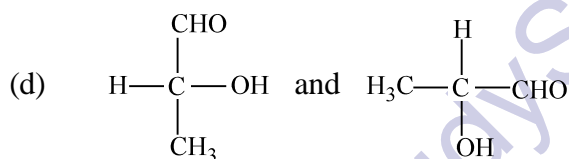
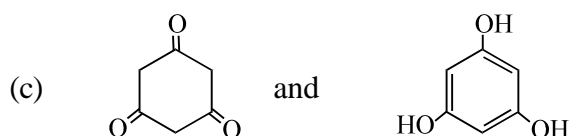
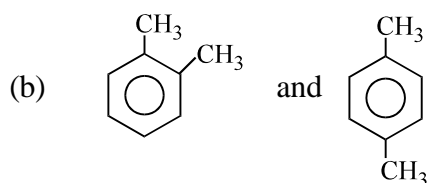
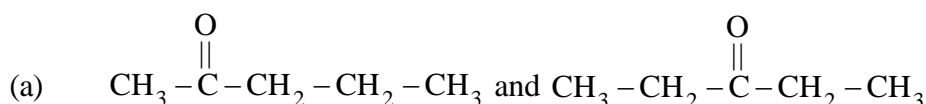
(A) III > IV > I > II (B) III > IV > II > I (C) I > II > III > IV (D) IV > III > II > I

Q.9 Which one of the following is least basic in character?



Q.10 Match List I with List II and select the correct answer from the codes given below the lists:

List I



List II

(1) Enantiomer

(2) Position isomers

(3) Metamers

(4) Tautomers

Codes:

	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)
(A)	3	2	4	1	(B)	3	2	1	4
(C)	1	2	3	4	(D)	2	3	4	1

Q.11 Arrange pH of the given compounds in decreasing order:

(1) Phenol (2) Ethyl alcohol (3) Formic acid (4) Benzoic acid

(A) 1 > 2 > 3 > 4 (B) 2 > 1 > 4 > 3 (C) 3 > 2 > 4 > 1 (D) 4 > 3 > 1 > 2

Q.12 Arrange acidity of given compounds in decreasing order:

(I) $\text{CH}_3 - \text{NH} - \text{CH}_2 - \text{CH}_2 - \text{OH}$

(II) $\text{CH}_3 - \text{NH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{OH}$

(III) $(\text{CH}_3)_3\text{N}^+ - \text{CH}_2 - \text{CH}_2 - \text{OH}$

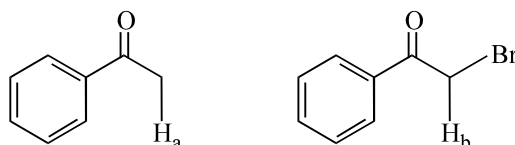
(A) III > I > II (B) III > II > I (C) I > II > III (D) II > I > III

Q.13 In each of the following pair of compounds, which is more basic in aqueous solution? Give an explanation for your choice:

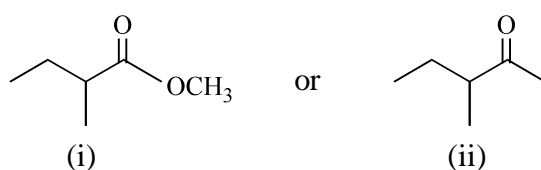
- (a) CH_3NH_2 or CF_3NH_2 (b) CH_3CONH_2 or $\text{H}_2\text{N}-\text{C}(\text{NH})=\text{NH}_2$
 (c) $n\text{-PnNH}_2$ or CH_3CN (d) $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$ or 2,6-dimethyl-N,N-dimethylaniline
 (e) m-nitroaniline or p-nitroaniline

Q.14 Answer the following:

- (a) Which proton is more rapidly abstracted by ethoxide ion and why?



- (b) Which compound is more rapidly attacked by a nucleophile and why?



Q.15 From the following pair, select the stronger base:

- (a) p-methoxy aniline or p-cyanoaniline (b) pyridine or pyrrole
 (c) CH_3CN or $\text{CH}_3\text{CH}_2\text{NH}_2$

Q.16 Write equations showing the Lewis acid-base reaction that takes place when

- (a) Methyl alcohol reacts with BF_3 . (b) Methyl chloride reacts with AlCl_3 .
 (c) Dimethyl ether reacts with BF_3 .

Q.17 Which of the following are lewis acids & which are lewis bases?

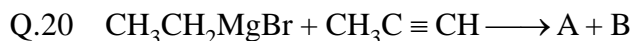
- (a) $\text{CH}_3\text{CH}_2-\ddot{\text{N}}(\text{CH}_3)_2$ (b) $\text{CH}_3-\text{C}^+(\text{CH}_3)_3$ (c) $(\text{C}_6\text{H}_5)_3\text{P:}$
 (d) $:\ddot{\text{Br}}:^-$ (e) $(\text{CH}_3)_3\text{B}$ (f) H^-

Q.18 Which would you expect to be the stronger acid? Explain your reasoning in each instance.

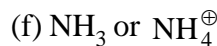
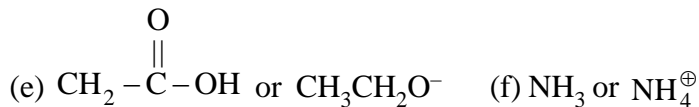
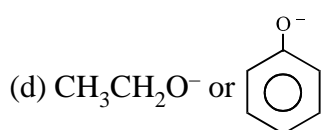
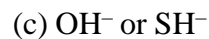
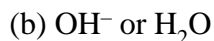
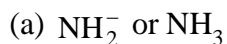
- (a) $\text{CH}_2\text{ClCO}_2\text{H}$ or $\text{CHCl}_2\text{CO}_2\text{H}$ (b) $\text{CCl}_3\text{CO}_2\text{H}$ or $\text{CHCl}_2\text{CO}_2\text{H}$
 (c) $\text{CH}_2\text{FCO}_2\text{H}$ or $\text{CH}_2\text{FCH}_2\text{CO}_2\text{H}$

Q.19 Write equations for the acid base reaction that would occur when each of the following compounds or solution are mixed. In each case label the stronger acid & stronger base, & the weaker acid & weaker base.

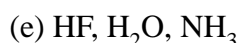
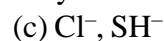
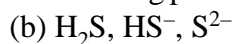
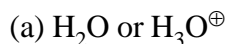
- (a) NaH is added to CH_3OH
 (b) NaNH_2 is added to $\text{CH}_3\text{CH}_2\text{OH}$
 (c) Gaseous NH_3 is added to ethyl lithium in hexane
 (d) NH_4Cl is added to NaNH_2 in liq. NH_3
 (e) $(\text{CH}_3)_3\text{CONa}$ is added to H_2O
 (f) NaOH is added to $(\text{CH}_3)_3\text{C-OH}$
 (g) $\text{C}_2\text{H}_5\text{OH}$ is added to a solution of $\text{HC}\equiv\text{C}^-\text{Na}^+$ in liquid NH_3 .



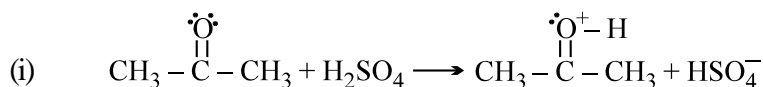
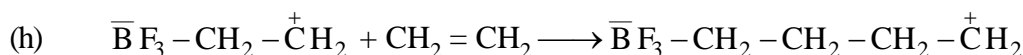
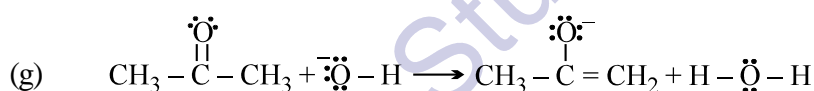
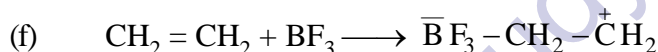
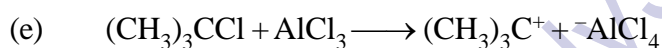
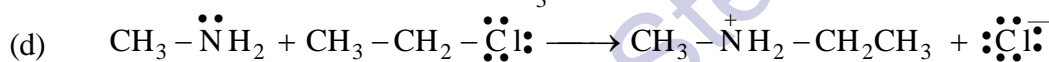
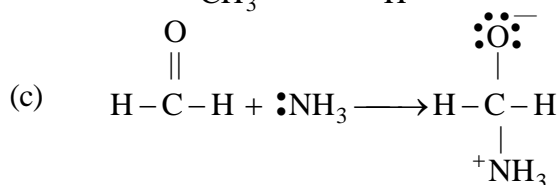
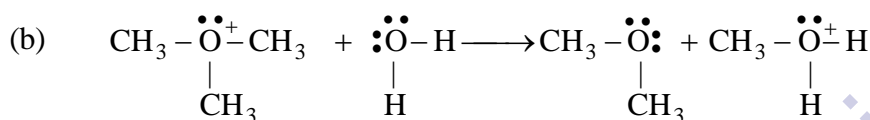
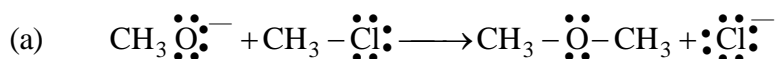
Q.21 Choose the member of each of the following pairs of compounds that is likely to be the stronger base.



Q.22 Choose the member of each of the following pairs of compounds that is likely to be the weaker base.



Q.23 Label the reactants in these acid – base reactions as Lewis acids (electrophiles) or Lewis bases (nucleophiles). Use curved arrows to show the movement of electron pairs in the reactions.

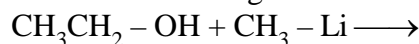


Q.24 Predict the products of the following acid_base reactions.



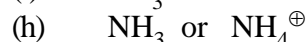
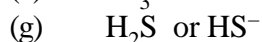
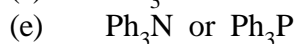
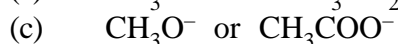
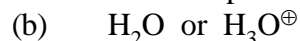
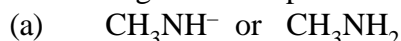
Q.25 Methylolithium (CH_3Li) is often used as a base in organic reactions.

(a) Predict the products of the following acid – base reaction.



(b) What is the conjugate acid of CH_3Li ? Would you expect CH_3Li to be a strong base or a weak base?

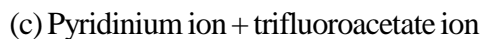
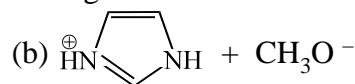
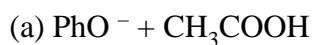
Q.26 Which reagent in each pair listed here would be the more reactive Nu in a protic solvent?



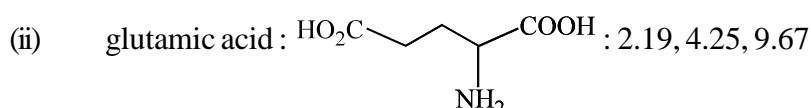
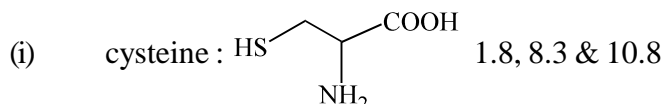
Q.27 Arrange the following compounds in order of increasing basicity.

- (a) CH_3NH_2 , CH_3NH_3^+ , CH_3NH^- (b) CH_3O^- , CH_3NH^- , CH_3CH_2^-
- (c) $\text{CH}_3\text{CH}=\text{CH}^-$, $\text{CH}_3\text{CH}_2\text{CH}_2^-$, $\text{CH}_3\text{C}\equiv\text{C}^-$

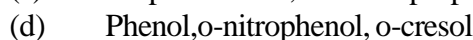
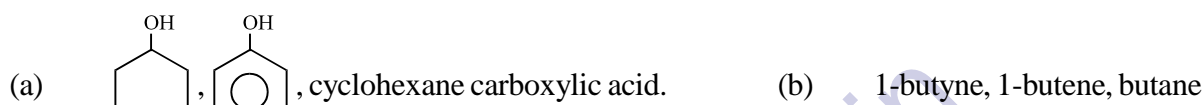
Q.28 Suggest what species would be formed by each of the following combinations :



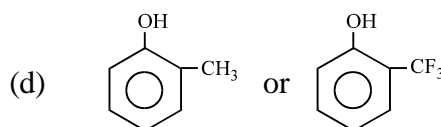
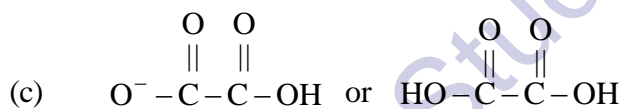
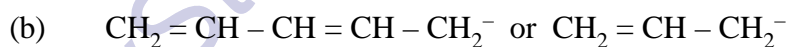
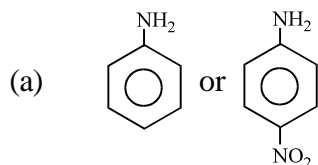
Q.29 Say which pK_a belong to which functional group in case of following amino acids :



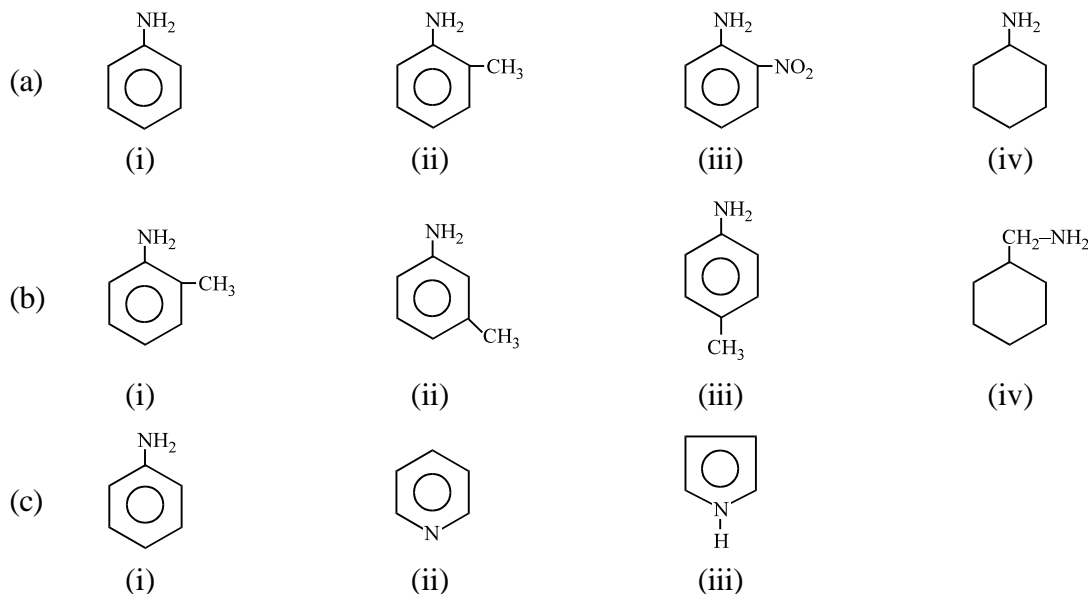
Q.30 Record the following sets of compounds according to increasing pK_a ($= -\log K_a$)

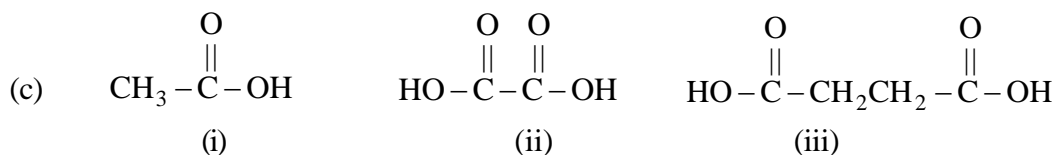


Q.31 Explain which compound is the weaker base.



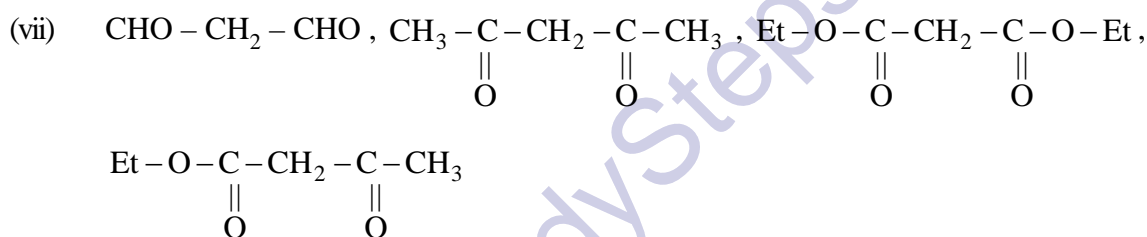
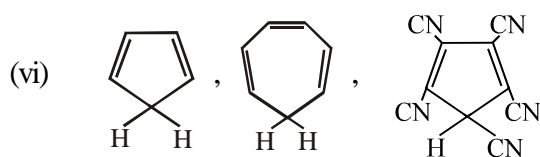
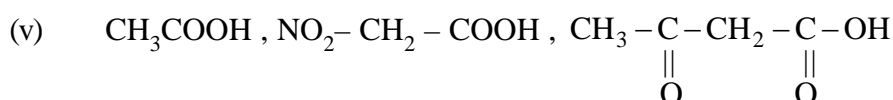
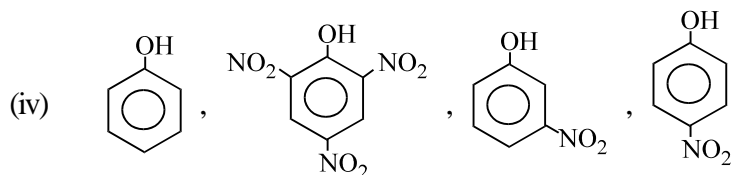
Q.32 Rank the following amines in increasing basic nature.





Q.37 Set the following in increasing order of $\text{p}K_a$:

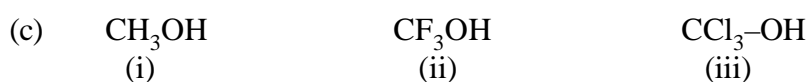
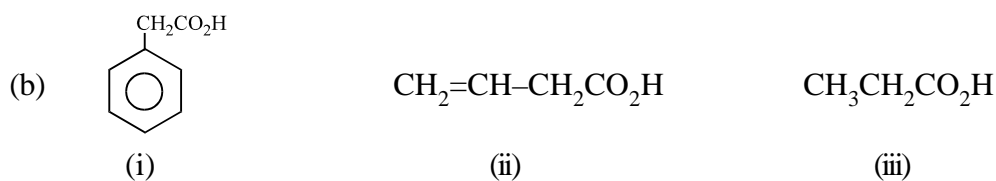
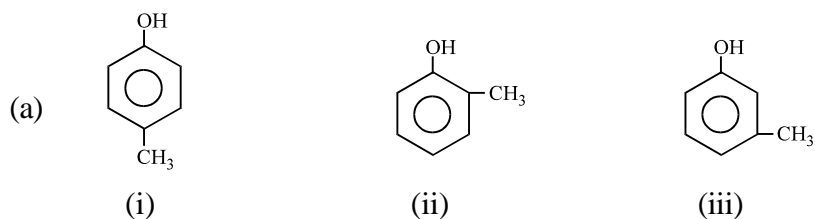
- (i) Methane sulfonic acid, acetic acid & methanol.
- (ii) $\text{CH}_3-\text{CH}_2-\text{CH}_3$, $\text{CH}_2=\text{CH}-\text{CH}_3$, CH_3-CHO , $\text{CHO}-\text{CH}_2-\text{CHO}$, CH_4
- (iii) CH_3NO_2 , $(\text{NO}_2)_2-\text{CH}_2$, $(\text{NO}_2)_3-\text{CH}$



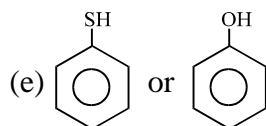
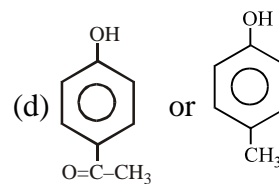
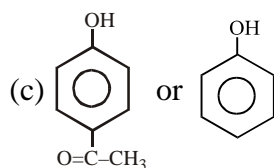
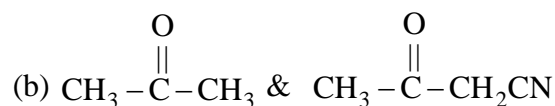
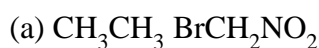
Q.38 Cyanic acid ($\text{HO}-\text{C}\equiv\text{N}$) & isocyanic acid ($\text{H}-\text{N}=\text{C}=\text{O}$) differ in the positions of their electrons but their structure do not represent resonance structures.

- (a) Explain
- (b) Loss of a proton from cyanic acid yields the same anion as that obtained by loss of a proton from isocyanic acid. Explain.

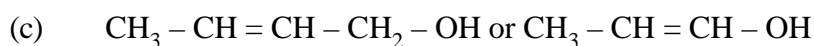
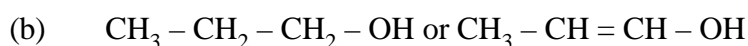
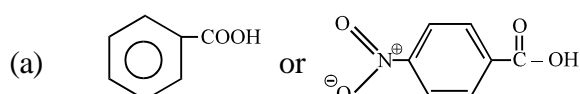
Q.39 Arrange the increasing order of acidic strength of the following compounds.



Q.40 Explain which is a stronger acid.



Q.41 Which of the following would you predict to be the stronger acid ?



Q.42 Which is a stronger base? & Why.

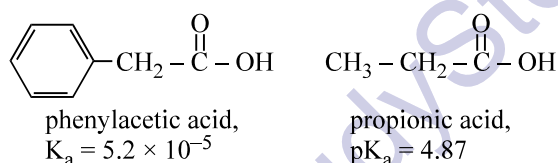
(a) ethylamine or aniline

(b) ethylamine or ethoxide ion

(c) phenoxide ion or ethoxide ion

(d) cyclohexylamine or aniline

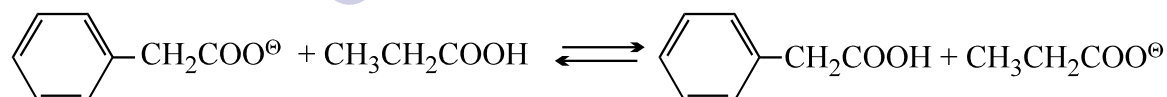
Q.43 The K_a of phenylacetic acid is 5.2×10^{-5} , and the $\text{p}K_a$ of propionic acid is 4.87.



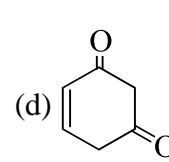
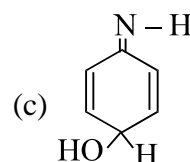
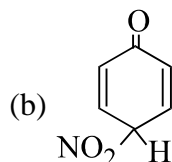
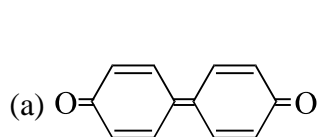
(a) Calculate the $\text{p}K_a$ of phenylacetic acid and the K_a of propionic acid.

(b) Which of these is the stronger acid?

(c) Predict whether the following equilibrium will favor the reactants or the products.

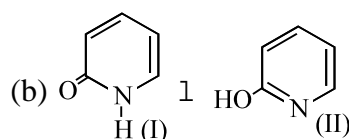
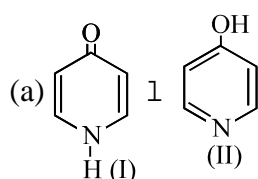


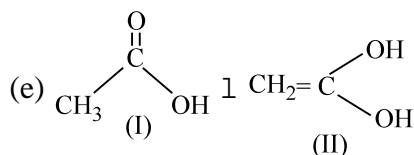
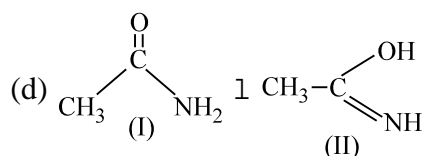
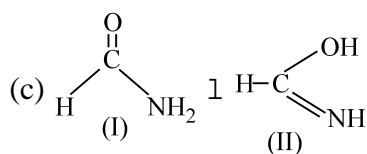
Q.44 Which of the following system show H-bonding during tautomerism.



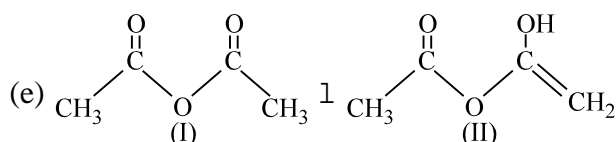
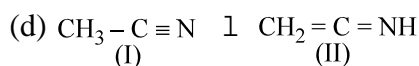
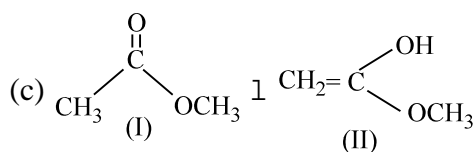
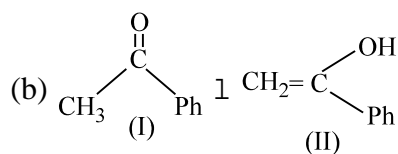
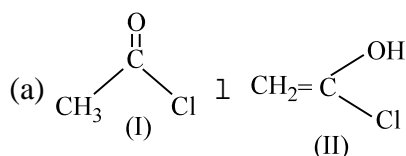
Q.45 What is the attacking site of conjugate base of triketo form of phloroglucinol in protic & aprotic solvent.

Q.46 In each of the following pairs which is more stable :

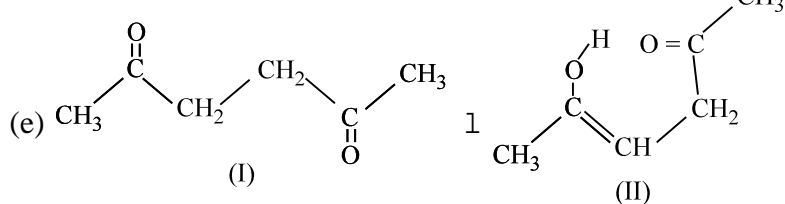
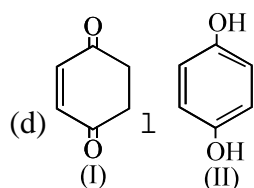
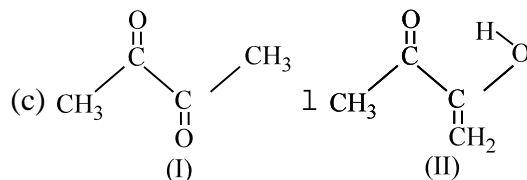
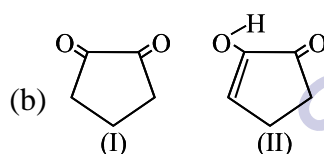
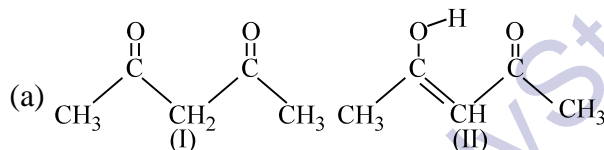




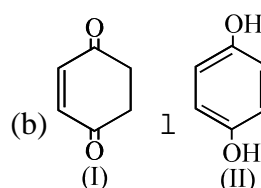
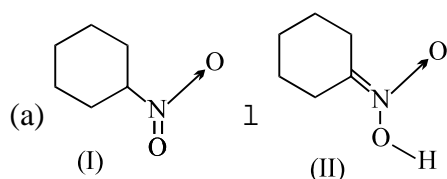
Q.47 In each of the following pairs which is less stable :

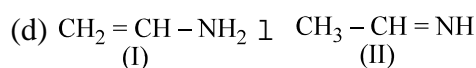
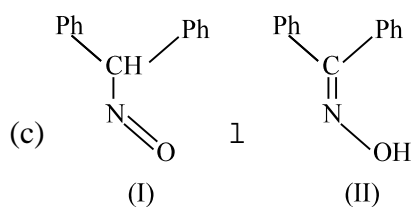


Q.48 In each of the following pairs which is more stable :

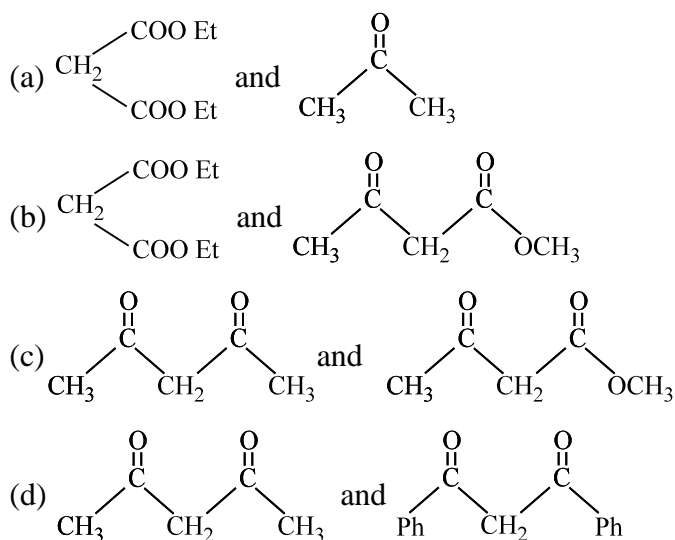


Q.49 In each of the following pairs which is less stable :

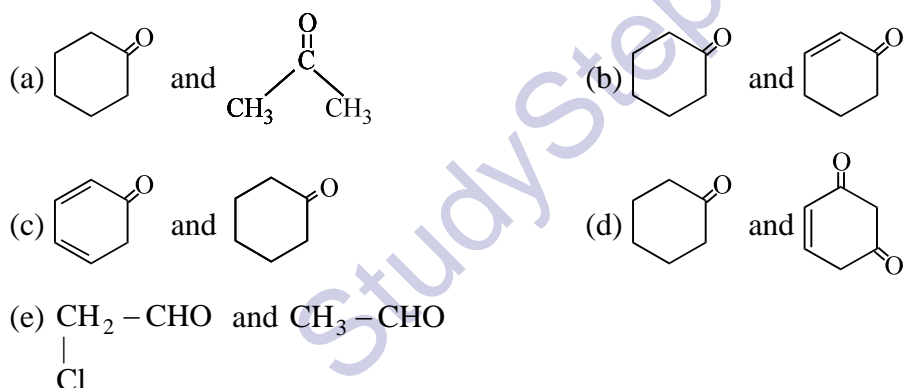




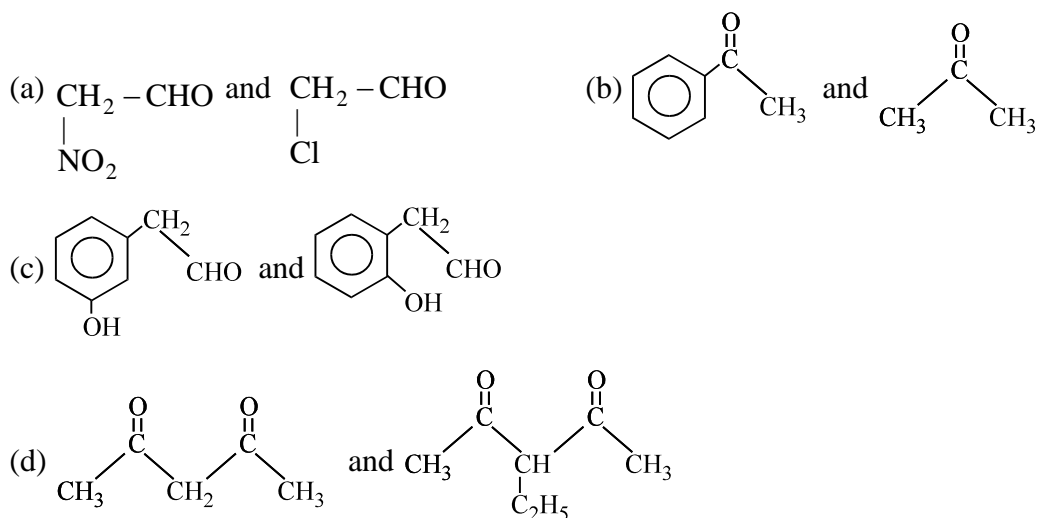
Q.50 In each of the following pairs which will have higher enol content :



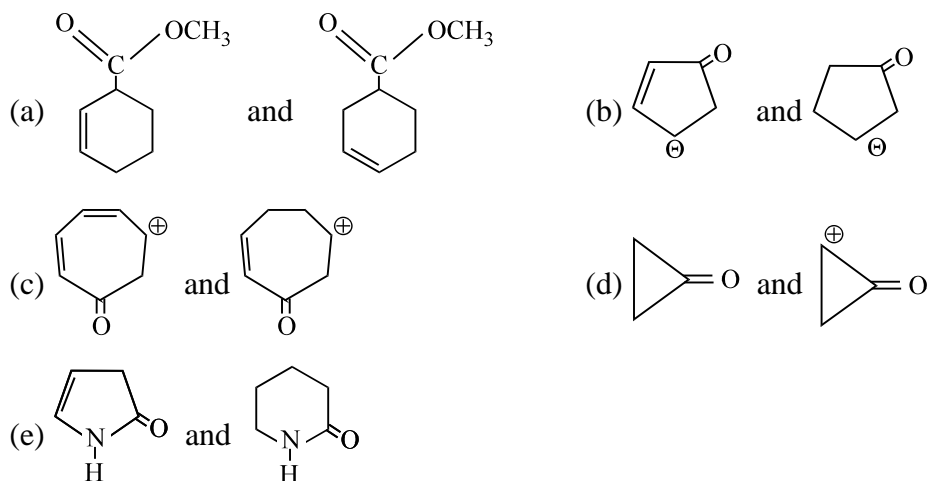
Q.51 In each of the following pairs which will have less enol content :



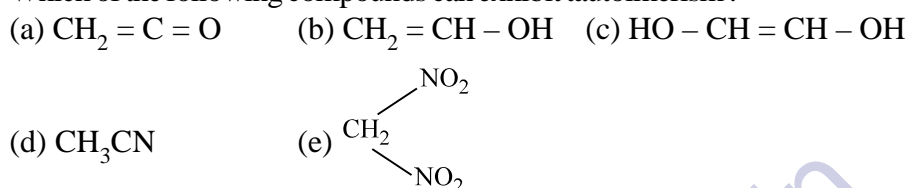
Q.52 In each of the following pairs which will have higher enol content :



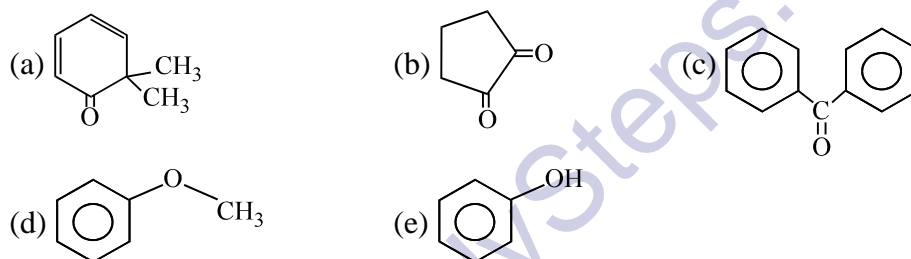
Q.53 In each of the following pairs which will have less enol content :



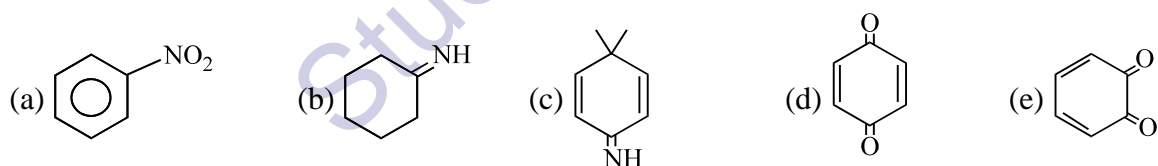
Q.54 Which of the following compounds can exhibit tautomerism :



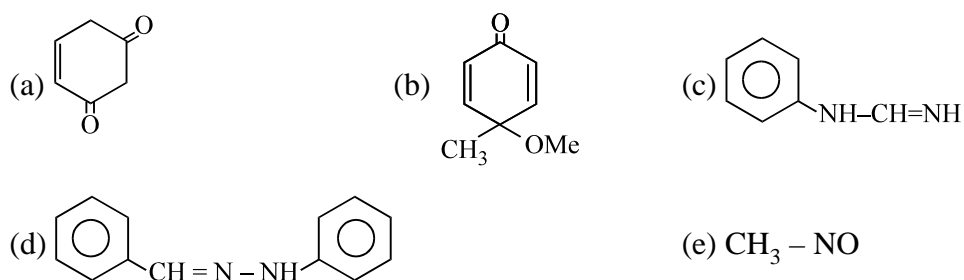
Q.55 Which of the following compounds can not exhibit tautomerism :



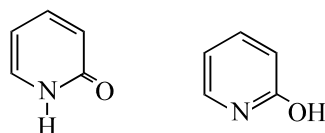
Q.56 Which of the following compounds can exhibit tautomerism :



Q.57 Which of the following compounds can not exhibit tautomerism :

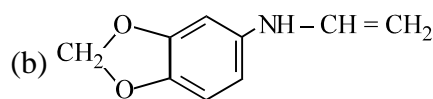
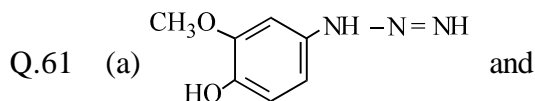
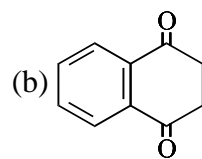
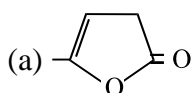


Q.58 What is the relationship between these two molecules? Discuss the structure of the anion that would be formed by the deprotonation of each compound.



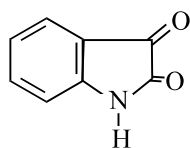
Q.59 Write down tautomeric structure of 5,5 – dimethylcyclohexane –1,3 –dione (dimedone).

Q.60 Draw enol forms of these carbonyl compounds and comment on the stability of the enol forms.



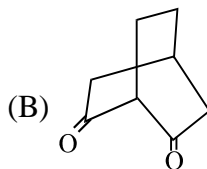
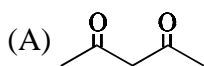
Shows tautomeric forms of (a) & (b).

Q.62 Isatin was the first compound to show tautomerism.

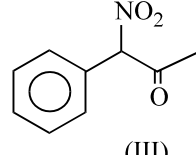
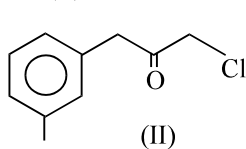
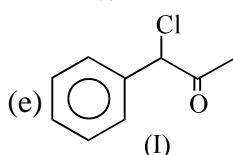
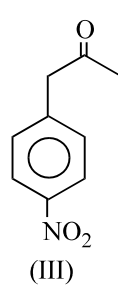
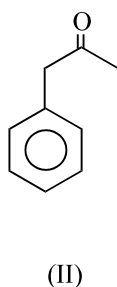
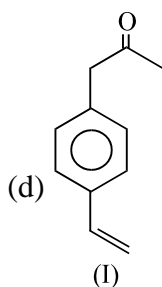
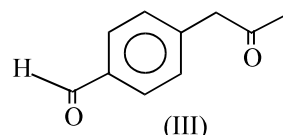
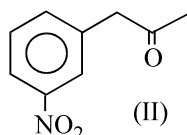
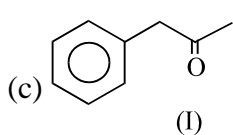
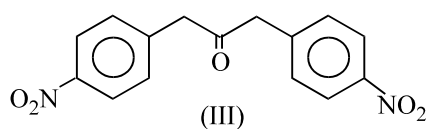
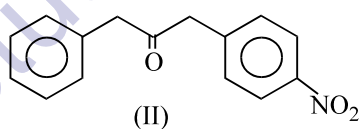
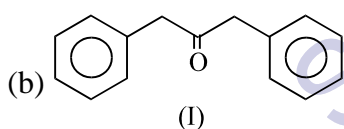
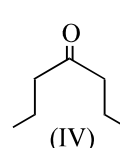
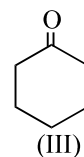
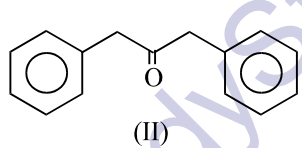
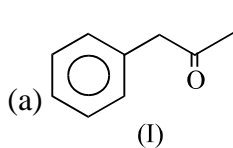


What is the tautomeric form of isatin.

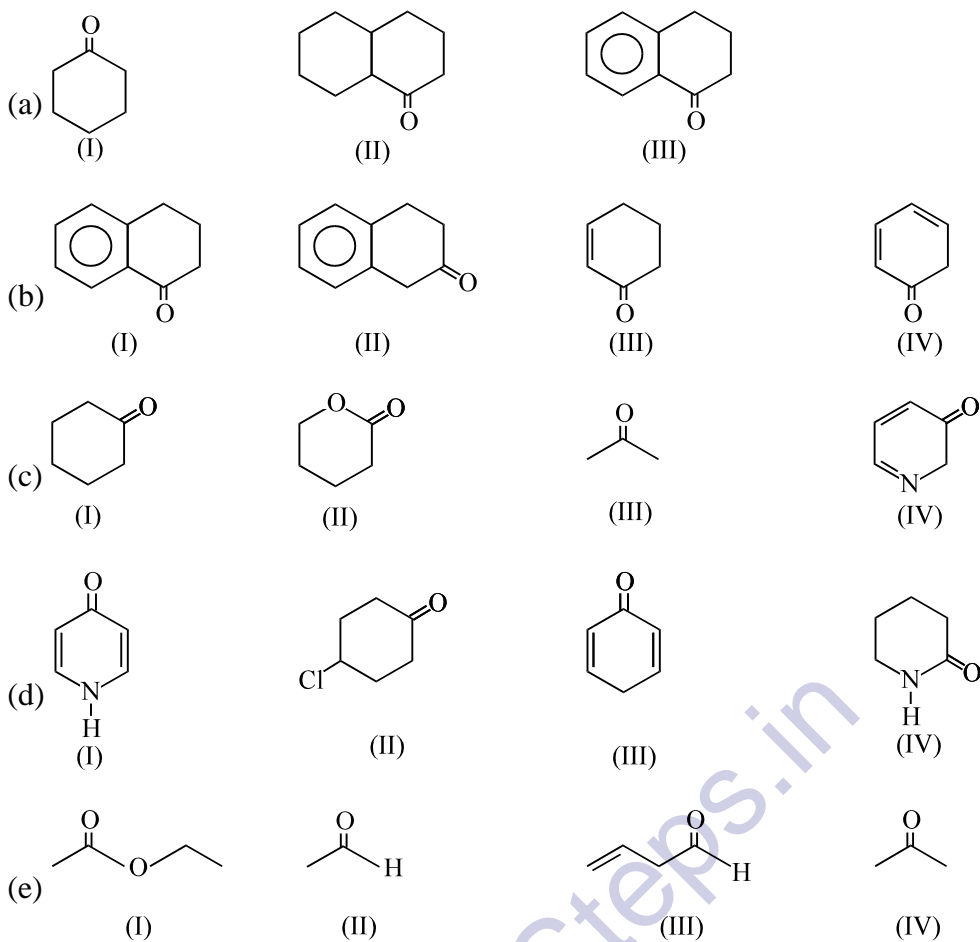
Q.63 1, 3 – dicarbonyl compounds such as (A) are usually mostly enolized. Why is this ? Draw the enols available to compounds A & B comment on the different pattern of enolization.



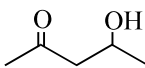
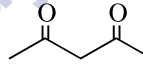
Q.64 In each of the following sets of compounds write the increasing order of % enol content

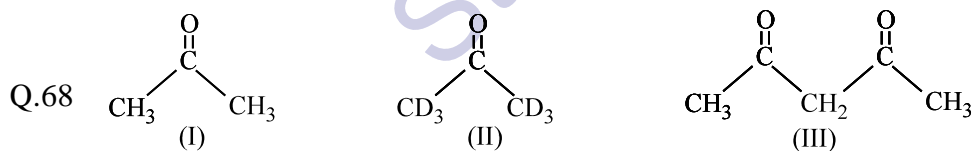


Q.65 In each of the following sets of compounds write the decreasing order of % enol content.



Q.66 Out of enol form of cyclobutanone and enol form of triketocyclobutane, which is more stable? Give reason also.

Q.67  has lower boiling point than  even when former has –OH group. Explain.



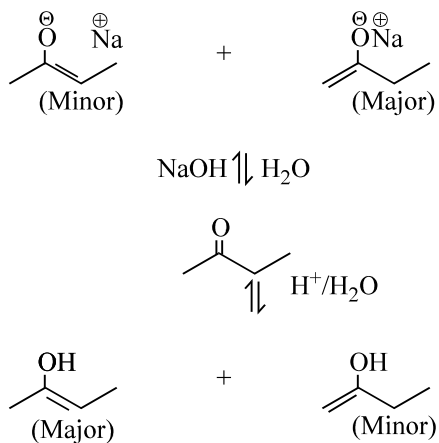
Among these give ease of enolization.

Q.69 % enol content of acetylacetone in following solvents is found as :

Solvent	% enol content
H ₂ O	15
Liquid state	76
hexane	92
gas phase	92

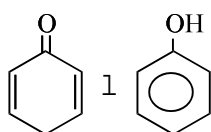
Explain the observation.

Q.70



Explain the observation.


Q.71

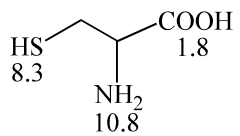
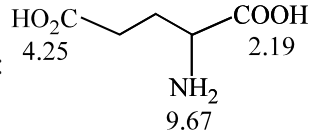


This tautomeric system exist almost exclusively in favour of phenol and it is insensitive to change in solvent.

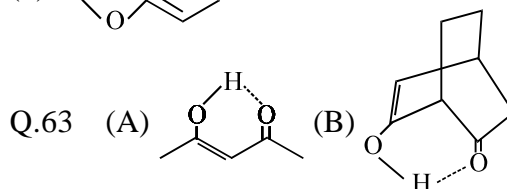
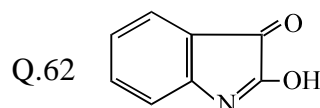
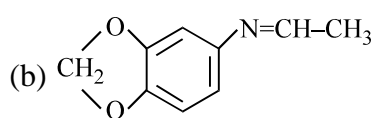
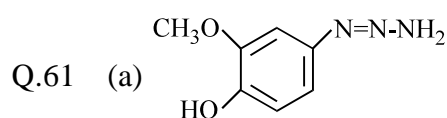
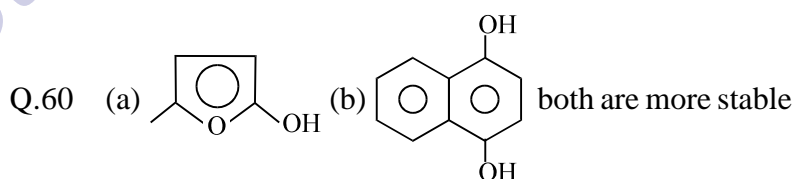
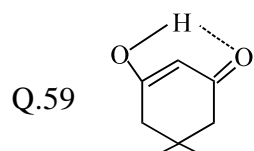
ANSWER KEY

- Q.1 B Q.2 C Q.3 D Q.4 B Q.5 C Q.6 B Q.7 A
 Q.8 A Q.9 A Q.10 A Q.11 B Q.12 A
 Q.13 (a) i, (b) ii, (c) i, (d) ii, (e) i Q.14 (a) H_b, (b) ii Q.15 (a) i, (b) i, (c) ii
 Q.17 LA b,e LB acdf Q.18 (a) 2; (b) 1; (c) 1
 Q.20 CH₃CH₃ + CH₃C ≡ CMgBr Q.21 (a) 1; (b) 1; (c) 1; (d) 1; (e) 2; (f) 1
 Q.22 (a) 2; (b) 1; (c) 1; (d) 1; (e) 1; (f) 3 Q.26 (a) 1; (b) 1; (c) 1; (d) 1; (e) 2; (f) 2; (g) 2; (h) 1
 Q.27 (a) 2<1<3; (b) 1<2<3; (c) 3<1<2

- Q.28 (a) PhOH + AcO[□], (b) MeOH + , (c) no reaction

- Q.29 (i) cysteine:  (ii) glutamic acid: 

- Q.30 (a) 3<2<1; (b) 1<2<3; (c) 3<2<1; (d) 2<1<3; (e) 2<3<1 Q.31 (a) 2; (b) 1; (c) 2; (d) 2
 Q.32 (a) 3<2<1<4; (b) 1<2<3<4; (c) 3<1<2
 Q.34 (a) 1>2>3; (b) 1<2<3; (c) 3<1<2; (d) 2<1<3; (e) 1<2<3; (f) 1<2<3<4<5
 Q.35 (i) 4>3>1>2; (ii) 1<2; (iii) 1<2 Q.36 (a) 1<2<3; (b) 3>1>2; (c) 1<3<2
 Q.37 (i) 1<2<3; (ii) 1>5>2>3>4; (iii) 1>2>3; (iv) 1>3>4>2; (v) 1>3>2; (vi) 2>1>3; (vii) 3>4>2>1
 Q.39 (a) 3>1>2; (b) 1>2>3; (c) 2>3>1 Q.40 (a) 2; (b) 2; (c) 1; (d) 1; (e) 1
 Q.41 (a) 2; (b) 2; (c) 2 Q.42 (a) 1; (b) 2; (c) 2; (d) 1
 Q.43⁻⁵, (c) reactant Q.46 (a) 2; (b) 2; (c) 1; (d) 1; (e) 1
 Q.47 (a) 2; (b) 2; (c) 2; (d) 2; (e) 1 Q.48 (a) 2; (b) 2; (c) 1; (d) 2; (e) 1
 Q.49 (a) 2; (b) 1; (c) 1; (d) 1 Q.50 (a) 1; (b) 2; (c) 1; (d) 2
 Q.51 (a) 2; (b) 1; (c) 2; (d) 1; (e) 2 Q.52 (a) 1; (b) 1; (c) 1; (d) 1
 Q.53 (a) 2; (b) 2; (c) 2; (d) 1; (e) 2 Q.54 a, b, c, d, e
 Q.55 a, c, d Q.56 b
 Q.57 b Q.58 Tautomers



- Q.64 (a) 2>1>3>4; (b) 3>2>1; (c) 3>2>1; (d) 3>1>2; (e) 3>1>2
 Q.65 (a) 3>1>2; (b) 4>2>1>3; (c) 4>3>1>2; (d) 1>3>4>2; (e) 3>2>4>1
 Q.66 enol form of triketocyclobutane
 Q.68 3>1>2