

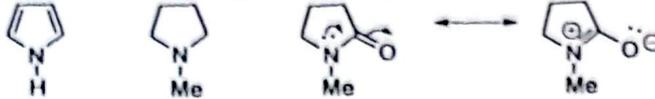


(الاختبار في ثلاث ورقات)

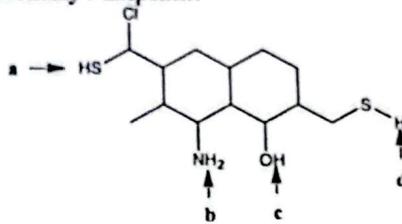
**The Following Question must be answered**

**First Question:**

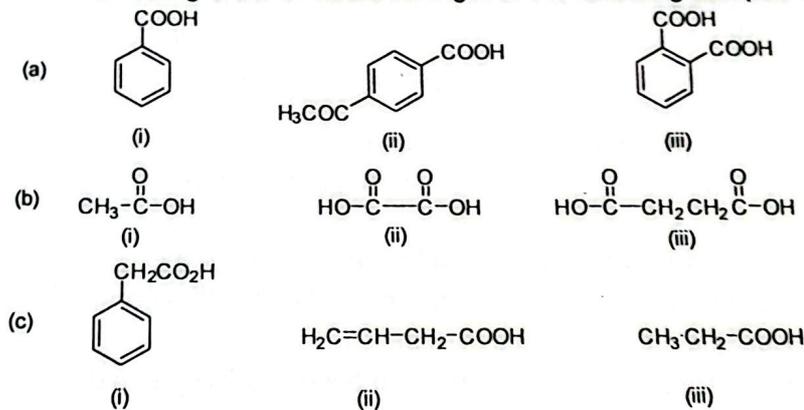
1. Label the hybridization of nitrogen atoms in the molecules below.



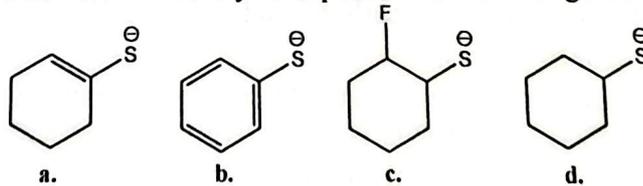
2. If the molecule below were reacted with a strong base, which proton would the base react with preferentially? Explain.



3. Which of the following cannot react as a nucleophile?  
a)  $\text{CH}_3\text{NH}_2$  b)  $(\text{CH}_3)_2\text{NH}$  c)  $(\text{CH}_3)_3\text{N}$  d)  $(\text{CH}_3)_4\text{N}^+$
4. Arrange the increasing order of acidic strength of the following compounds

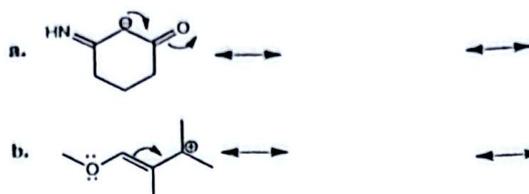


5. Which compound below would you expect to be the strongest base? (3 marks)



6. For each structure shown below, complete the following: (4 marks)

- i. Draw all relevant resonance structures.
- ii. Use curved arrows to show electron flow in the first structure.
- iii. Circle the "best" resonance structure (the major contributor to the resonance hybrid).



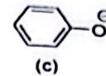
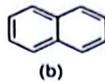
7. Arrange the following nucleophile ( $\text{HO}^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{PhO}^-$ , and  $\text{CH}_3\text{O}^-$ ) in the decreasing order of reactivity with Benzyl chloride.
8. Which of the following alkyl halides would undergo  $\text{S}_{\text{N}}2$  reaction most rapidly?
  - a.  $\text{CH}_3\text{CH}_2\text{-Br}$
  - b.  $\text{CH}_3\text{CH}_2\text{-I}$
  - c.  $\text{CH}_3\text{CH}_2\text{-Cl}$
  - d.  $\text{CH}_3\text{CH}_2\text{-F}$
9. Account for the fact that pyrrole is much less basic than pyrrolidine.



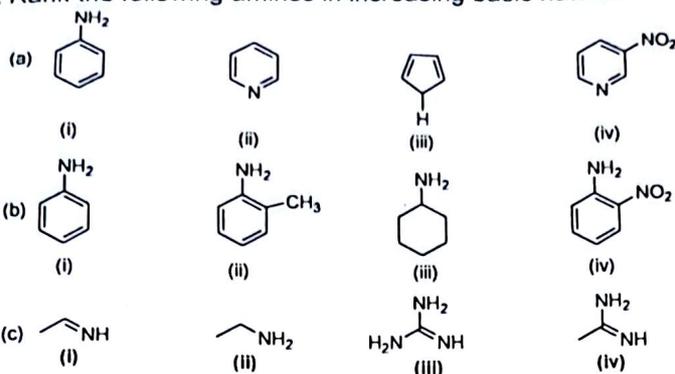
10. Which of the following best describes the mechanism of the Williamson ether synthesis ( $\text{RX} + \text{R}'\text{ONa} \rightarrow \text{R-O-R}'$ )?
  - a.  $\text{S}_{\text{N}}1$  reaction
  - b.  $\text{E}^2$  reaction
  - c.  $\text{S}_{\text{N}}2$  reaction
  - d. nucleophilic acyl substitution
11. Which of the following compounds contain all the carbon atoms in the same hybridisation state?
  - (i)  $\text{H}_2\text{C}=\text{CH}-\text{CH}=\text{CH}_2$
  - (ii)  $\text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CH}_3$
  - (iii)  $\text{H}_2\text{C}=\text{C}=\text{CH}_2$
  - (iv)  $\text{H}-\text{C}=\text{C}=\text{C}=\text{C}-\text{H}$
12. Hyperconjugation involves delocalisation of \_\_\_\_\_.
  - (i) electrons of carbon-hydrogen  $\sigma$  bond of an alkyl group directly attached to an atom of unsaturated system.
  - (ii) electrons of carbon-hydrogen  $\sigma$  bond of alkyl group directly attached to the positively charged carbon atom.
  - (iii)  $\pi$ -electrons of carbon-carbon bond
  - (iv) lone pair of electrons
13. The order of decreasing stability of the following cations is:
 

(I) $\text{CH}_3\text{C}^+\text{HCH}_3$	(II) $\text{CH}_3\text{C}^+\text{HOCH}_3$	(III) $\text{CH}_3\text{C}^+\text{HCOCH}_3$
a) III > II > I	b) I > II > III	
c) II > I > III	d) I > III > II	

14. Draw the major resonance contributors of the following species.



15. Rank the following amines in increasing basic nature.



**Third Question:**

State whether the following statements is True or False?

- Benzene ring has two different types of bond length for single and double bonds
- All the bond length in benzene ring is equal due to hyperconjugation
- Delocalizing one lone pair causes aromaticity
- Resonance stabilization is the extra stability a compound gains from having delocalized electrons
- Delocalized electrons destabilize a compound
- When there are a greater number of relatively stable resonance contributors, then a molecule will have greater resonance stabilization
- Resonance forms are in equilibrium with each other
- Hyperconjugation involves the delocalisation of both  $\sigma$  and  $\pi$  bond orbital
- Ethene is devoid of any alpha hydrogen so hyperconjugation is not possible.
- Inductive effect is the ability of an atom or a group of atoms to cause polarization of electron density along the covalent bond so that the atom of higher electronegativity becomes electron deficient.

**Fourth Question:**

Write step by step mechanisms that account for the major product of the following:

