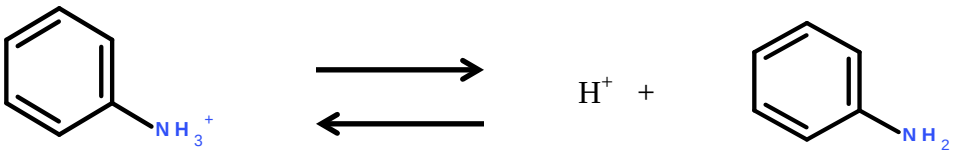
Organic Chemistry Practice Problems

Organic Chemistry I Practice Set #2 (Chapter 1 - Carey)

1) Draw ***complete*** structural formulas showing ***all*** atoms and bonding electrons for 5 constitutional isomers that have the molecular formula **C_4H_5FO** ***and that have one ring***. Your ***complete*** structural formulas must have no nonzero formal charges and the most typical arrangements of bonding and nonbonding valence electrons. ***For this problem you must show all atoms and bonding electrons.***

2) The acetate ion is an anion with a -1 charge and can be represented by the condensed structural formula $CH_3CO_2^-$.
(a) Give the two different and equivalent resonance structures (Lewis structures) that contribute most significantly to the resonance hybrid of the acetate ion. ***Remember that for a Lewis structure, you must show all atoms, all bonding valence electrons, all unshared valence electrons, and each nonzero formal charge.***
(b) Appropriately give the single representation of the resonance hybrid for the acetate ion. Provide a value for each bond order in the hybrid structure. Provide a value for each bond angle in the hybrid structure.
(c) Give the best Lewis structure for the conjugate acid of the acetate ion.

3) Consider the heterolytic dissociation of an NH bond in anilinium ion to give a proton and aniline.



anilinium ion aniline

Give the 5 most important resonance structures that contribute to the resonance hybrid of aniline. **Recall Lewis structure/resonance structure rules.**

4) Which one is more acidic ***(i) cyclohexylammonium ion*** or ***(ii) anilinium ion? (Choose one; give the letter.)*** Why?

(ii) anilinium ion ***(i) cyclohexylammonium ion***

5) Using curved arrows to show the flow of electrons in the reactants, give the best Lewis structure for each reactant and for each product in the following chemical equation. Also, clearly put a ***circle*** around your Lewis structure of the acid and clearly put a ***square*** around your conjugate acid.

$$CH_3CH_2CO_2H + NaOH \rightarrow CH_3CH_2CO_2Na + H_2O$$

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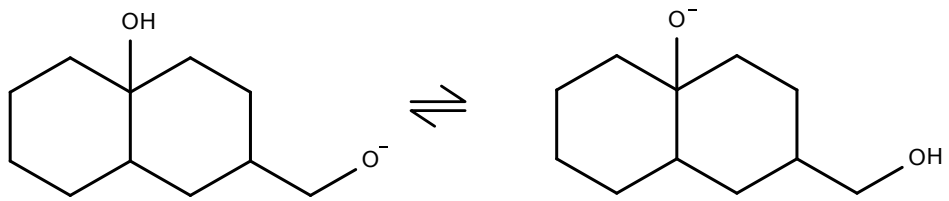
6) Consider each of the following.
Does the equilibrium lie to the ***left*** or ***right***?

a. $HF + Cl^- \leftrightarrow HCl + F^-$

b.

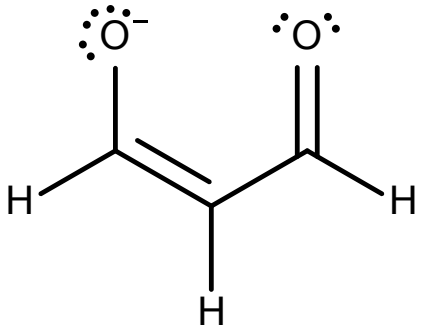


c. $CH_3CH_2CH_2CH_2SH + CH_3CH_2CH_2CH_2ONa \leftrightarrow CH_3CH_2CH_2CH_2SNa + CH_3CH_2CH_2CH_2OH$

d. $HC{\equiv}CH + H_2C{=}CHNa \leftrightarrow HC{\equiv}CNa + H_2C{=}CH_2$

7) Give the best Lewis structure for the conjugate base in problem 6d.

8) One resonance structure for the ***conjugate base*** of **propanedial** is given below. Including the one that is given, there are a total of three resonance structures that contribute to the resonance hybrid of this anion.



a. Give a Lewis structure for each of the other two resonance structures.
b. Put a ***circle*** around the resonance structure that contributes ***least*** to the resonance hybrid
c. Give a numerical value for the CCC bond angle (in degrees).
d. Give the best Lewis structure for propanedial.

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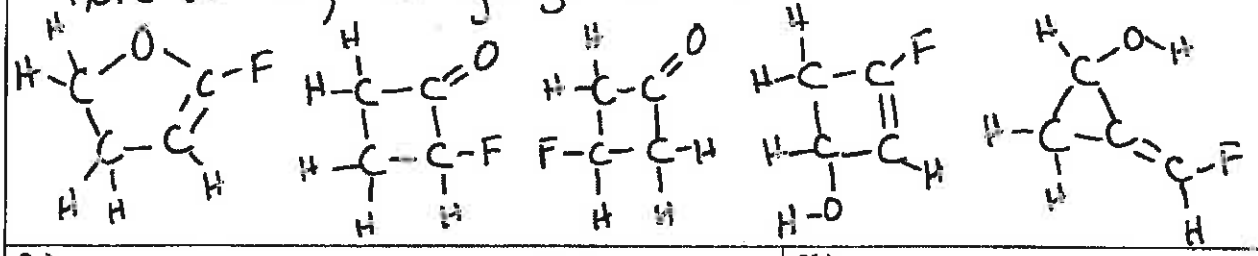
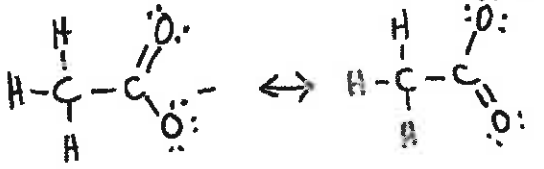
Answers – Other answers may be acceptable.

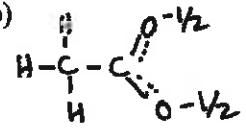
1) Here are 5; Can you give more?



2a)



2b)



each $B.O._{HC} = 1$

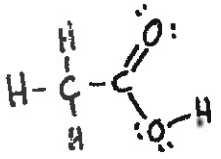
each $B.O._{CC} = 1$

each $B.O._{CO} = 3/2$

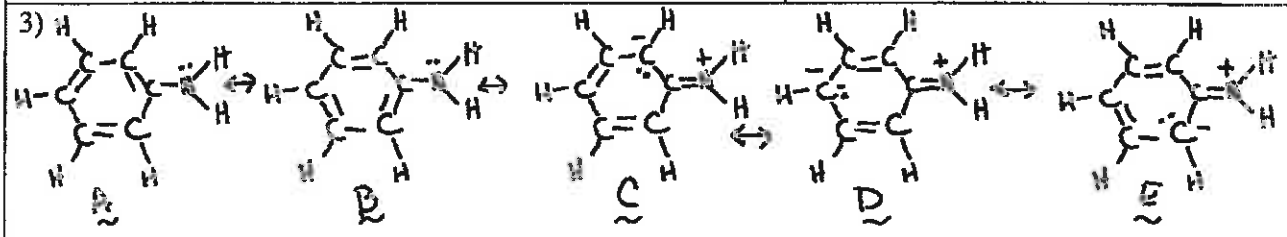
each $\angle_{HCH} = \sim 109°$; each $\angle_{HCC} = \sim 109°$

each $\angle_{CCO} = \sim 120°$; $\angle_{OCO} = \sim 120°$

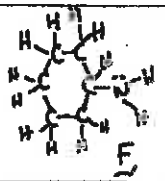
2c)



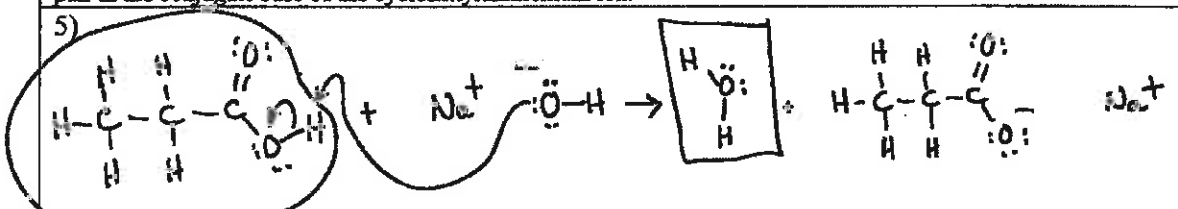
3)



4) ii. The conjugate base of anilinium ion is more stable than the conjugate base of cyclohexylammonium ion. Although **C**, **D**, and **E** contribute less than **A** and **B**, there are 5 resonance structures that contribute to the resonance hybrid of the conjugate base of the anilinium ion. However, there is only one Lewis structure (**F**) that can be drawn for the conjugate base of the cyclohexylammonium ion. The electron pair that originally held the H^+ in the acid is more delocalized in the conjugate base of the anilinium ion than the analogous electron pair in the conjugate base of the cyclohexylammonium ion.

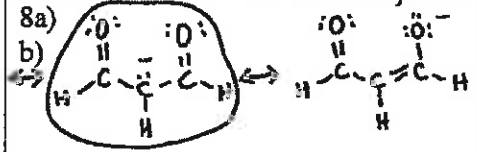


5)



6a) left	6b) Left	6c) Right	6d) Right	7) conjugate base from 6d is H–C≡C:⁻

8a) b)



8c) 120°

8d)