Homework One

Organic Chemistry I (223) • Prof. Chad Landrie

Spring 2013

Completion (6 pts)		**Name** (-1 pt)	
Random Sample(s) (4 pts)		**BID** (-1 pt)	
Total (10 pts)		**Section-CRN** (-1 pt)	

Additional Recommended Problems from McMurray (8th Ed.)	1.22, 1.23, 1.26, 1.27, 1.28, 1.30, 1.31, 1.33, 1.34, 1.36, 1.38, 1.40, 1.47, 1.48, 1.50, 1.51, 2.31, 2.32, 2.33, 2.34, 2.36, 2.37, 2.39, 2.40, 2.42, 2.44, 2.48, 2.51, 2.52, 2.53, 2.54, 2.56, 2.57

1. Draw a bond-line/skeletal Lewis structure for the following condensed formulas.

   a. $CH_3CH_2CH_2CH(CH_3)_2$

   b. $CH_3CH(NH_2)CH_2CHO$

   c. CH_3CN

   d. $(CH_3CH_2O)_2C(CHCH_2)_2$

   e. $CH_3COCH_2COCH_3$

   f. $NH_2CH_2CH_2CH_2COOH$

2. Draw three Lewis structures (bond-line notation) for a compound that has a molecular formula of C_5H_8O and that contains a carbonyl bond (carbon-oxygen double bond).

3. The O-H hydrogen in acetic acid (CH_3CO_2H) is more acidic than any of CH hydrogens. Explain this result using resonance structures.

4. Draw a Lewis structure for $C_7H_5O_2Na$ that contains a benzene ring. This compound is a common food preservative. It contains an ionic bond, which means there are two oppositely charged atoms next to one another. Draw all electron lone-pairs on these two atoms and write the formal charge next to each.

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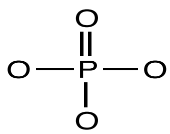
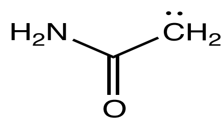
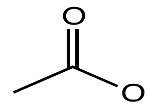
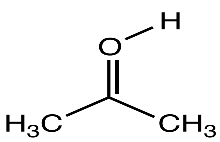
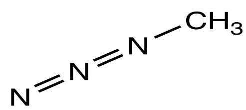
5. **First**, draw all the missing lone pairs of electrons on every atom so that they obey the octet rule. **Second**, write the formal charge next to all charged atoms. *There may be more than one charged atom in each structure; check them all. Assume all carbons in bond-line notation contain the maximum number of hydrogens unless otherwise indicated.*

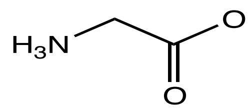












6. For each carbon atom indicated, list the hybridization, geometry and bond angles formed at that atom.

	Hybridization	Geometry	Bond Angle
a	sp^3	tetrahedral	109.5°
b			
c			
d			
e			
f			
g			

	Hybridization	Geometry	Bond Angle
a'			
b'			
c'			
d'			
e'			
f'			
g'			

7. Draw a complete molecular orbital diagram of helium (He_2). Be sure to include the orbitals themselves, not just the labels. Use this diagram to explain why He_2 does not exist.

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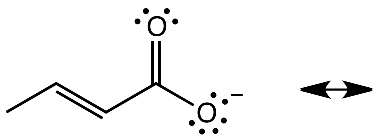
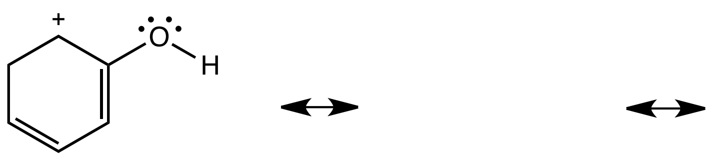
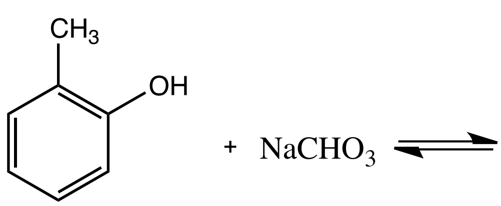
8. **First**, draw resonance structures for each compound, depending on how many resonance arrows are present. **Second**, draw a mechanism using curved-arrow notation to show how the resonance structure on the right is formed from the one on the left. **Third**, circle the major contributor for each series. If two or more are equally the major contributor, circle both. **Fourth**, explain your choice of major contributor in the box below each series.

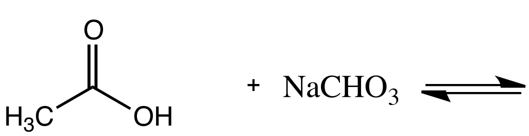




9. Sodium bicarbonate ($NaHCO_3$) is the conjugate base of carbonic acid (H_2CO_3, pKa = 6.37). **First**, draw the products of the reaction of sodium bicarbonate with phenol and acetic acid. **Second**, use your book to determine the pKa values of a phenol and a carboxylic acid. **Third**, determine which of these substances will react significantly (i.e., $K_{eq} > 1$) with sodium bicarbonate. Explain your reasoning.



2-methylphenol
a phenol



acetic acid
a carboxylic acid

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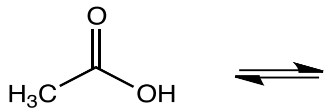
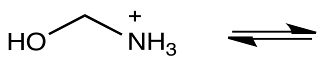
10. **First,** draw the missing conjugate acid or conjugate base in each dissociation reaction. For acids that have more than one type of H, you should only consider the most acidic H. Be sure to include all formal charges and all lone-pairs on charged atoms. **Second**, write the approximate pK_a under each conjugate acid. Use the table of pKa's in your textbook (Appendix B). **Third**, using those pKa values, rank the conjugate acids in order of increasing acidity (1 = least acidic, 5 = most acidic).



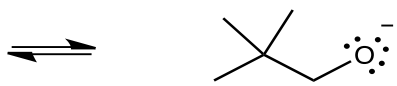
+ H^+ ☐

pK_a ~



+ H^+ ☐

pK_a ~ 9.0

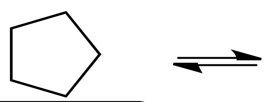


+ H^+ ☐

pK_a ~

+ H^+ ☐

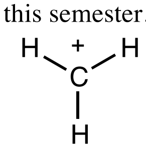
pK_a ~



+ H^+ ☐

pK_a ~

11. Carbocations are positively charged trivalent carbon atoms and are common intermediates in many of the chemical reactions we'll learn this semester.

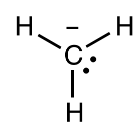


a. How many valence electrons does the positively charged carbon atom have?

b. What hybridization do you expect this carbon to have?

c. What geometry is the carbocation likely to have?

12. Carbanions are negatively charged, trivalent carbon atoms and are very strong bases.



d. How many valence electrons does the negatively charged carbon atom have?

e. What hybridization do you expect this carbon to have?

f. What geometry is the carbanion likely to have?

g. What is the similarity between a carbanion and a molecule of ammonia (NH_3)?