Oakton Community College	**Homework 1** Organic Chemistry I (CHM 221/223) • Prof. Chad Landrie

Score (4 pts)		**Name**	

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

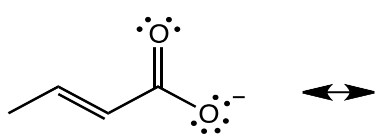
   a. $CH_3CH_2CH_2CH(CH_3)_2$
   b. $CH_3CH(NH_2)CH_2CHO$
   c. CH_3CN
   d. $(CH_3CH_2O)_2C(CHCH_2)_2$
   e. $CH_3COCH_2COCH_3$
   f. $NH_2CH_2CH_2CH_2COOH$

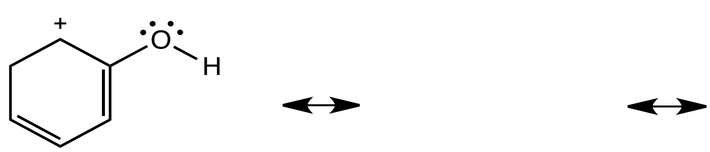
2. Draw three structural isomers (bond-line notation) for a compound that has a molecular formula of C_5H_8O and that contains a carbonyl bond (carbon-oxygen double bond).

3. Draw the Lewis structures of acetic acid and acetone as well as their conjugate bases. Draw one additional resonance structure of each conjugate base in which all atoms follow the octet-rule. Acetic acid is significantly more acidic (pKa = 4.7) than acetone (pKa = 19.3). Explain this result using the resonance structures you've drawn.

4. Draw a complete molecular orbital diagram of hydrogen (H_2) and helium (He_2). Be sure to draw the orbitals themselves, not just the labels. Use this diagram to explain why He_2 does not exist but H_2 does. *Hint: You must used shading to indicate locations of nodes*.

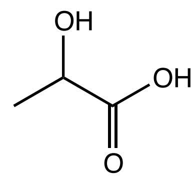
5. **First**, draw resonance structures for each compound, depending on how many resonance arrows are present. **Second**, draw a mechanism using curved-arrow notation to show how the resonance structure on the right is formed from the one on the left. **Third**, circle the major contributor for each 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.

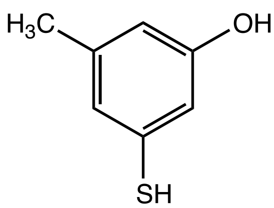


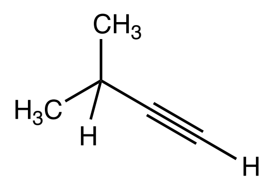


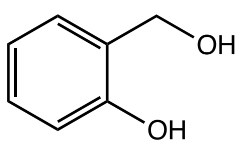
6. Draw the conjugate **base** for each molecule below. Include all electron lone-pairs and charges where applicable. If there is more than one type of hydrogen in the molecule, you must choose the most acidic hydrogen.

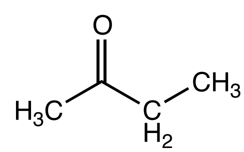
CH_3CH_2OH

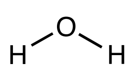


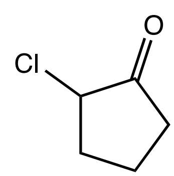


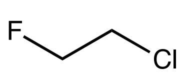


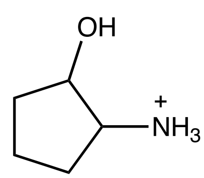




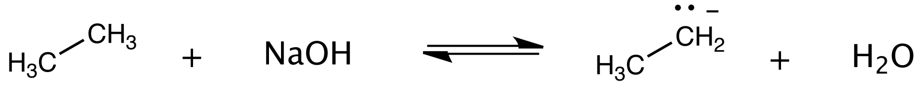






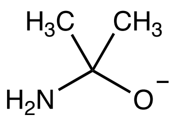


7. Calculate the K_{eq} for the following acid-base reaction. Show all work.



$pK_a = 62$ $pK_a = 15.7$

8. Draw the conjugate **acid** for each molecule below. Include all electron lone-pairs and charges. If there is more than one basic atom in the molecule, you must choose the most basic atom to protonate.



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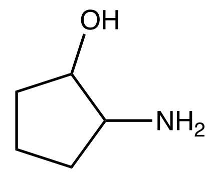

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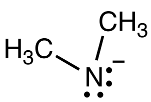

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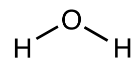

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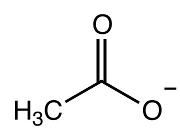
K_2HPO_4 ______________________



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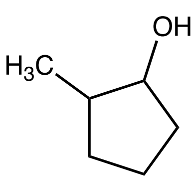

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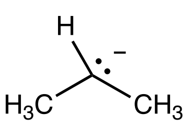
$CH_3CH_2NH_2$ ______________________



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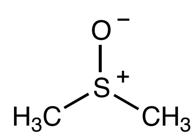

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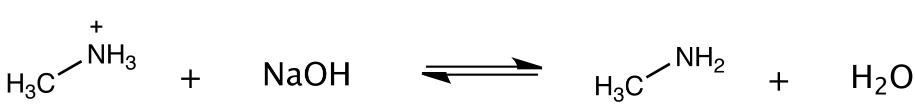
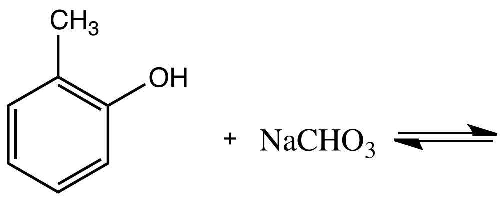
9. Calculate the K_{eq} for the following acid-base reaction. Show all work.

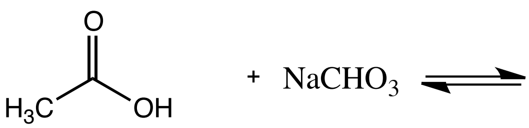


$pK_a = 9$ $pK_a = 36$ $pK_a = 15.7$

10. 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

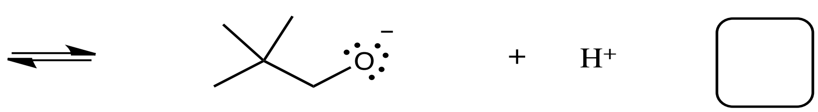


acetic acid
a carboxylic acid

11. **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 pK_a's in your textbook (Appendix B; You may not find the exact compound below. Find the closest match.). **Third**, using those pK_a values, rank the conjugate acids in order of increasing acidity (1 = least acidic, 5 = most acidic).

pK_a ~

pK_a ~ 9.0



pK_a ~

pK_a ~

pK_a ~