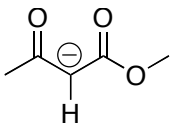
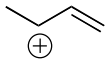
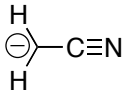
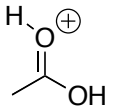
Problem Set 4 Name_____
S-ID_____

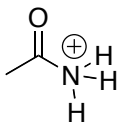
1) (6 pts each) Draw resonance contributing structures for the following molecules:

A) 

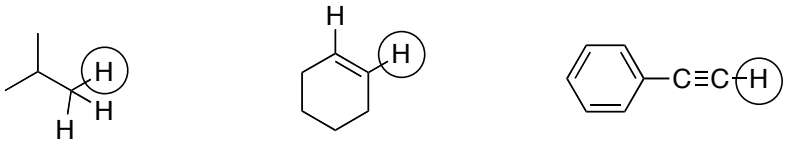
B) 

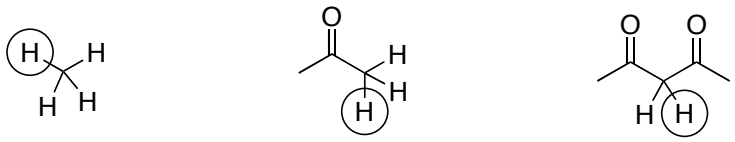
C) 

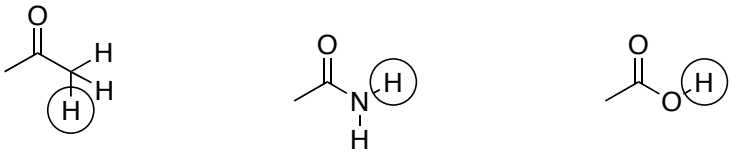
D) 

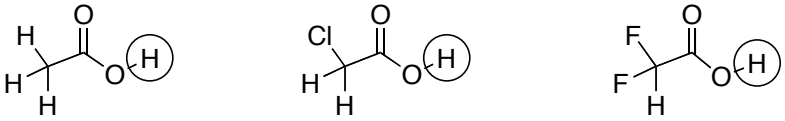
E) 

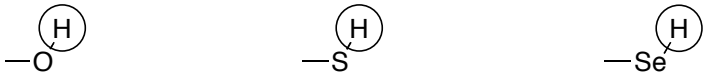
2) (4 pts each) For each of the following sets of molecules, indicate which is the strongest acid. Also, indicate which is the weakest acid. The acidic proton in each is circled. Use Table 4.1 (p 160) for pKa's. If a molecule isn't listed in the table, estimate the pKa for your comparison. If there isn't a close comparison, think about possible resonance structures and/or inductive effects that might stabilize the charge on the conjugate base. In other words, use what you've learned in chapter 4 to figure it out.

A) 

B) 

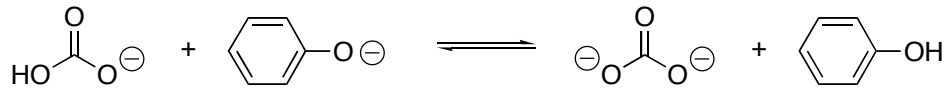
C) 

D) 

E) 

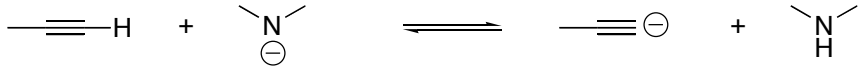
3) (3 pts each) For each of the following equilibrium reactions, predict the position of the equilibrium by circling the side on which it lies. **If you have to estimate a pKa, write the estimated pKa under the acid/conjugate acid whose pKa is being estimated.**

A)

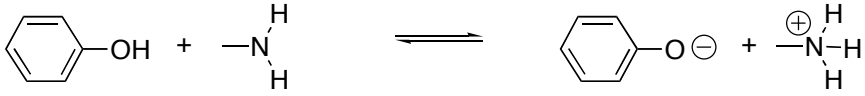


bicarbonate phenol

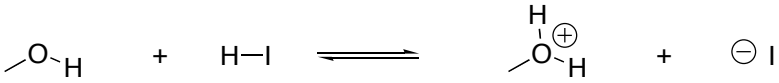
B)



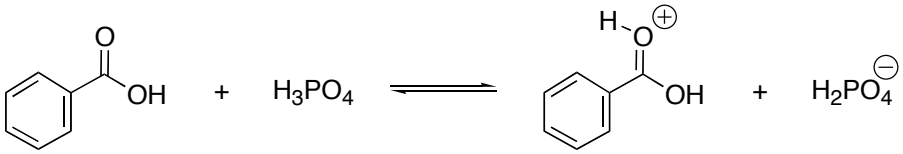
C)



D)

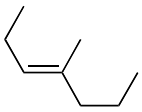


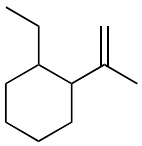
E)

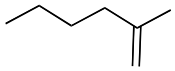


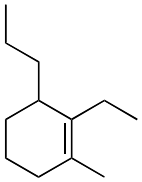
4) (5 pts total) For Equations A and C in problem 3, calculate the equilibrium constant for the forward (as drawn) reaction.

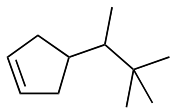
5) (6 pts each) Give IUPAC names for the following molecules:

A) 

B) 

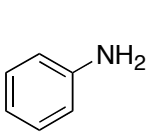
C) 

D) 

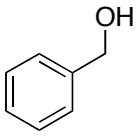
E) 

Extra Credit (10 pts) For this problem, use everything you know about predicting the equilibrium of acid-base reactions. Remember that salts (charged derivatives) of organic compounds are more soluble in water than the neutral molecules. The idea of using acid/base chemistry to help separate organic molecules from one another is an important and useful technique. You are doing something very similar in the lab sections this week. To solve this problem, think about the possible acid and base reaction that can happen at each stage of the extractions. Drawing a flowchart will probably help you keep track of different solutions. As a hint, the equilibrium must lie very far in the direction of forming a salt to make it usable for this kind of extraction.

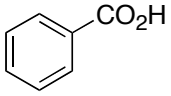
A mixture of aniline (**7**), benzyl alcohol (**8**), and benzoic acid (**9**) are mixed together with an organic solvent, Et_2O (diethyl ether), to form a solution. The organic solution is washed with three portions of aqueous NaOH (1 M). These aqueous base washes are combined and labeled "Base Extract." The organic solution is then washed with three portions of aqueous HCl (1 M), and the aqueous acid washes are combined and labeled "Acid Extract." The organic solution is then dried (with Na_2SO_4), filtered, and evaporated to give product **A**. The "Base Extract" is made acidic with concentrated HCl, and this new solution is extracted with three portions of an organic solvent (CH_2Cl_2, dichloromethane). The CH_2Cl_2 washes are combined, dried (Na_2SO_4), filtered, and concentrated to give product **B**. The "Acid Extract" is made basic with NaOH, and this new solution is extracted with three portions of an organic solvent (Et_2O). The organic washes are combined, dried (Na_2SO_4), filtered, and concentrated to give product **C**.



7



8



9

What are the structures of **A**, **B**, and **C**?