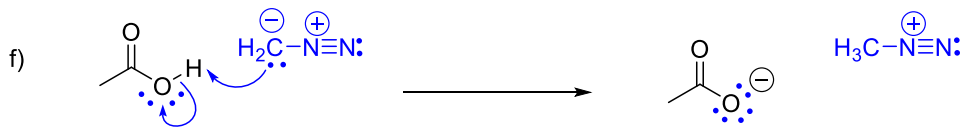
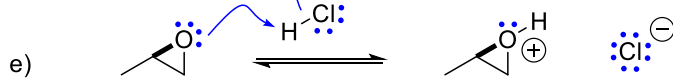
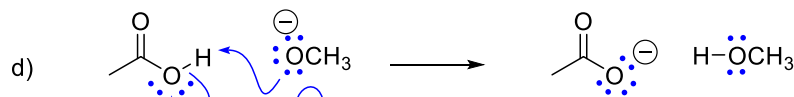
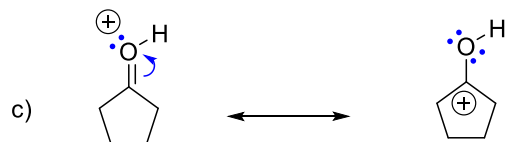
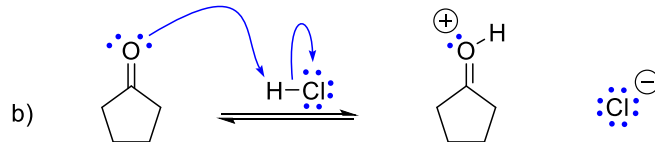
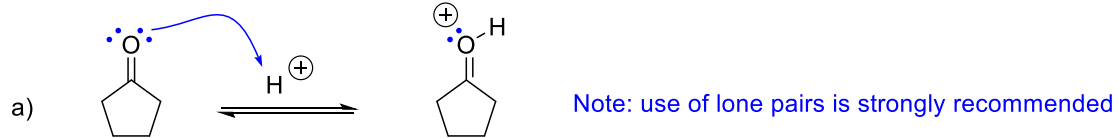


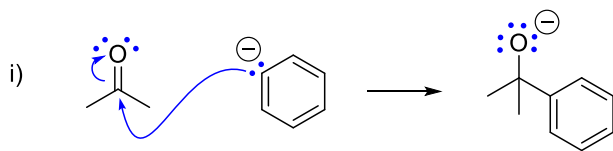
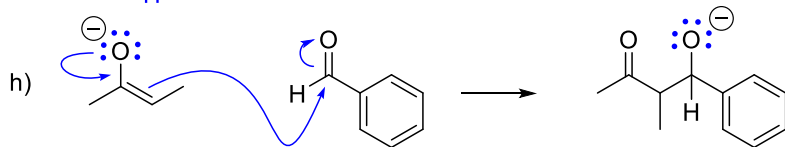
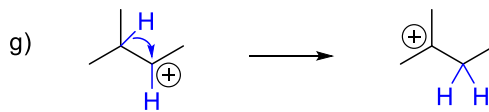
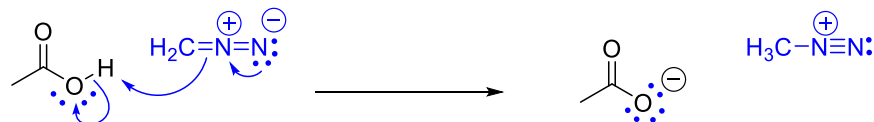
CHM 1321

Assignment 4 Answers

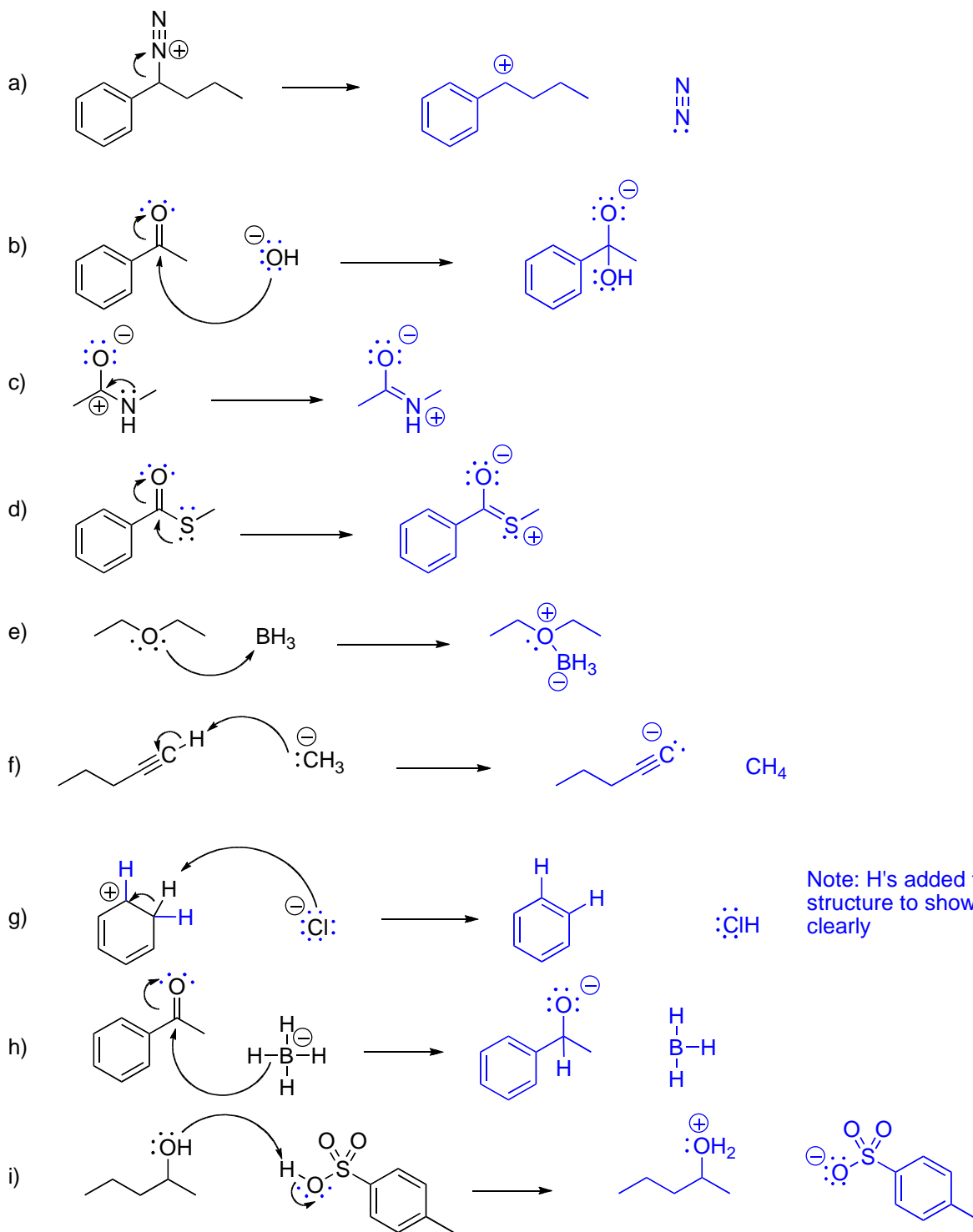
- 1) Draw mechanistic arrows for each of the following transformations that explain the formation of the products shown. (**Note:** you are not responsible for memorizing these reactions. The goal is for you to analyze what is happening and draw the appropriate arrows)



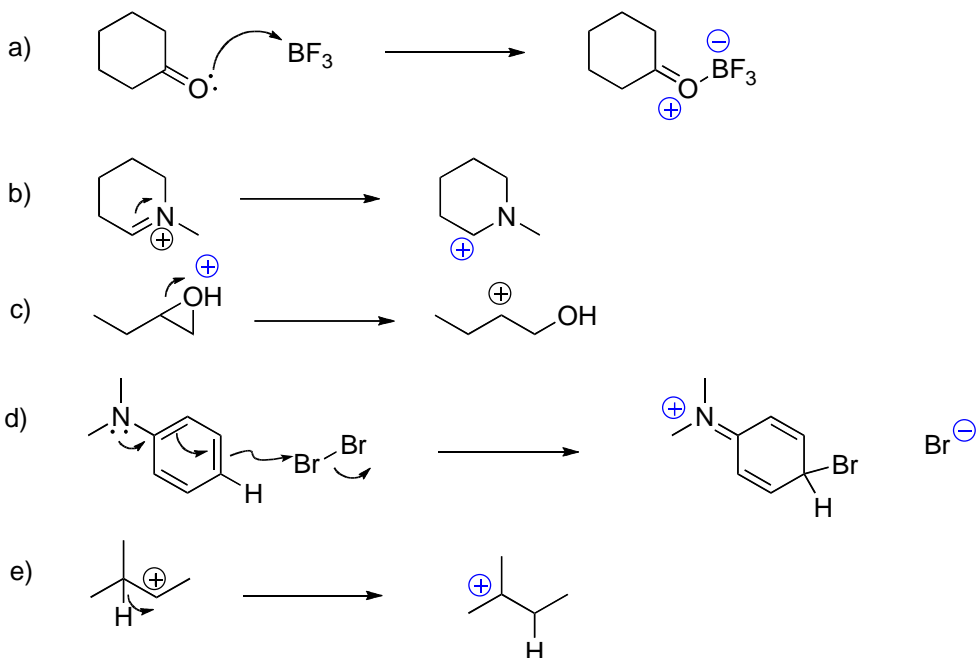
Note: this reaction can use either resonance form of CH_2N_2



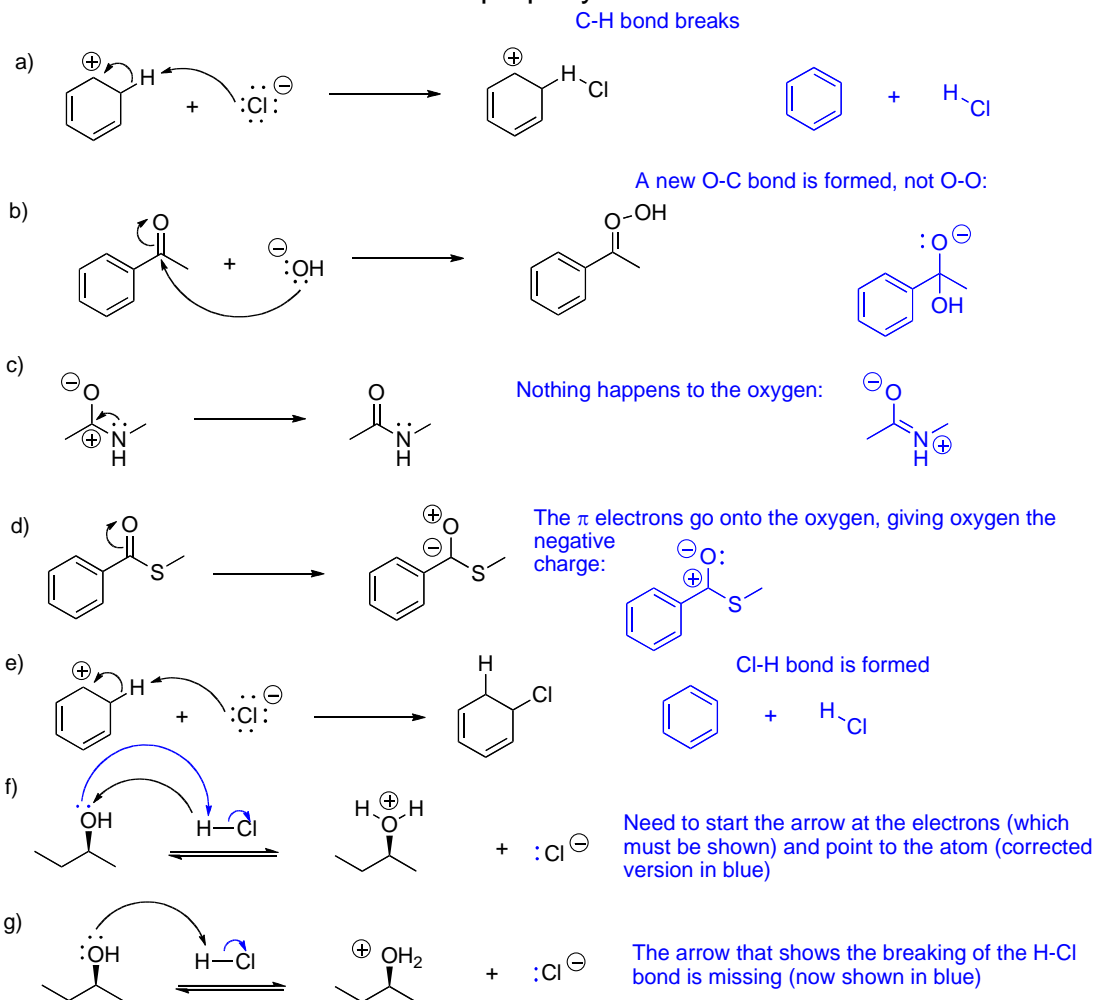
2) Draw the product of each of the following reactions. (**Note:** you are not responsible for memorizing these reactions. The goal is for you to analyze what is happening and draw the resulting products)



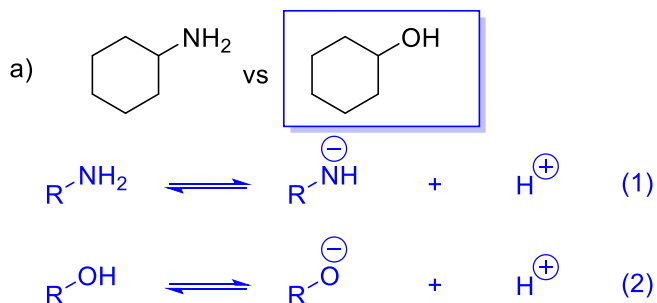
3) Add charges to the products or reactants as necessary.



4) Each of the following mechanisms contains at least one error. Identify the error(s) in each case and re-draw the mechanism properly.



5) For the following pairs of compounds, predict which one will be the strongest acid and justify your choice.



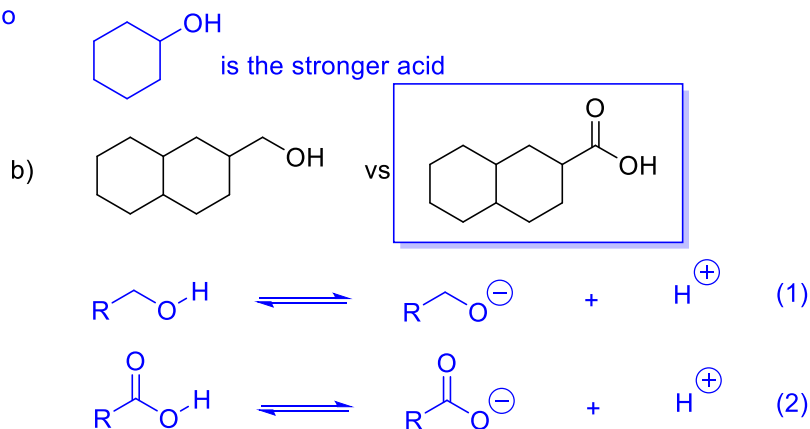
look at the conjugate bases (charged):

-in equation 2 the atom bearing the negative charge is more electronegative than the atom holding the negative charge in equation 1. Therefore the negative charge will be more stabilized in the conjugate base of equation 2

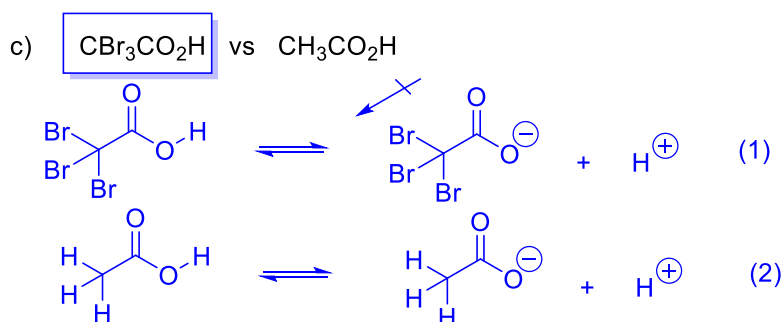
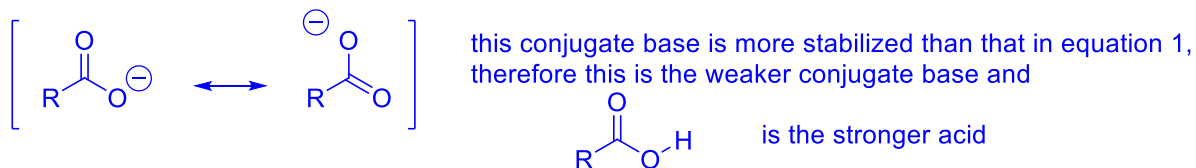
-this means that this conjugate base will be more stable and a weaker base than the conjugate base in equation 1

- since the conjugate base in equation 2 is weaker, the corresponding acid will be stronger

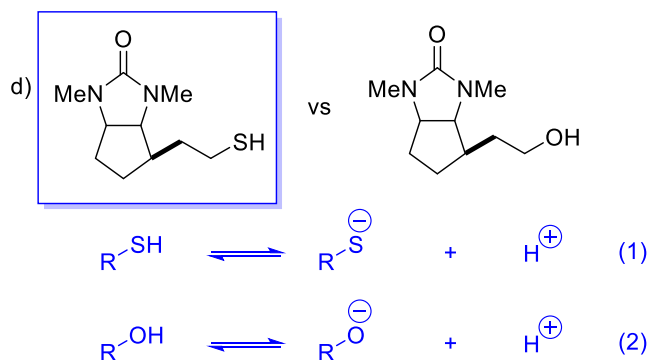
So



The conjugate base in equation 2 is stabilized by delocalization



The bromines in equation 1 are more electronegative than the corresponding hydrogens in equation 2. The stronger electron withdrawing power of the bromines stabilize the conjugate base in (1) by the inductive effect. Since the conjugate base in (1) is more stable than in (2) it is a weaker base and therefore the acid in equation (1) is the stronger acid

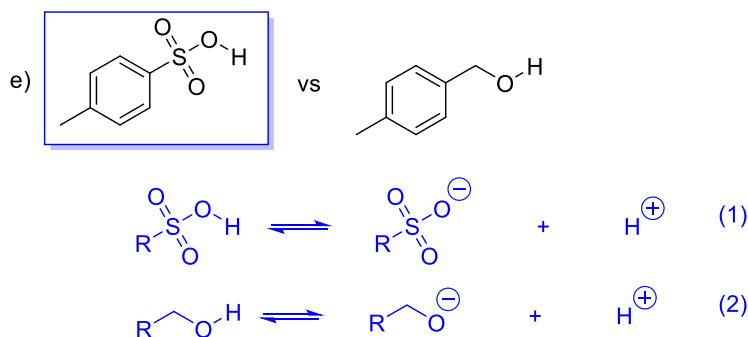
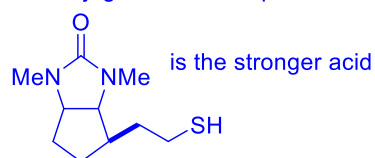


-in equation 1 the atom bearing the negative charge is larger (lower in the periodic table) than the atom holding the negative charge in equation 2. Therefore the negative charge will be more dispersed in the conjugate base of equation 1

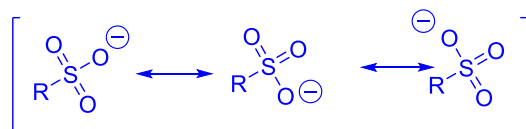
-the dispersion of negative charge in the conjugate base in equation 1 results in better stabilization of the negative charge, therefore this conjugate base will be more stable and a weaker base than the conjugate base in equation 2

- since the conjugate base in equation 1 is weaker, the corresponding acid will be stronger

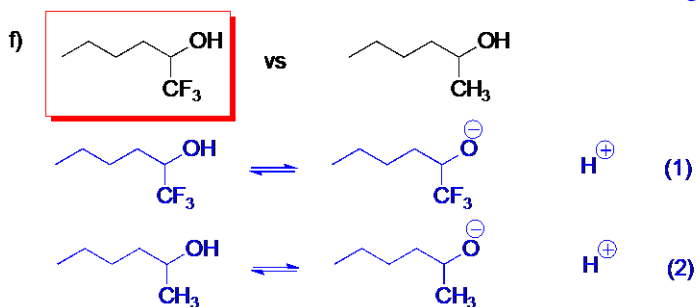
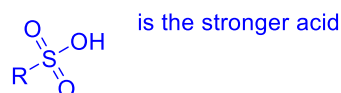
So



The conjugate base in equation 1 is stabilized by delocalization

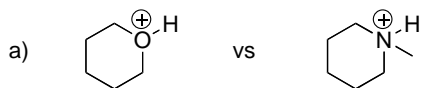


this stabilizes this conjugate base more than that in equation 2, therefore this is the weaker conjugate base and

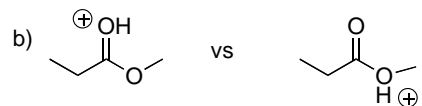
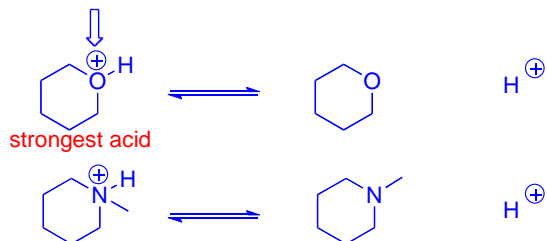


the conjugate base in equation (1) is stabilized by induction from the 3 fluorine atoms. these are very electronegative and withdraw electrons from the negatively charged oxygen reducing the effective charge on that oxygen. this means that this will be the weakest conjugate base and the corresponding acid is the strongest acid

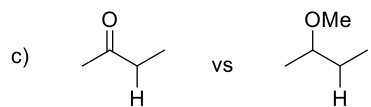
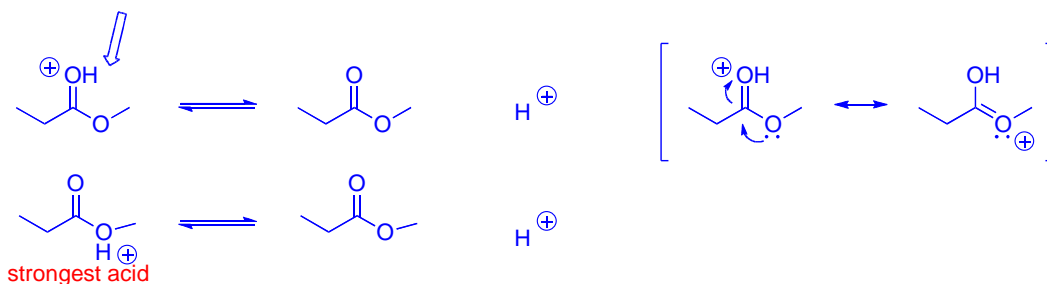
6) For the following pairs, predict the strongest acid and justify your choice



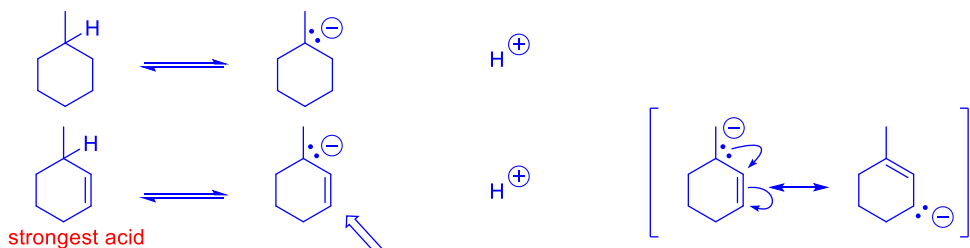
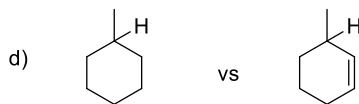
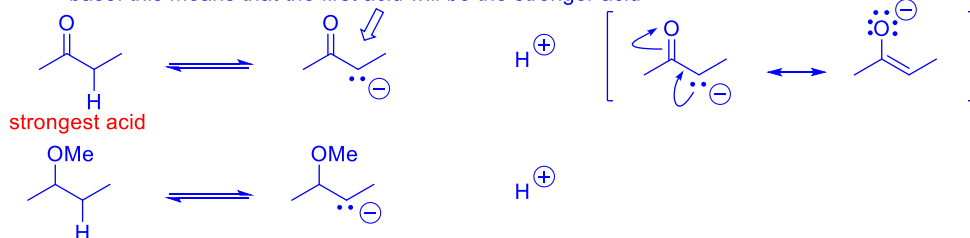
oxygen is right of nitrogen on the periodic table and is therefore more electronegative. positive charge will be less stable on this more electronegative atom. because this ion is less stable it will be the stronger acid



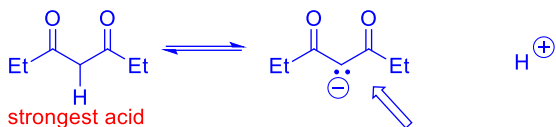
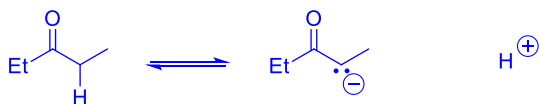
resonance is possible for the top structure. this will stabilize the positive ion relative to the other one. the more stable ion will be the weaker acid.



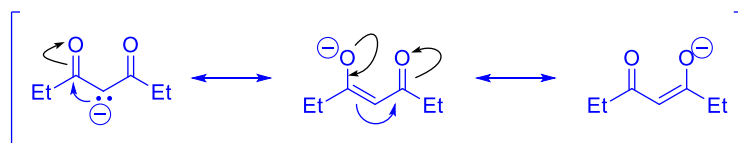
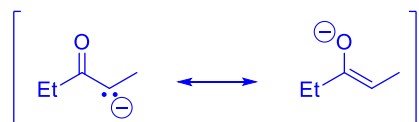
this anion is stabilized by delocalization this stabilizes the conjugate base relative to the other conjugate base. this means that the first acid will be the stronger acid



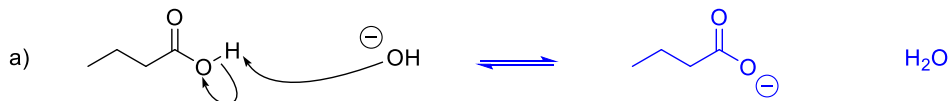
this anion is stabilized by delocalization. this stabilizes the conjugate base relative to the other conjugate base. this means that the first acid will be the stronger acid



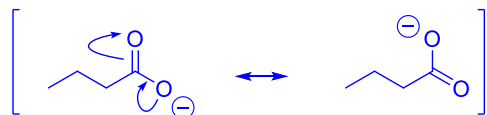
both anions are stabilized by delocalization. this anion spreads the charge over 3 atoms, whereas the charge is only spread over two atoms in the top anion. therefore the lower conjugate base is more stable and weaker. the second acid is the strongest acid



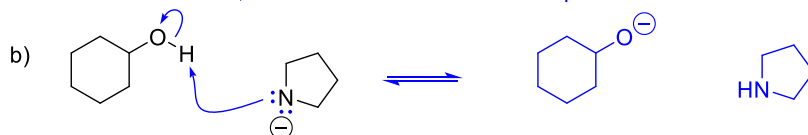
7) Write balanced equations and mechanisms for the following acid-base reactions using arrow notation. Predict whether the reaction will favor the starting materials or products and justify your choice.



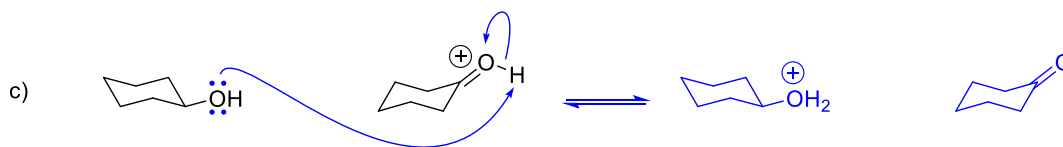
compare the conjugate bases (charged species):
charge is located on oxygen in both cases. no difference in electronegativity or size.



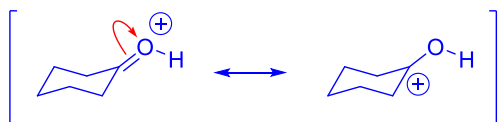
is stabilized by delocalization. this makes it the weaker conjugate base. reactions "push" towards weaker acids and bases, and so the reaction favors the products



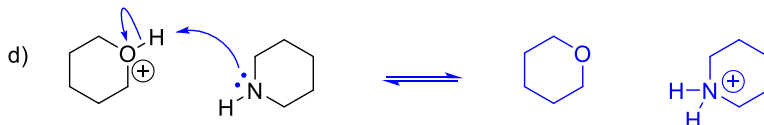
compare the conjugate bases (charged species):
oxygen is right of nitrogen on the periodic table. oxygen is therefore more electronegative than nitrogen and will stabilize negative charge better than nitrogen will. the alkoxide is therefore the weaker base. equilibria "push" towards weak bases and the reaction favors the products



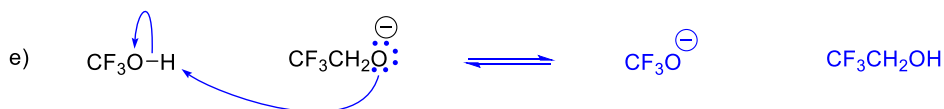
compare the conjugate acids (charged species):
charge is located on oxygen in both cases. no difference in electronegativity or size.



in this structure, charge is stabilized by delocalization. this makes it the weaker (more stable) conjugate acid. reactions "push" towards weaker acids and bases, and so the reaction favors the reactants (starting materials)

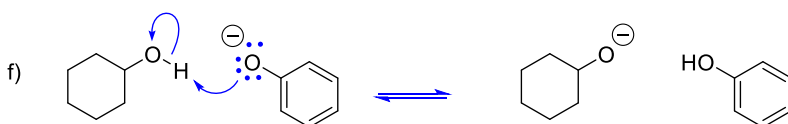


compare the conjugate acids (charged species):
oxygen is right of nitrogen on the periodic table. oxygen is therefore more electronegative than nitrogen. positive charges will be less stable on oxygen than on nitrogen. the alkoxide is therefore the stronger acid and the ammonium ion is the weaker acid. equilibria "push" towards weak acids and the reaction favors the products

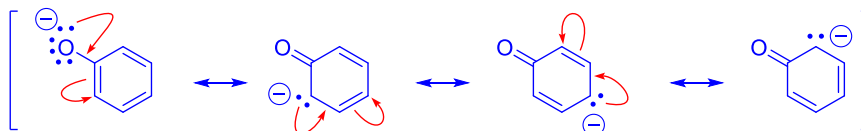


compare the conjugate bases (charged species):
charge is located on oxygen in both cases. no difference in electronegativity or size.
no possibility for resonance.

each molecule contains a CF₃ group that can stabilize the negative charge by induction. fluorine is very electronegative and withdraws electrons from nearby charges thus reducing the effective charge. in CF₃O⁻ the F's are very close to the negative oxygen and therefore have a strong effect. in CF₃CH₂O⁻ the F's are farther away reducing the amount of charge reduction. CF₃O⁻ is therefore more stable and the weaker base. the reaction favors products.

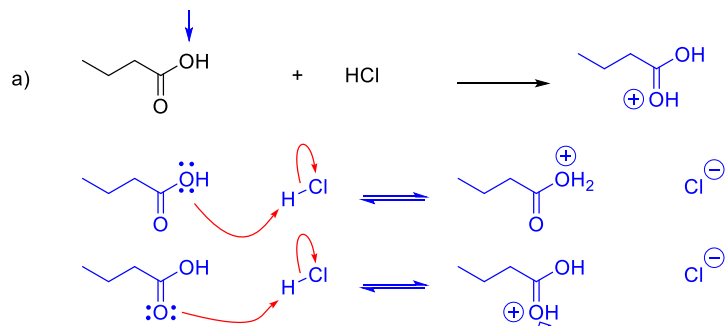


compare the conjugate bases (charged species):
charges are located on oxygen in both cases. no difference in electronegativity or size. resonance is possible for the following conjugate base

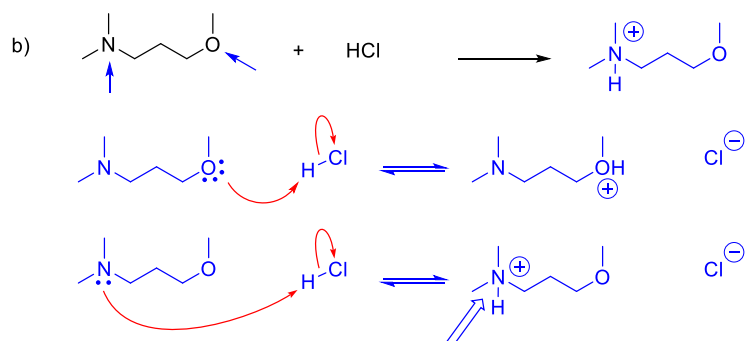
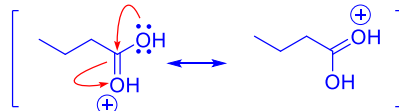


this stabilizes the base relative to the other one and will make it the weaker base. reaction will push towards the weakest base and favors the starting materials (reactants)

8) Predict the most likely location of protonation (H⁺ addition) in the following:



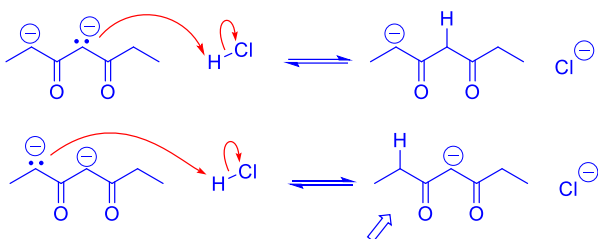
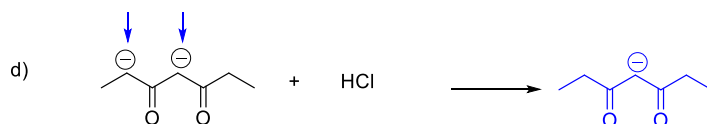
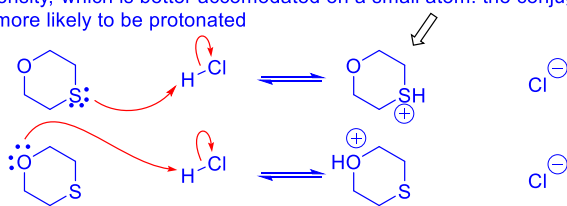
this ion is stabilized by delocalization. the molecule will be protonated at this location because this leads to the most stable ion



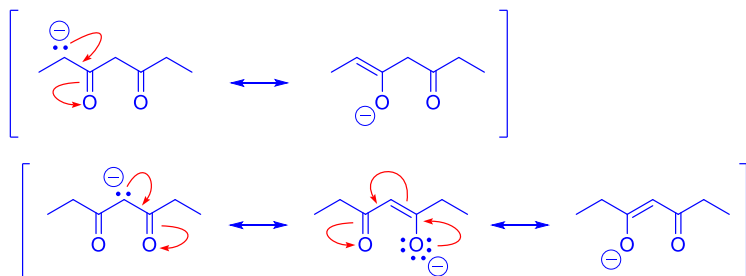
oxygen is right of nitrogen in the periodic table and is therefore more electronegative. this means that positive charges will be less stable on oxygen than they are on nitrogen. the top ion is therefore less stable than the bottom one, and protonation will occur on nitrogen



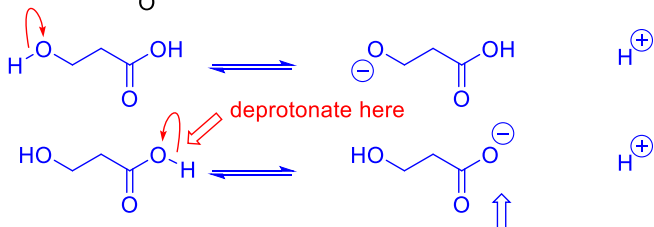
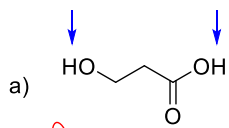
sulfur is below oxygen in the periodic table and is therefore larger. positive charge represents a lack of electron density, which is better accommodated on a small atom. the conjugate acid involving oxygen is therefore more likely to be protonated



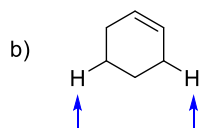
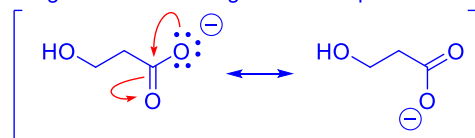
both anions are stabilized by delocalization. however the product anion on the bottom spreads charge over more atoms than the anion on the top does. this means that the lower anion is more stable and protonation will happen on the site farthest left in the starting material



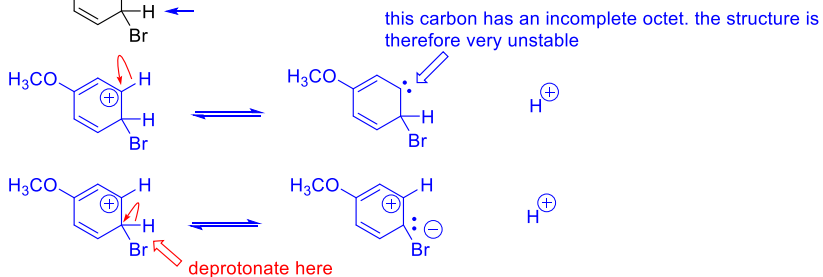
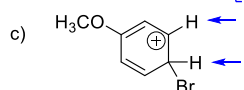
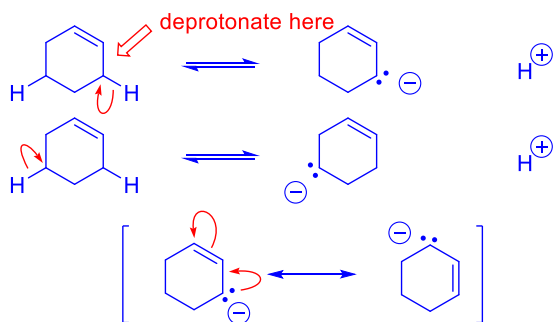
9) Predict the most likely location of deprotonation (H+ removal) in the following:



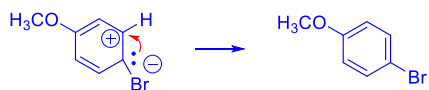
anion on the bottom is stabilized by delocalization. this means that this is the weakest base, the corresponding acid is the strongest acid. deprotonation will happen on the right



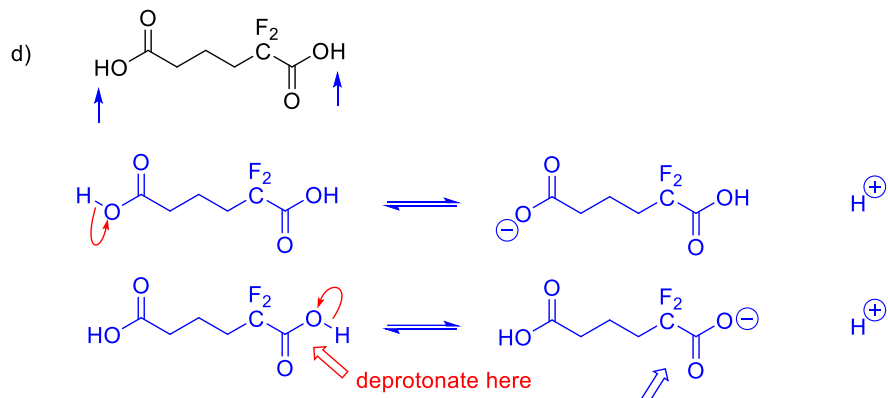
anion on the top is stabilized by delocalization. this means that this is the weakest base, the corresponding acid is the strongest acid. deprotonation will happen on the right



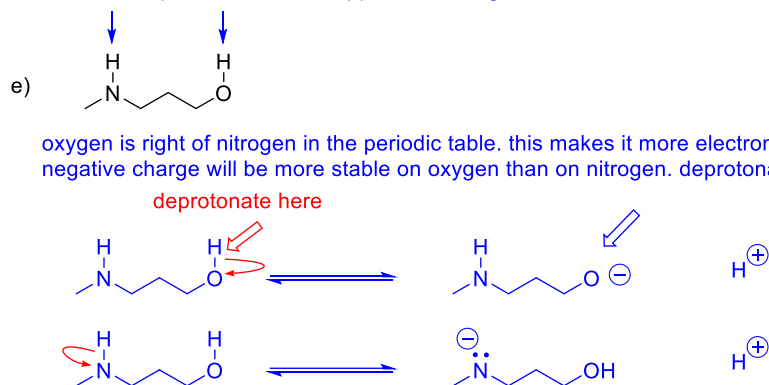
deprotonation at the lower position gives an insignificant resonance form. however the unlike charges are adjacent and the lone pair can be used to construct a new π bond with the adjacent + carbon giving a neutral structure with complete octets



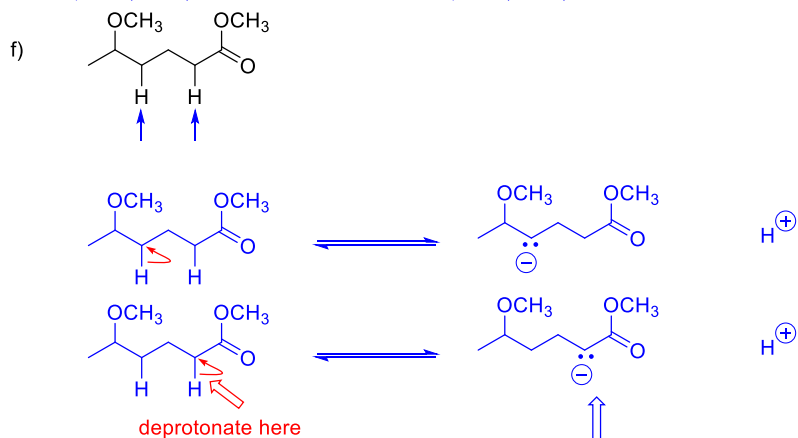
the product is a stable material. no charges and all atoms have octets



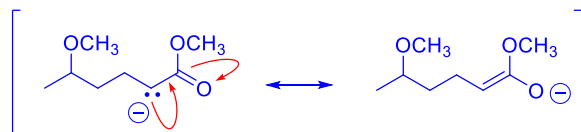
this anion is stabilized by the inductive effect of the fluorine atoms nearby. this reduces the effective charge on the oxygen on the right and stabilizes it relative to the top anion. deprotonation will happen on the right hand site

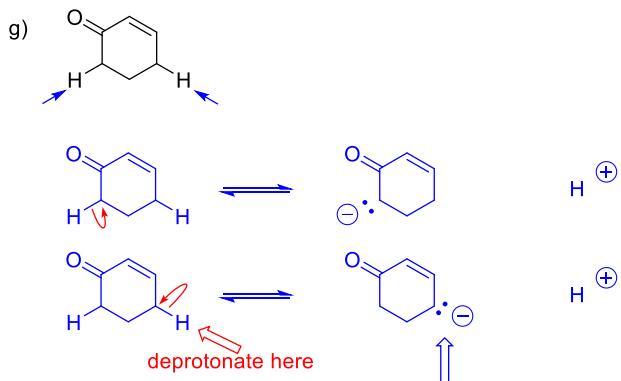


oxygen is right of nitrogen in the periodic table. this makes it more electronegative than nitrogen. the negative charge will be more stable on oxygen than on nitrogen. deprotonation will occur on oxygen.



negative charge on this anion is stabilized by resonance. this distributes the charge over several atoms and stabilizes the anion. deprotonation will occur on the right hand position





both anions are stabilized by delocalization. the anion on the bottom spreads the charge over a larger number of atoms and will be more stable. deprotonation occurs on the right hand position

