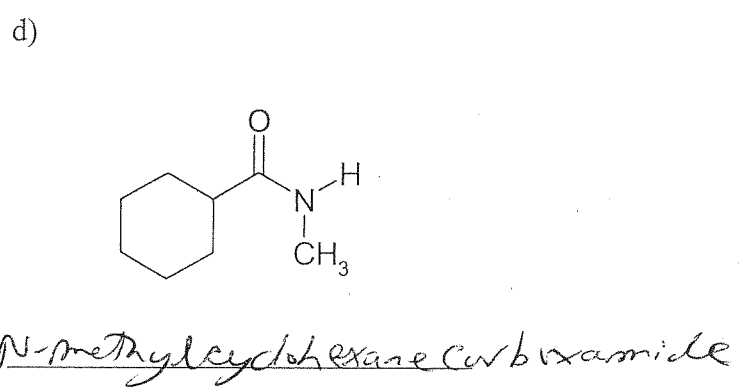
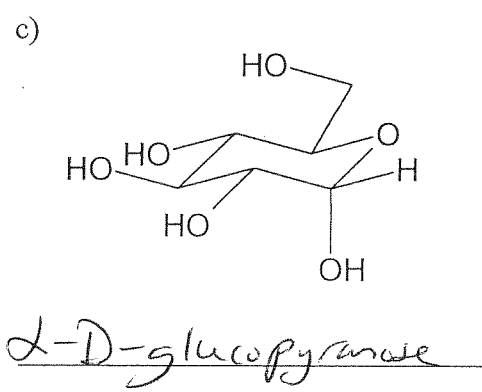
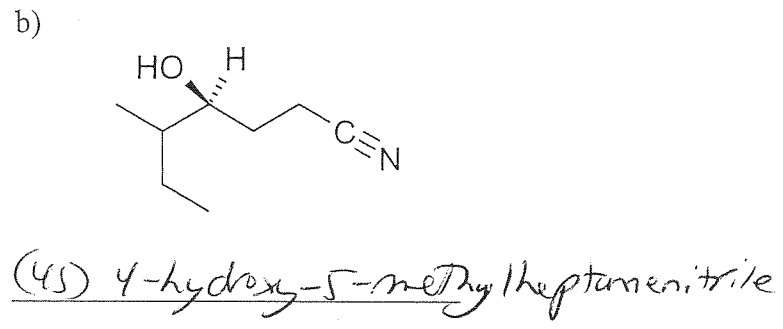
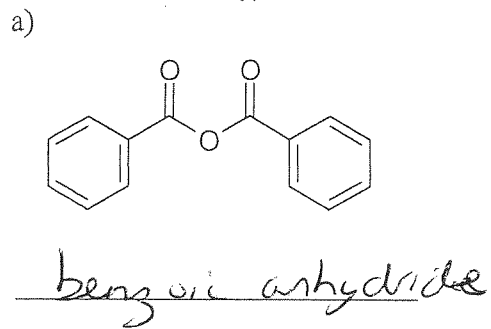
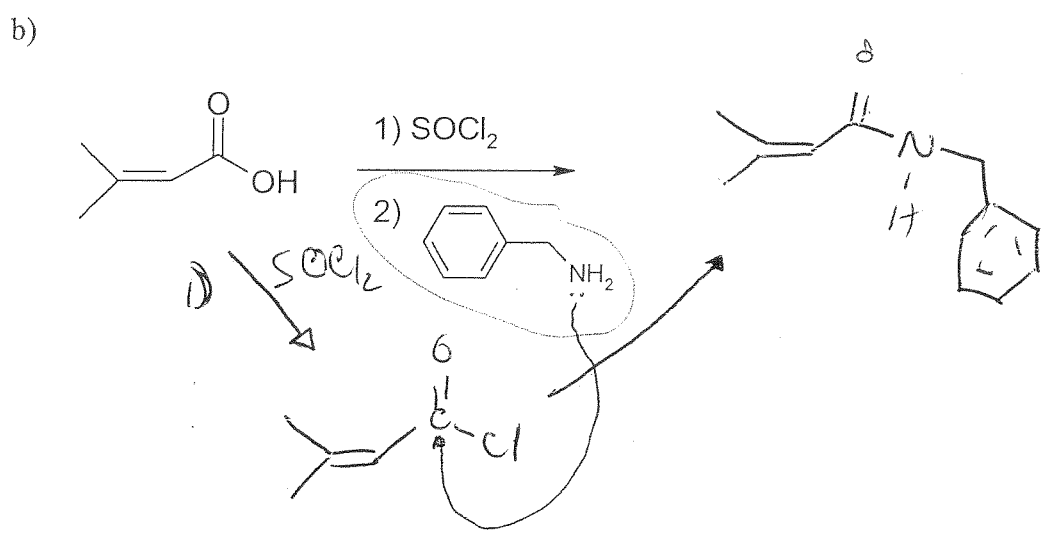
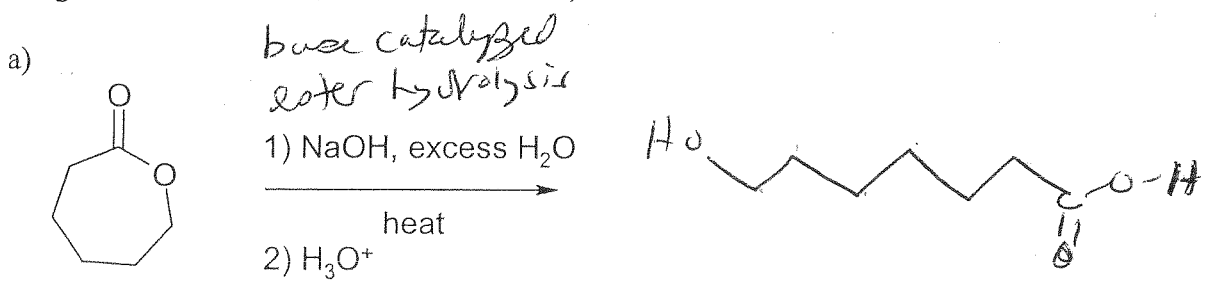


1. (16 pts, 4 each) Give the IUPAC name of the following compounds (except c). (Be sure to use R and S when necessary).

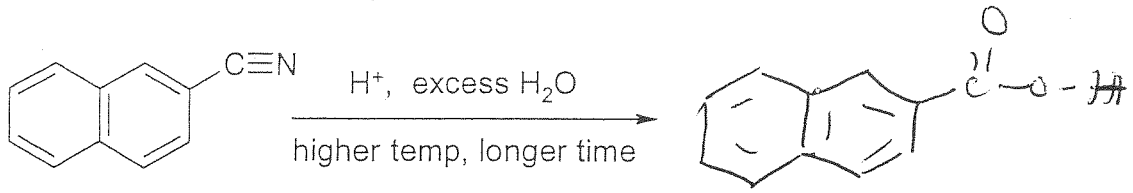


2. (40 pts, 4 each) Give the structures for the **major product** or the **reagents needed** for the following transformations. If no reaction occurs, write **NO RXN**.

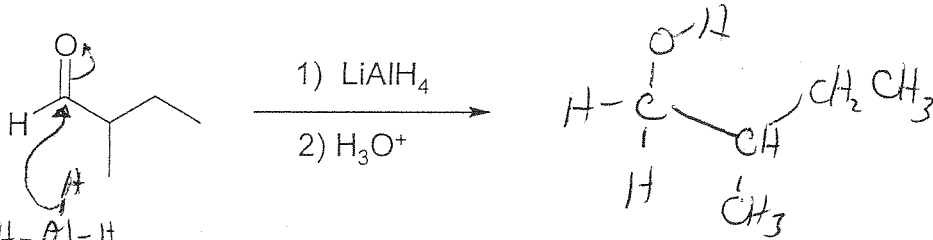


acid-catalyzed
nitrile hydrolysis
to CO_2H

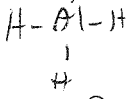
c)



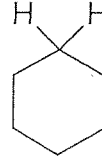
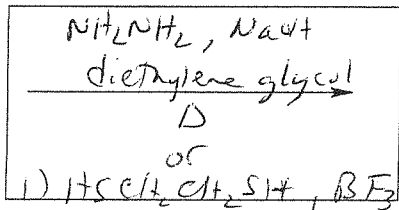
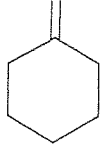
d)



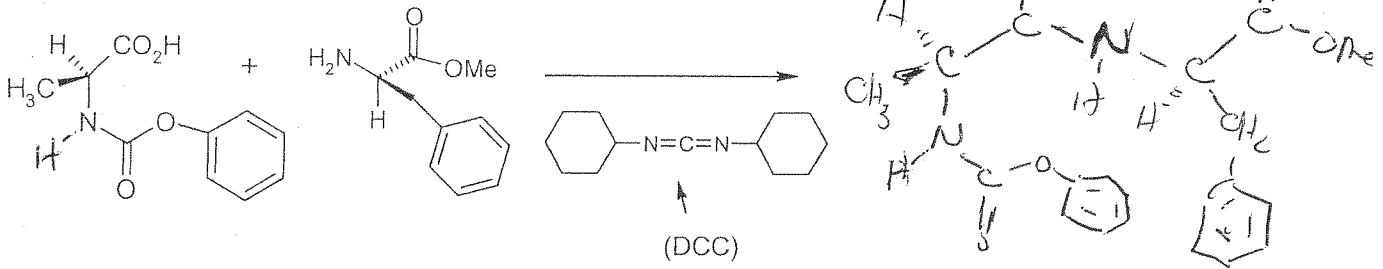
e)



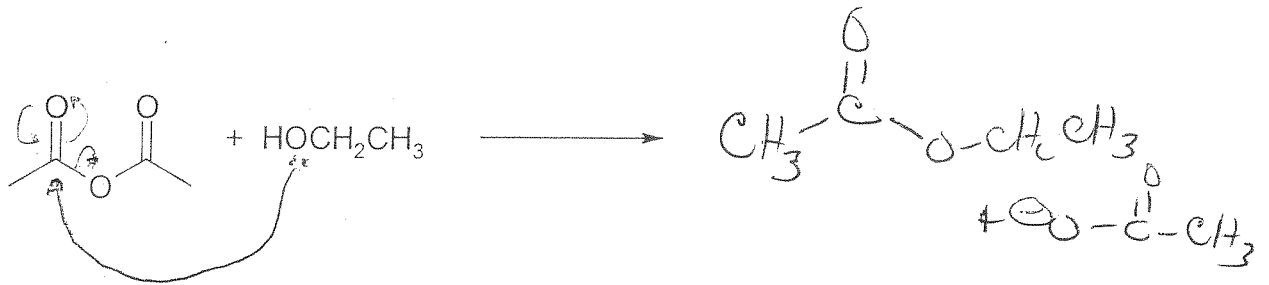
Wolff-Kishner or Raney Nickel Reduction



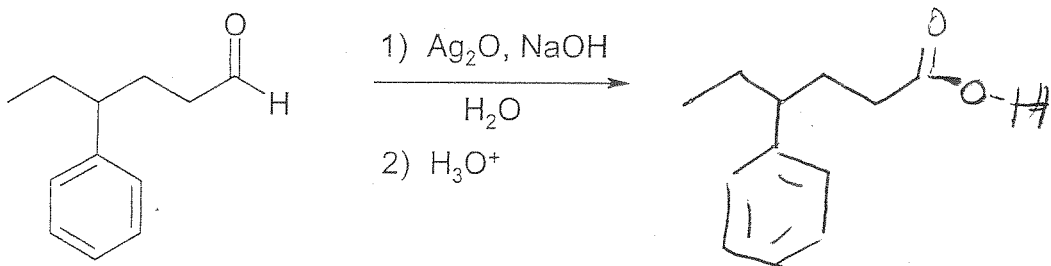
f)



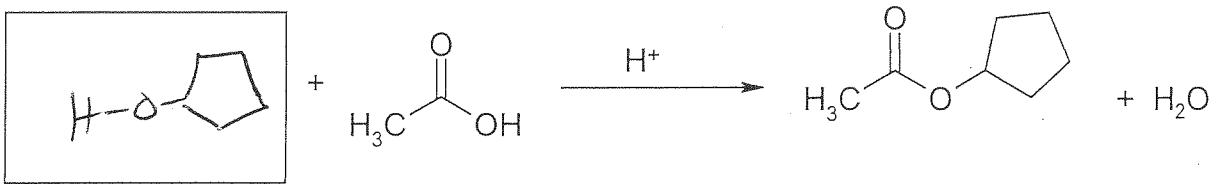
g)



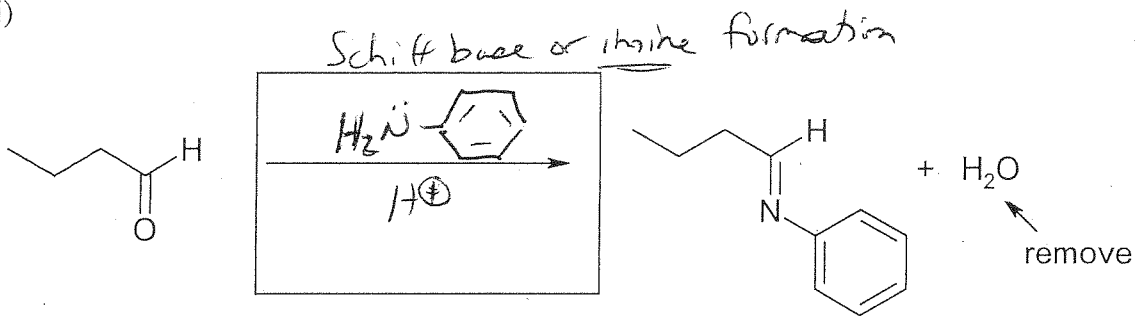
h)



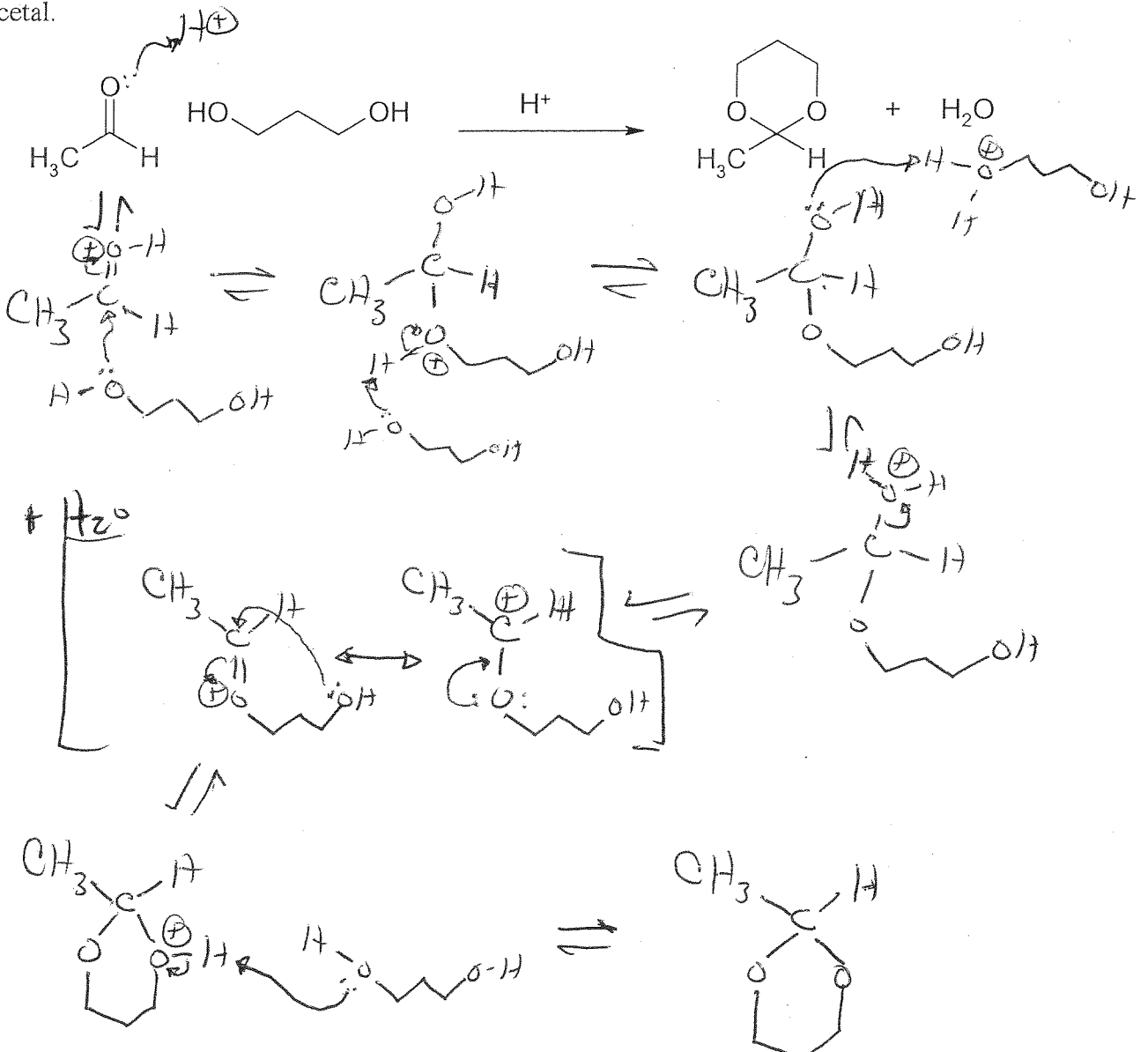
i) Fischer Esterification
(acid-catalyzed esterification)



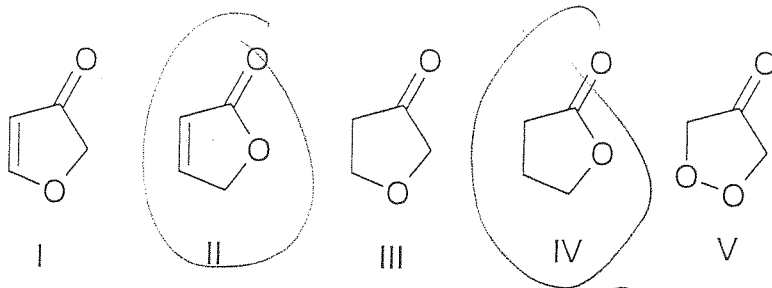
j)



3. (12 pts) Give the complete mechanism for the following acid-catalyzed formation of a cyclic acetal.

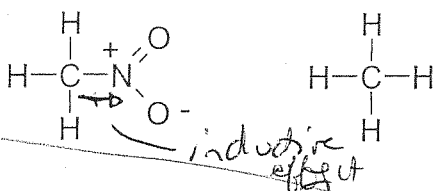


4. (3 pts) Which of the following is(are) lactone(s)?

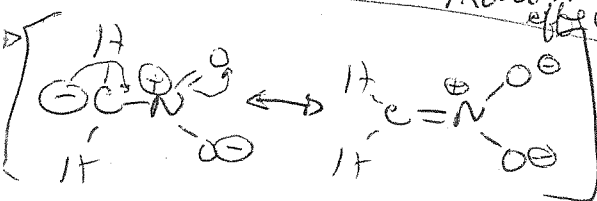


- a) I b) II c) III d) IV e) V f) I, II g) II, ~~III~~ h) I, III **i) II, IV** j) I, II, V

5. (5 pts) Briefly explain why the pKa of nitromethane (pKa = 10.2) is much lower than the pKa of methane (pKa = 49).



After picking off one of the hydrogens in nitromethane, the conjugate base can be stabilized by the inductive effect of the electron withdrawing NO₂ group & can also be stabilized by resonance delocalization of the ⁻ charge to the nitro group oxygen. A more stable conj. base means a more acidic proton. In

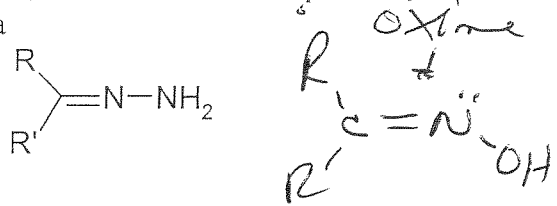


Contrast, the conj. base of methane is not stabilized by either an inductive effect or resonance.

6. (4 pts) What is the general structure needed for a surfactant (with soap being one type of surfactant).
 A long hydrophobic tail and a polar, hydrophilic head that is charged.
 ex.

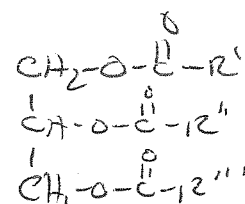
(Note: The hydrophilic head doesn't have to be a carboxylate - it can be a quaternary ammonium, sulfonate etc. $R-S(=O)_2O^-$)

7. (1 pt) **True** or False An oxime has the general formula

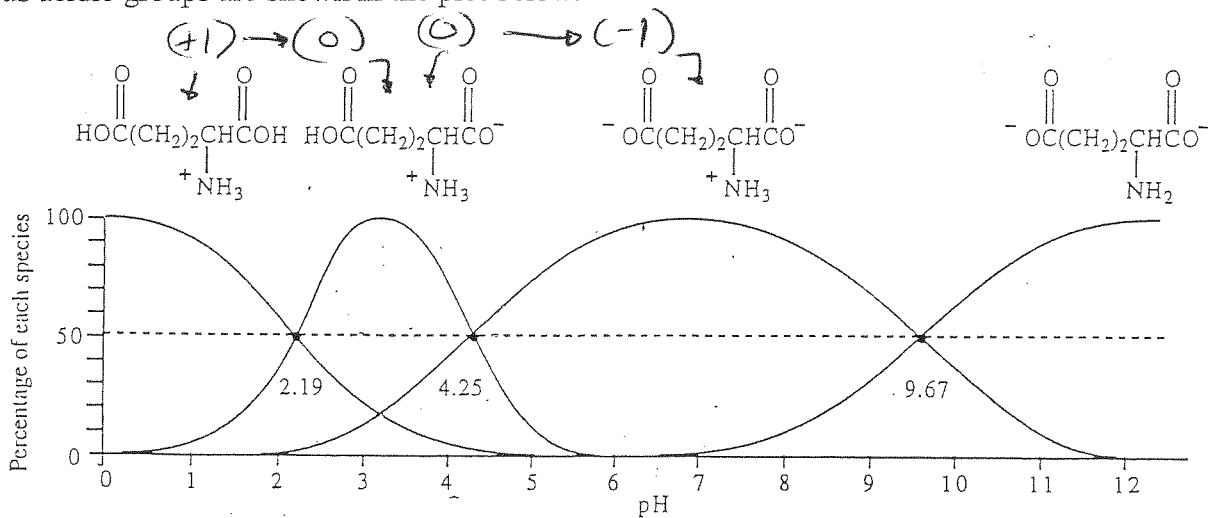


8. (1 pt) **True** or **False** The main difference between a fat and an oil is that a fat is a triester whereas an oil is a monoester.

9. (1 pt) **True** or **False** An anhydride is easier to hydrolyze than an amide.



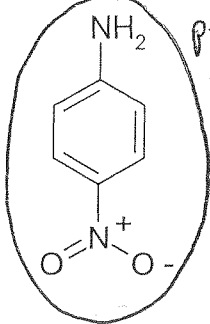
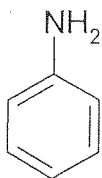
10. (4 pts) Calculate the isoelectric point (pI) for glutamic acid, whose structures and pKas for the various acidic groups are shown in the plot below.



$$\text{pI} = \frac{2.19 + 4.25}{2} = \boxed{3.22}$$

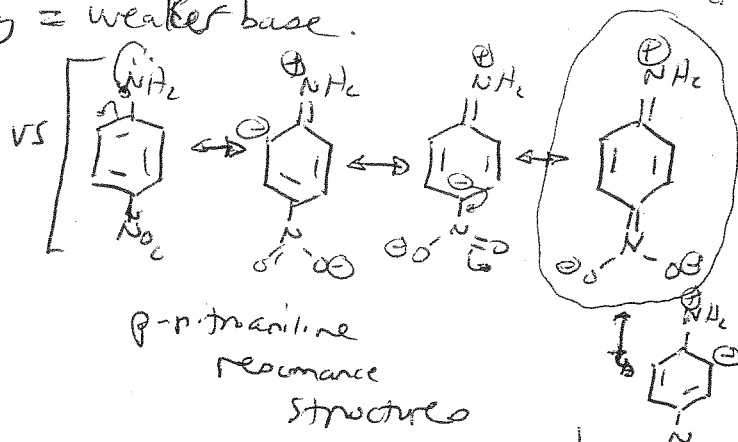
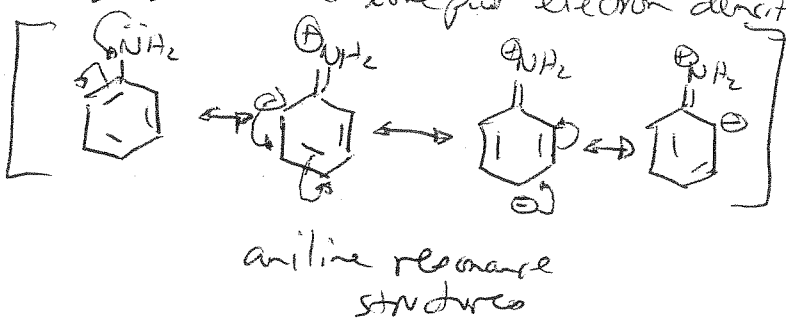
(helps pull electron density away from nitrogen)

11. (6 pts) You have two aromatic amines - aniline and p-nitroaniline. Circle the compound which is least basic of the two, and briefly explain why you chose your answer. (Be sure to include a discussion of resonance effects in your explanation).

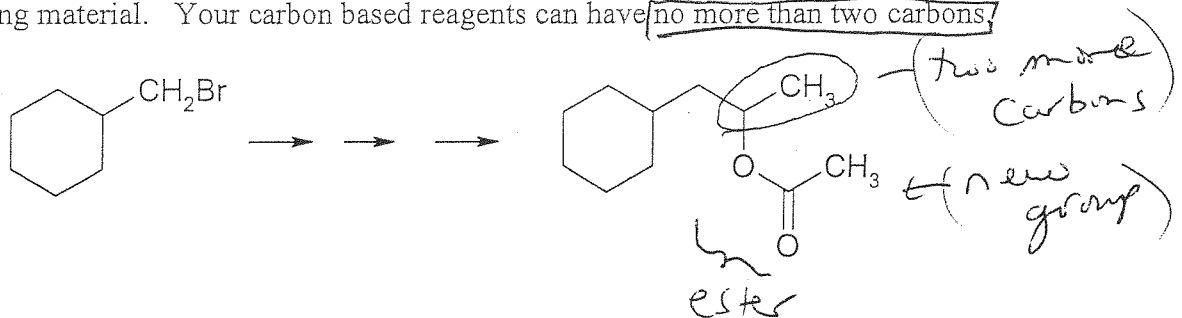


p-Nitroaniline is less basic than aniline because of the electron withdrawing effect of the electronegative nitro group + the fact that another resonance structure is possible with nitroaniline (that is not possible w/ aniline) which helps the p-nitro aniline lone pair electrons on nitrogen to be less available for protonation than aniline.

Less available lone pair electron density = weaker base.



12. (7 pts) Multistep synthesis. Give the reagents needed as well as the structures of the intermediate products on the pathway to synthesize the following product from the given starting material. Your carbon based reagents can have no more than two carbons.



Retro synthetic Analysis

