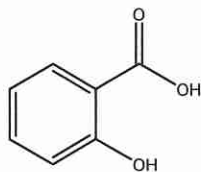


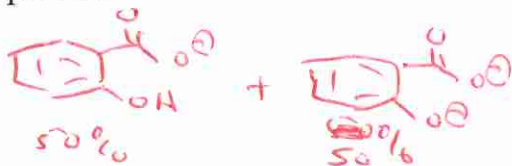
Name: _____

Directions: The exam is worth 106 points but scored out of 100.

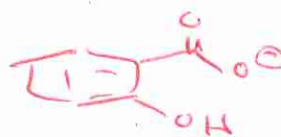
1) Given below is salicylic acid. Give the major form or forms present at the listed pH. (3 pts. each)



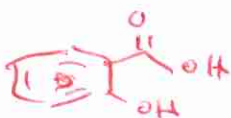
a) pH 10.0



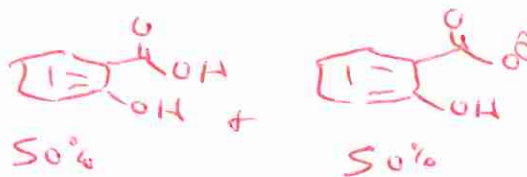
b) pH 6



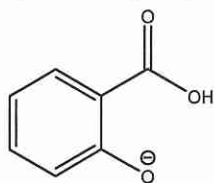
c) pH 1.0



d) pH 4.5



2) Give a pH [if possible] that will give the structure below. Explain your answer. (4 pts.)



This is no pH that will deprotonate the phenol ($pK_a \approx 10$) while leaving the carboxylic acid ($pK_a < 4.5$) protonated.

always grab most acidic proton first.

3) a) Give the electron configuration of Fe. You may use the Noble gas configuration if you want. (3 pts.)



b) Give the electron configuration of Os. You may use the Noble gas configuration if you want. (3 pts.)



4) a) How many degrees of unsaturation does a molecule with the molecular formula $C_{10}H_8$ have? SHOW YOUR WORK. (3 pts. each)

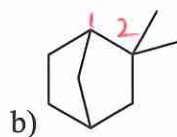
$$\begin{array}{r} C_{10}H_{22} \\ C_{10}H_8 \\ \hline 14/2 = 7^\circ \text{ of unsaturation} \end{array}$$

b) Draw a molecule with the molecular formula $C_{10}H_8$ that only has sp^2 carbons.



5) Nomenclature: Give the name if given the structure or give the structure if given the name for the following molecules. (3 pts. each)

a) 5-Ethyl-2,4,6-trimethyloctane

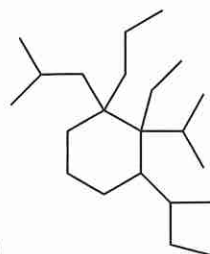


2,2-dimethylbicyclo [2.2.1] heptane

c) 2-cyclobutylpentane

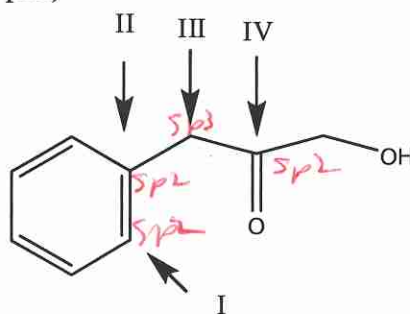


d)



3-sec-butyl or 3-(butan-3-yl)
2-ethyl-1-isobutyl
2-isopropyl-1-propyl
cyclohexane

6) What are the hybridizations of the atoms marked I, II, III, and IV in the molecule below? (4 pts.)



a) I = sp^2 , II = sp^2 , III = sp^3 , IV = sp^3

b) I = sp , II = sp^3 , III = sp , IV = sp^2

c) I = sp^2 , II = sp^3 , III = sp^2 , IV = sp^3

d) None of the above.

e) Cannot be determined.



7) Draw a Lewis Dot structure for CH_3N_2 . Show your work. (5 pts.)

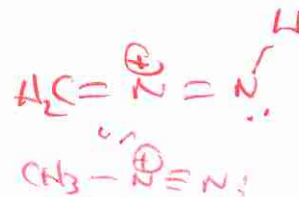
$$\text{N } 2 \times 5 = 10$$

$$\text{C } 1 \times 4 = 4$$

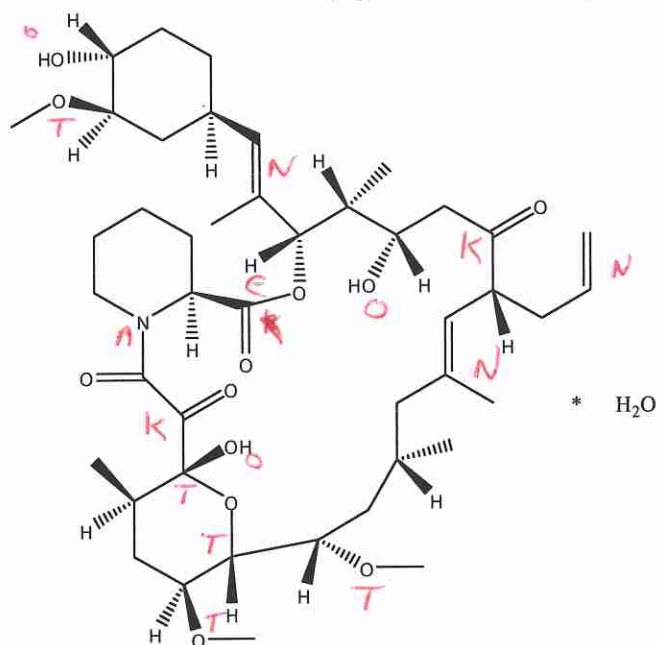
$$\text{H } 1 \times 3 = 3$$



18e⁻



8) Given below is tacrolimus. Identify the following functional groups (if present.) If the functional group is present more than once, you only have to indicate it one time. Indicate a ketone with a K. An ester with an E. An alcohol with an O. An ether with a T. An amide with an A. An alkene with an N. (2 pts. each, 12 total)



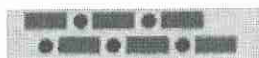
9) Indicate TWO of the types of crystals below by writing in the blank after their structure. (4 pts.)



polycrystals



amorphous



solvate

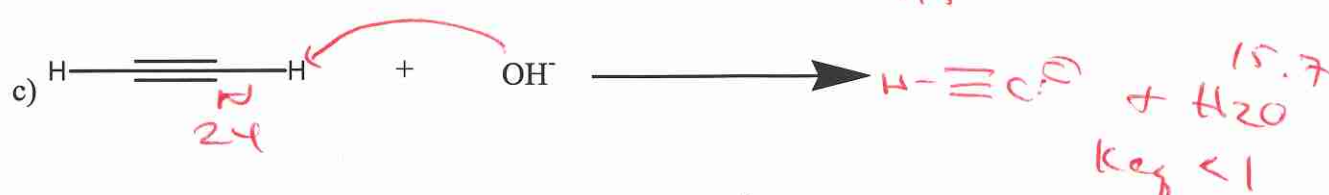
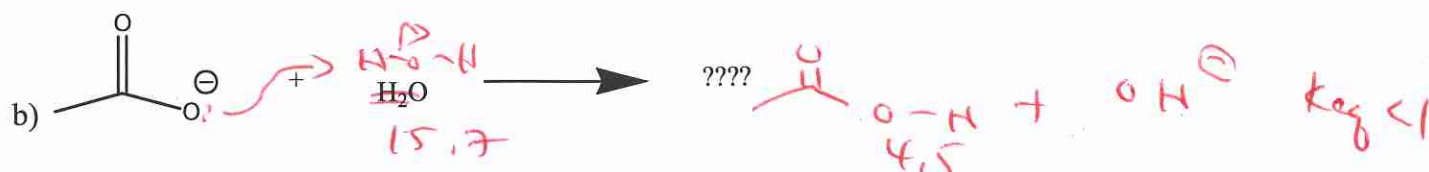
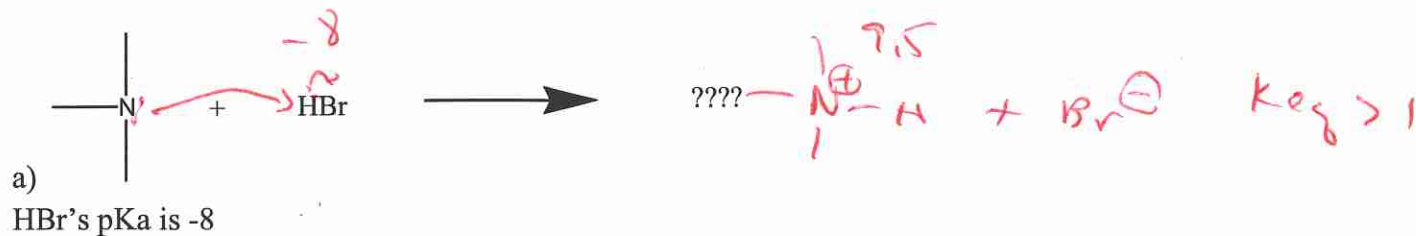


salt

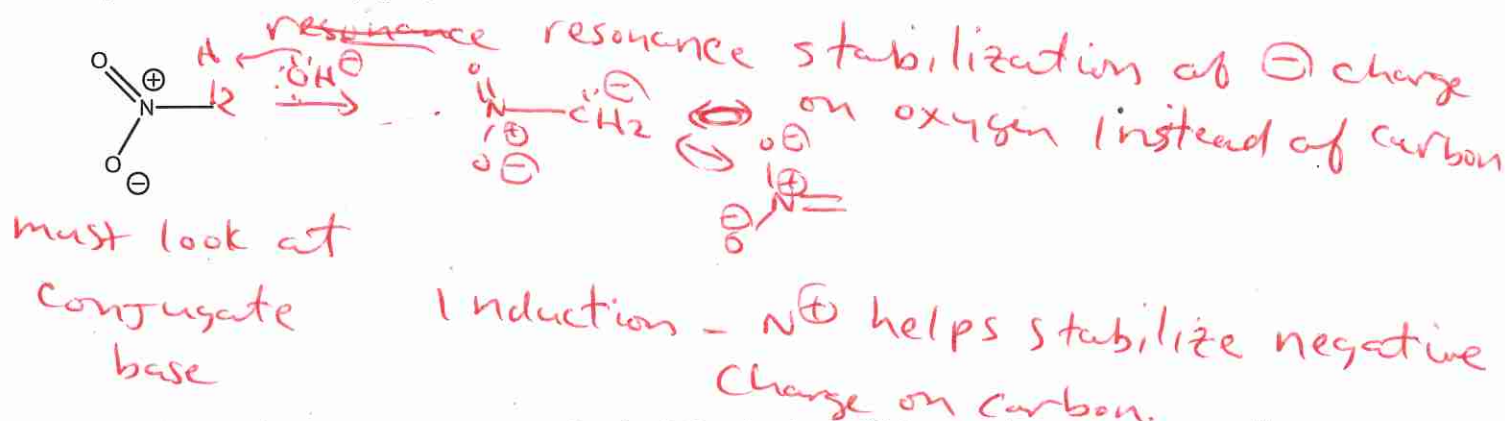


cocrystal

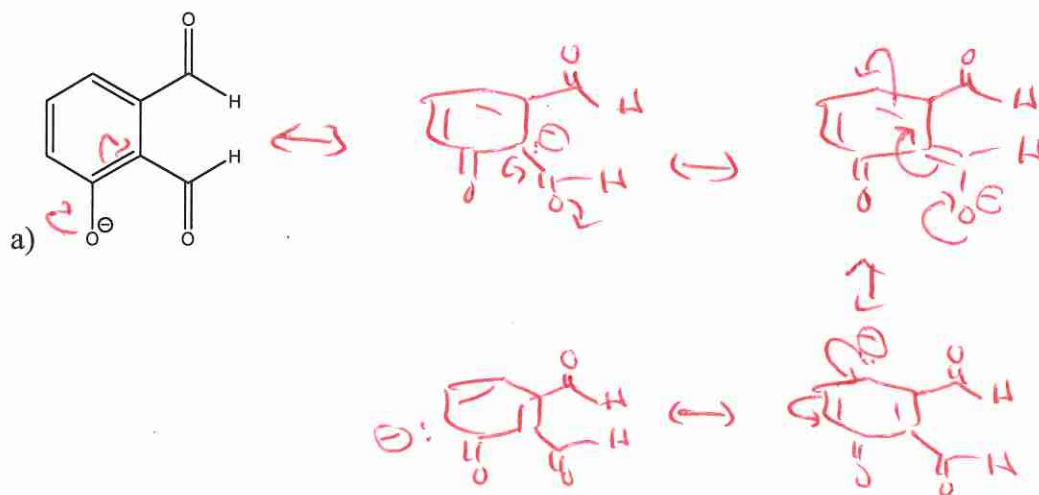
10) Given below are Bronsted-Lowry reactions. Inspect the reaction and draw the products. If no reaction is possible, indicate no reaction. Indicate if the K_{eq} is $>$ or < 1 . (3 pts. each)

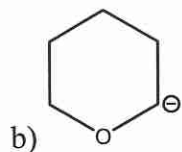


11) Nitromethane (shown below) has hydrogens on an sp^3 hybridized carbon. The protons have a pK_a of 5 which is very acidic. Explain why the protons are acidic compared to normal sp^3 hybridized carbons. (4 pts.)



12) Give another resonance structure for the following ions. Write no other resonance contributor if no other resonance contributor exists. (3 pts. each)

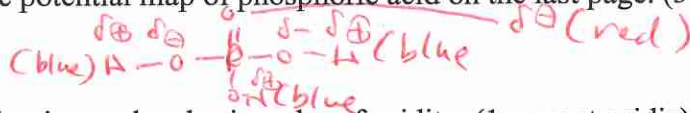




no other resonance contributors



13) a) Indicate where the hydrogens (marked with an H) are on the electrostatic potential map of phosphoric acid on the last page. (3 pts.) b) Indicate where an oxygen (marked with an O) is on the electrostatic potential map of phosphoric acid on the last page. (3 pts.)



14) Put the following molecules in order of acidity. (1 = most acidic) (5 pts.)

HF

HCl

HBr

HI



4

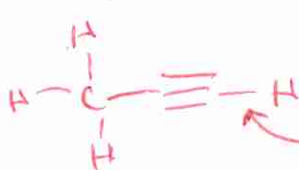
3

2

1

5

15) a) How many sigma bonds are there for the alkyne in question # 14? b) How many pi bonds? c) How many delta bonds? d) Which bond is the shortest? (4 pts.)



a) 6 σ 3) 0 δ

2) 2 π 4) # C-H bond (sp-s)

16) Free Question: Give something you studied that was not asked on this test. (4 pts.)

