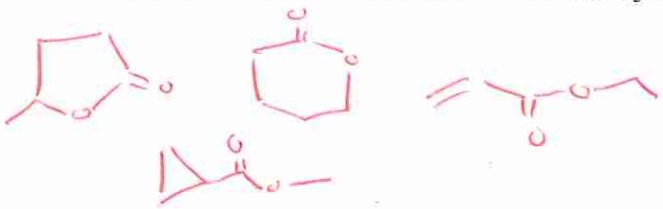
Assignment # 4
Organic 211
Fall 2020

Name:_____

1) Draw 4 compounds that are esters and that have the molecular formula $C_5H_8O_2$.

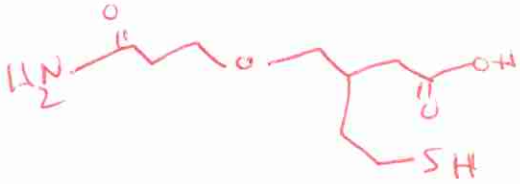
C_5H_{12}
C_5H_8
$4/2 = 2°$ of unsaturation
C=O is 1 so either a ring or C=C

lots of possibilities

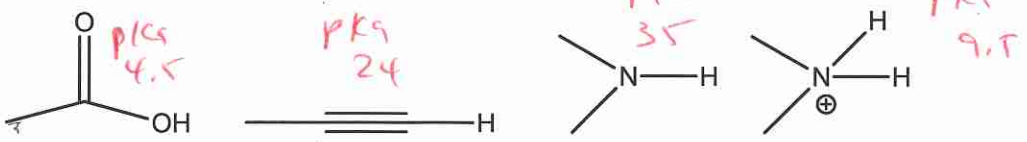


2) Draw a single molecule that contains an ether, carboxylic acid, amide, and thiol.

lots of possibilities



3) Put the following compound in order from most acidic (= 1) to least acidic (= 5).



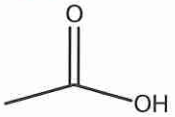
pKa 4.5 pKa 24 pKa 35 pKa 9.5 pKa 44

∴ 1 > 2 > 3 > 4 > 5

4) For the following three Bronsted/Lowry reactions, draw the products and specify whether the equilibrium lies towards the reactants (Keq < 1) or products (Keq >1). Indicate also if no reaction is possible.

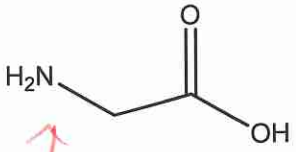
a) $^-CH_3$ + NH_3 ⟶ CH_4 + NH_2^- Keq > 1
base (B) acid (A) pKa 35 pKa 51
CA CB

b) NH_3 + H_2O ⟶ NH_4^+ + OH^- Keq < 1
B A pKa 15.7 CA pKa 9.1 CB

c)  + OH^- ⟶  + H_2O Keq > 1
A B pKa 4.5 CB CA pKa 15.7

5) Given below is glycine. Give a pH value for a solution in which glycine will look as depicted below. (amine as free base and carboxylic acid as acid)

NO pH!



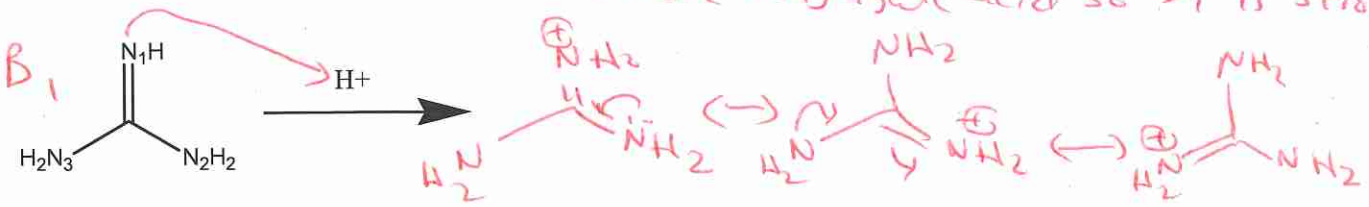
carboxylic acid means pH < 4.5

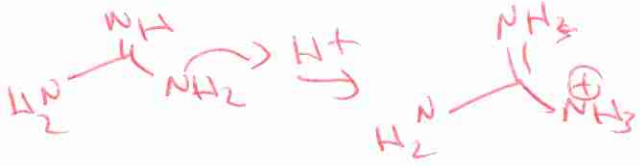
You cannot be below 4.5 & above 9.5

amine as free base means pH > 9.5

6) Guanidine (shown below) is a strong base. Reaction with a proton occurs on nitrogen 1, not nitrogen 2 or 3. (Numbers are to identify the nitrogens and not to indicate how many amines that are present.) Explain why guanidine is a strong base. Resonance structures may (or ~~may not~~) help.

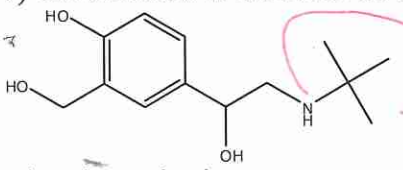
stable conjugate acid so B_1 is strong base





only resonance structure possible so will add to N_1 first.

7) Given below is albuterol as the free base. It is sold as the sulfate salt for asthma inhalers.



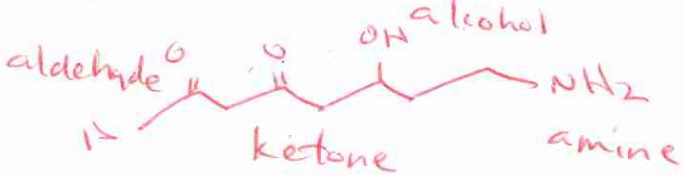
Give the major ion present at a pH of 4.

pKa 9.5

so pH 4 is protonated form.

8) Draw a molecule with four different functional groups.

lots of possibilities !

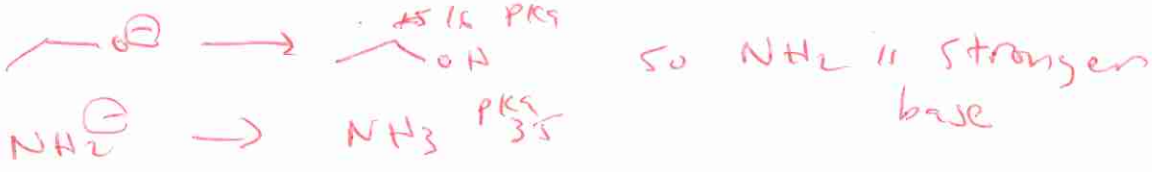


9) Define polar. difference > 0.5 in electronegativity

e.g. CH_3-O-H (3.5, 2.1) 1.4 means polar

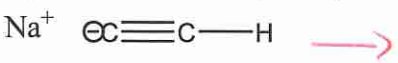
10) Which is the stronger base in each of the following pairs?

a) Sodium ethoxide ($NaOCH_2CH_3$) or sodium amide ($NaNH_2$)



so NH_2 is stronger base

b) Sodium acetylide (below) or sodium amide



pKa 35

$NH_2^- \rightarrow NH_3$

pKa 24

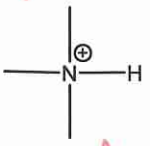
$\therefore NH_2^-$

c) Sodium acetylide or sodium ethoxide

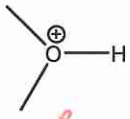
24 vs 16

10) a) Which is the stronger acid below? Explain your answer.

pKa ≈ 9.5 pKa ≈ -2



A



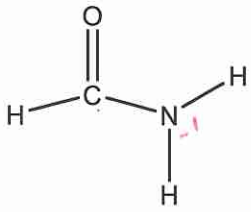
B

B is stronger acid due to oxygen not wanting ⊕ charge due to higher electronegativity

11) Hypochlorous and hypobromous acid (HOCl and HOBr) are weak acids. Predict which one is the strongest acid and explain why.

Cl is more electronegative: helps stabilize ⊖ better.

12) Formamide is given below.Answer the following questions.



a) Draw a resonance contributor of formamide.

b) Draw a conjugate base of formamide.

c) Draw a conjugate acid of formamide.