Chemistry 231 Name(s):

Exercise 1: Review of general chemistry ideas

You may work individually or in groups on exercises. Exercises may be turned in individually or as a group, but make sure that your name does not show up on two different papers!

1. Draw the **Lewis (electron) dot structure** for HCO_3^-. Be careful about the connectivity! Don't forget the **lone pairs** and give the **formal charges**, if any, of atoms on the ion. Finally, draw the overall **dipole moment**, if any, as an arrow.

b. Give the **hybridization** of the carbon and each oxygen in the bicarbonate ion (what you drew above). You may label the oxygens "O_a", "O_b" and "O_c" to keep them separate.

c. According to **VSEPR theory** (and the hybridization of atomic orbitals), what is the **predicted shape** of the bicarbonate ion at the carbon atom? at the oxygen atom?

d. Will the oxygen-carbon-oxygen **bond angles** be **ideal**? If some or all of them are not ideal, describe whether the angle will be greater than or less than ideal. Finally, what about the ion allows you to conclude that the bond angles are not ideal?

e. Are all the carbon-oxygen bonds the same **length** and same **strength**? If not, then which carbon-oxygen bond is the a) shortest and b) strongest?
f. Write the **equilibrium** reactions of the **protonation**/**deprotonation** of bicarbonate ion. There should be two reactions.

g. The pK_a of the bicarbonate ion is 10.2. Given your chemical equations above, what form of this substance should predominate at physiological pH (pH = 7.2)? There is one other pK_a you will need to look up in Appendix II of the textbook.

2. Which of the following compounds is the stronger acid? Give a justification for your answer!

$CH_3C(Cl)HCH_2COOH$ or $CH_3CH_2C(Cl)HCOOH$

3. You are making a 0.100 M acetic acid/ 0.100 M sodium acetate buffer. Initially, you will mix 5.00 mL of each of the two solutions to make 10.00 mL of buffer.

a. Calculate the **theoretical pH** of this $HC_2H_3O_2/NaC_2H_3O_2$ buffer (Buffer A) without any added acid or base. Note that Appendix II in the textbook may provide a helpful number. Why is your answer not surprising?

b. The buffer needs to be adjusted to pH 5.0. You cannot change the concentrations of the stock solutions. How would you go about making 10.00 mL of this buffer, adjusted to pH 5.0?