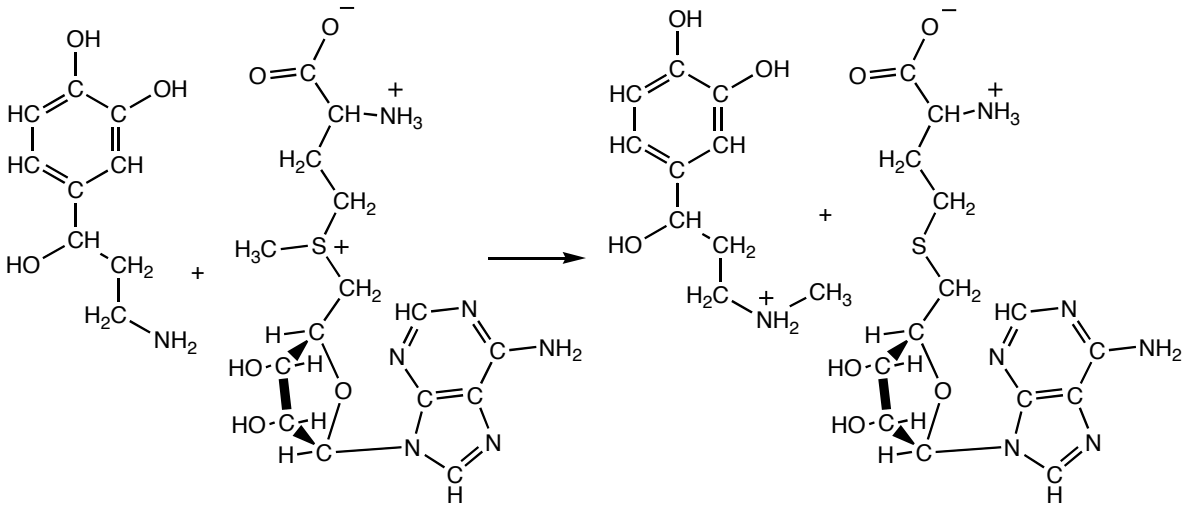
Name _____ Test 1

PHYS 0213 (Biochem) Spring 2006

1. The following reaction is an example of a nucleophilic substitution.



a. (3 pts.) Identify the atom that is acting as the nucleophile (circle and label it).

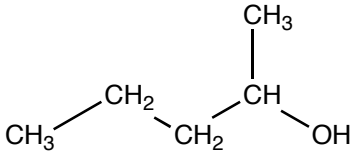
b. (3 pts.) Explain why the atom circled in part a can act as a nucleophile.

c. (3 pts.) Circle and label the atom, ion, or molecule that is acting as the leaving group.

2. a. (3 pts.) Name the functional groups on the following molecules.

b. (3 pts.) Identify the most electrophilic (electron deficient) C atom on each molecule.

c. (3 pts.) Identify the most nucleophilic atom on each molecule.

i. 

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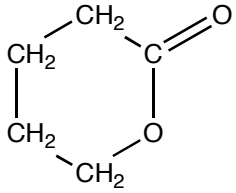
ii. 

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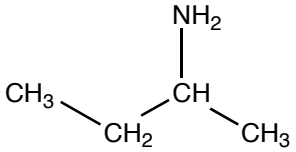
iii. 

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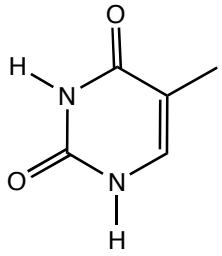
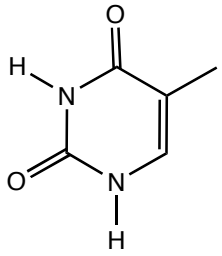
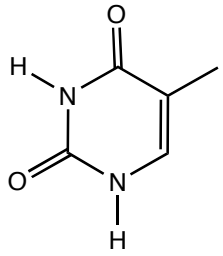
3. A molecule of thymine is drawn below.

a. (3 pts.) There are how many H atoms on a molecule of thymine?

b. (3 pts.) Identify any elements that have at least one lone pair of electrons.	c. (3 pts.) Identify any H atom that can be donated into a hydrogen bond.	d. (3 pts.) Identify any element that <u>could</u> act as an H-bond acceptor.
		

e. (4 pts.) Draw two resonance structures for thymine.

4. (6 pts.) The class of molecules known as fatty acids derives its name from the two traits that all fatty acids share. Describe how the structure of a fatty acid gives rise to these traits.

5. (3 pts. ea.) Determine which if any of the following solutions would be buffers.

a. A solution made by combining 0.5 mol of the weak acid CH_3CO_2H and 0.2 mol of the strong base NaOH in 1 L of water.

b. A solution made by combing 0.03 mmol of the weak acid NaH_2PO_4 with 0.03 mmol Na_2HPO_4 in 50 mL of water.

c. A solution made by combining 0.5 mmol of the strong acid HCl with 0.5 of its conjugate base Cl^- in 100 mL of water.

6. (8 pts.) In addition to the pH of a buffer, describe two attributes that should be considered when designing a buffer for biochemical studies. Please make your descriptions concise.

7. (8 pts.) What is so darn special about water? Pick one of the following topics and write a concise explanation or description: water's thermal stability, water's role in acid-base chemistry, water's role as a solvent, the density of liquid water as compared to the density of solid water, which is called "*ice*" by some people. (Notice that word "concise" again… use details where appropriate, but please don't ramble like I am now.)

8. a. (3 pts.) Think about what you feel when you hold your hands near a fire. From your point of view, are you absorbing energy from the fire or are you releasing energy to the fire?

b. (3 pts.) What's the fire doing energy wise, absorbing or releasing?

c. (4 pts.) ΔH for the fire is less than zero or greater than zero? Explain, from a product–reactant energy content point of view, why the sign of your answer makes sense.

9. (8 pts.) What is ΔG° or $\Delta G^{\circ\prime}$ good for; that is, can the value tell us whether a specific reaction will occur spontaneously? If not, what can it tell us? Feel free to relate ΔG° to other thermodynamic quantities of interest if it will help your explanation.

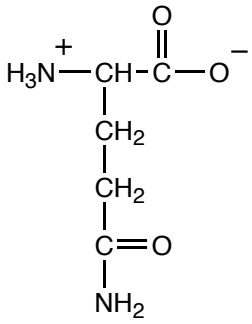
10. It is impossible for a reaction to have a negative ΔS.
    a. (6 pts.) Using terms like order or randomness, explain what the previous assertion means.

    b. (6 pts.) Is the statement true? Explain.

11. (12 pts.) Provide the names, abbreviations and structures for a non-polar amino acid and a basic amino acid. Do not concern yourself with the stereochemistry of the amino acids that you draw. Remember to label the amino acids as non-polar or basic.

12. At physiological pH, glutamine exists as the ammonium carboxylate drawn to the right.

a. (4 pts.) Explain why the nitrogen in the side chain remains unprotonated.

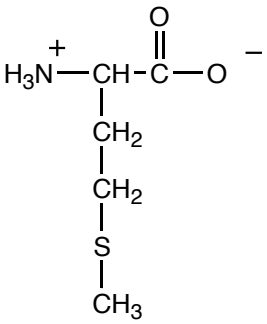


b. (4 pts.) The side chain on a glutamine residue can interact with other molecules using what kinds of intermolecular forces?

13. (6 pts.) For a so-called "salt bridge" to form, what kinds of amino acid side chains need to be close to each other?

14. a. (6 pts.) Describe a disulfide link in a protein; that is, is the link a non-covalent interaction or is it a covalent bond, and is the link stronger or weaker than a hydrogen bond?

b. (6 pts.) Can methionine, drawn to the right, form disulfide links? Explain.



c. (4 pts.) What can methionine do that other amino acids in its class can't?