Biochemistry I Fall 2015 Exam 1 Dr. Stone Name_____

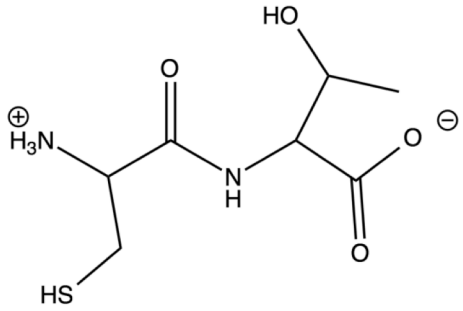
Ka for acetic acid = 1.74×10^{-5} Ka for formic acid, $CH_2O_2 = 1.78 \times 10^{-4}$ Ka for lactic acid, $C_3H_6O_3 = 1.41 \times 10^{-4}$	Ka = [H+][A-]/[HA] pH = pKa + log [A-]/[HA] Ka for $H_3PO_4 = 7.5 \times 10^{-3}$
Kw = [H+][OH-]= 1×10^{-14}	Ka for $H_2PO_4^- = 1.38 \times 10^{-7}$
Ka for $H_2CO_3 = 2.7 \times 10^{-4}$	Ka for $HPO4^{-2} = 3.98 \times 10^{-13}$
Keq for the formation of carbonic acid from carbon dioxide and water= 0.003 (K_h) at 37°C	K for dissolving $CO_{2\,(g)}$ in water at 37°C: 0.23 (conversion from kPa to mM)

Multiple choice: 10 questions, worth 2 points each. Circle the correct answers.

1) The three-dimensional structure of macromolecules is formed and maintained primarily through noncovalent interactions. Which one of the following is *not* considered a noncovalent interaction?

A) carbon-carbon bonds
B) hydrogen bonds
C) hydrophobic interactions
D) ionic interactions
E) van der Waals interactions

2) What functional groups are present on this molecule?



A) ether, amide, alchohol, phenyl
B) primary amine, ketone, seondary amine, primary alcohol, thiol
C) primary alcohol, primary amine, amide, carboxylic acid, thiol
D) primary alcohol, amide, phenyl ring, alkene, thiol
E) primary alcohol, ketone , amine, alkene, thiol

3) What is the relationship between Keq and ΔG°'?
A) There is a direct logrithmic relationship between Keq and ΔG°'.
B) There is an inverse logrithmic relationship between Keq and ΔG°'
C) There is no relationship Keq and ΔG°'.
D) There is an inverse relationship between Keq and ΔG°'
E) There is an increase in entropy.

4) Stereoisomers that are due to a double bond are known as:

A) anomers.
B) cis-trans isomers.
C) diastereoisomers.
D) enantiomers.
E) geometric isomers.

5) If the free energy change ΔG for a reaction is 12.34 kJ/mol, the reaction is:
A) at equilibrium.
B) endergonic.
C) endothermic.
D) exergonic.
E) exothermic.
F) Increases entropy
G) Decreases entropy

6) Enzymes are biological catalysts that enhance the rate of a reaction by:
A) decreasing the activation energy.
B) decreasing the amount of free energy released.
C) increasing the activation energy.
D) increasing the amount of free energy released.
E) increasing the energy of the transition state.

7) In ice, each water molecule forms hydrogen bonds with four other water molecules, as compared to liquid water in which each water molecule forms hydrogen bonds with 3.4 other water molecules. A consequence of this is that

A) ice is more dense that water
B) water has a relatively low boiling point
C) water has a relatively high melting point
D) water turning into ice is a spontaneous reaction because more hydrogen bonds are involved in ice.
E) None of these, or more than one of these, circle all correct answers.

8) Which of the following is/are true about hydrogen bonds? Circle all of the correct answers.
A) Hydrogen bonds are longer and stronger than covalent bonds.
B) The geometry of a water molecule results in the equal sharing of electrons
C) Hydrogen bonds must involve at least one water molecule.
D) Polar molecules are soluble in water because they can form hydrogen bonds with water molecules.
E) Ion-dipole interactions are stronger than hydrogen bonds.
F) Induced dipole-induced dipole interactions are stronger than hydrogen bonds.

9) Osmosis is water movement across a semi-permeable membrane. Which of the following is **true** about water movement across cell membranes?
A) In a hypotonic solution, cells will shrink.
B) In an isotonic solution, cells will shrink.
C) In a hypertonic solution, cells will shrink.
D) Cells can neither shrink nor swell because water cannot penetrate the plasma membrane.
E) There is an decrease in enthalpy.

10) Micellles are characteristic of what type of molecules:
A) non polar
B) charged
C) amphipathic
D) polar
E) amphiprotic

11) A dynamic steady state results when
A) there is no net energy transfer
B) an organism is at equilibrium with its surroundings.
C) there is no net energy transfer.
D) the rate of intake or synthesis of a molecule equals the rate of its disappearance.
E) None of these, or more than one of these, circle all correct answers.

12) Which of the following is an example of hydrophobic interactions:
I. Soap molecules form micelles
II. Water dissolves sodium chloride
III. Membrane lipids form a bilayer
IV. Ethanol dissolves in water
a. I and III b. II and IV c. I,II, and III d. IVonly e.none of these

13) Carbonic anhydrase is an important enzyme in red blood cells. It is involved in the reaction of carbon dioxide and water to form carbonic acid. What is the effect of carbonic anhydrase on the equilibrium constant, Kh and the standard free energy change (ΔG°') for this reaction?

a. Carbonic anhydrase increases the Kh and decreases ΔG°'
b. Carbonic anhydrase decreases the Kh and decreases ΔG°'
c. Carbonic anhydrase increases the Kh and increases ΔG°'
d. Carbonic anhydrase decreases the Kh and increases ΔG°'
e. Carbonic anhydrase has no effect on Kh or tΔG°'

14) Which of the following describes what a buffer is and what it does? Circle all of the correct statements:

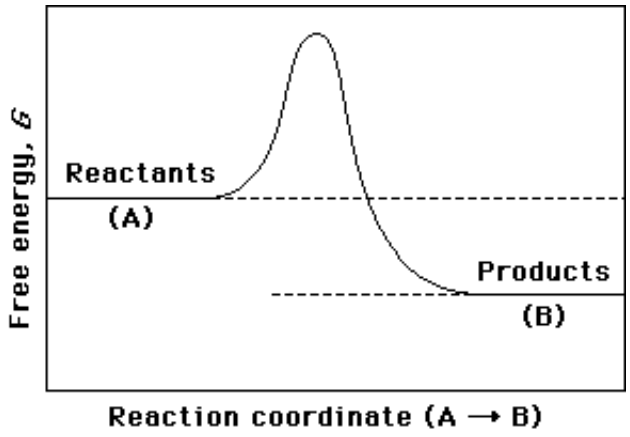
A) Buffers are solutions that have an acid and a base
B) Buffers resist pH change
C) Buffers are solutions that have a weak acid and a base
D) Buffers maintain neutral solutions
E) Buffers resist pH change so that the pH is neutral
F) Buffers are solutions that have a weak acid and its conjugate base
G) Buffers neutralize reactions

V. (4 points) Matching amino acid side chains with Intermolecular forces. Which IMF exists between the side chains (R groups) of each pair of amino acids, write the Roman numeral for the IMF in front of the amino acid pair. Each IMF may be used more than once.

_____a. W and T	I. Ionic (salt bridge)
_____b. L and F	II. Ion-dipole
_____c. Q and E	III. Hydrogen bond
_____d. D and R	IV. Induced dipole-induced dipole (London dispersion)

VI. (5 points) On the reaction coordinate diagram shown below, **label** the transition state and **label** the overall free-energy change (ΔG) for the uncatalyzed reaction A → B.

a. Is this an exergonic or endergonic reaction?
b. Draw a second curve showing the energetics of the reaction if it were enzyme-catalyzed.



Problem section. Show all of your work. No work= no points.

15) (15 points) Draw the titration curve for the titration of 20 mL of a 0.15 M solution of glutamate (pka_1 = 2.19, pKa_2 = 9.67) with 0.18 M sodium hydroxide. Clearly label the axes of your graph in mL of sodium hydroxide added. Be sure to include pH values and volumes for the following: Start of the titration (no sodium hydroxide added), the pH at the volume that is half of the volume of the endpoint, pH and volume at the end point of the titration, the pH of the solution when 1 more mL of the sodium hydroxide (past the final end point) has been added. Show all of your calculations.

VII. (10 points) A 67 year old, 50 kg female is brought into the ER. The patient is awake and breathing very rapidly (panting) and is very agitated. Dr. House orders blood gases and blood pH to be determined. The results of the tests indicate that the patient has metabolic acidosis. Dr. House did not take his Chemistry II seriously, so now you need to help him save his patient.

Normal values:	Patient values:
pH 7.4	pH 7.0
HCO_3^- 24 mM	
CO_2 1.2 mM	CO_2 1.0 mM

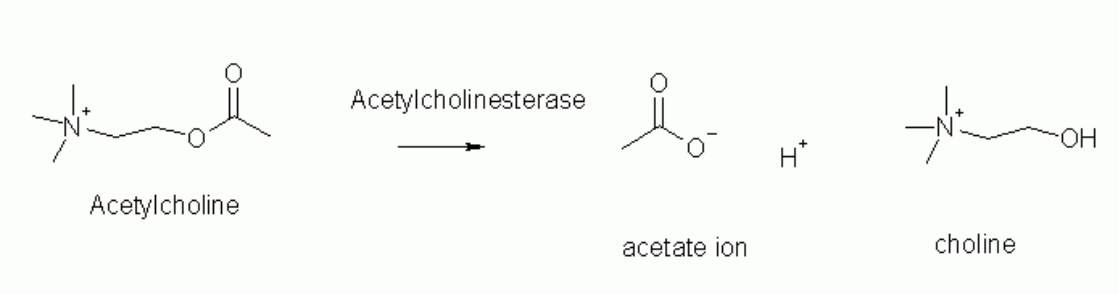
a. What effect does breathing rapidly (panting) have on blood pH? Explain.

b. Determine the amount of bicarbonate (mM) in the patient's blood.

c. How much bicarbonate should be administered to this patient. Her total blood volume is 4.0L. The bicarbonate is supplied in ampules (little glass vials) that contain 1mEq (milli-equivalent) per mL. Each ampule has 25 mEq. For bicarbonate, 1mmole = 1 mEq. How many vials of bicarbonate should be given to this patient?

VIII. (10 points) If 150 mL of a 0.2M phosphate buffer at pH 6.5 has a new pH of 7.8 after some volume of 0.18 M sodium hydroxide was added, what volume of 0.18 M sodium hydroxide was added?

IX. (5 points) Acetylcholine is a neurotransmitter that is degraded by acetylcholinesterase to form acetic acid and choline, as shown below. If a 10 mL sample of acetylcholine at pH 7.52 was incubated with acetylcholinesterase and the new pH was 6.94, determine the number of moles of acetylcholine present in the 10 mL sample.



X. (20 points) Draw the **structures** and give the **names** and **one letter codes** for these amino acids. Also, indicate if the R group is polar or non polar and give the pKa for any ionizable R groups

One letter code	Name	Structure	polar or non polar?	pKa of R group

a. Leu

b. His

c. Thr

d.Ser

XI. (10 points) Draw the structure for the tripeptide HPI that predominates at pH=7.

XII. (5 points) What is the pI for the tripeptide HPI? The pKa for the carboxy terminus is 3.4, the pKa for the amino terminus is 8.