Biochemistry I Fall 2013 Exam 1 Dr. Stone 100 points 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]
Kw = [H+][OH-]= 1×10^{-14}	pH = pKa + log [A-]/[HA]
Ka for $H_2PO_4^-$ = 1.38×10^{-7}	Ka for $H_3PO_4 = 7.5 \times 10^{-3}$
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 in water at 37°C: 0.23 this is the conversion from mPa (gas) to mM (dissovlved)

Put your answers on this exam

Multiple choice questions, use the best correct answers, circle them on this paper. Each question is worth 3 points.

1. Why is cell size limited by O_2 diffusion?

a. Cells must have a small surface area to volume ratio, so that oxygen cannot reach all of the inside cell volume.
b. Cells must have a small surface area to volume ratio, so that oxygen can reach all of the inside cell volume. c. Cells must have a large surface area to volume ratio, so that oxygen does not reach all of the inside cell volume.
d. Cells must have a large surface area to volume ratio, so that oxygen can reach all of the inside cell volume.
e. none of these

2. What is a kilodalton (kDa)? What is it used to represent?

a. 1 x 10-3 grams, mass of proteins
b. 1 x 10-3 grams/mole, molar mass of proteins
c. 1000 daltons, mass of biological molecules
d 1000 g/mol, molar mass of a large biological molecule
e. None of these

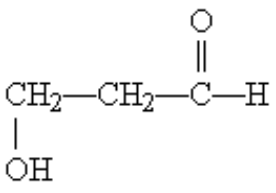
3. What is the relationship between Keq and ΔG°?

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 a direct relationship between Keq and ΔG°.
d. There is no relationship Keq and ΔG°.
e. There is an inverse relationship between Keq and ΔG°.

4. 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

5. What functional groups are present on this molecule?



1. ether and aldehyde
2. hydroxyl and aldehyde
3. hydroxyl and carboxylic acid
4. hydroxyl and ester
5. hydroxyl and ketone

6. 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. IV only e. none of these

7. 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, K_h and the standard free energy change ($\Delta G°'$) for this reaction?
   a. Carbonic anhydrase increases the K_h and decreases $\Delta G°'$
   b. Carbonic anhydrase decreases the K_h and decreases $\Delta G°'$
   c. Carbonic anhydrase increases the K_h and increases $\Delta G°'$
   d. Carbonic anhydrase decreases the K_h and increases $\Delta G°'$
   e. Carbonic anhydrase has no effect on K_h or $t\Delta G°'$

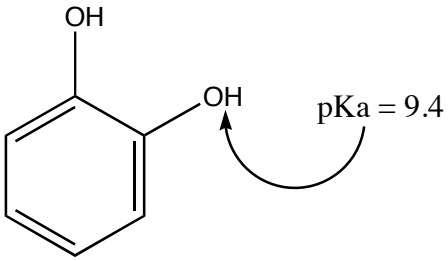
Short answer section:

8. (10 points) Put the following solutions in order from lowest pH to highest pH: 0.1 M sodium hydroxide, 0.1 M formic acid, 0.1 M sodium acetate, 0.1 M acetic acid, 0.1 M nitric acid. Put your answers on the answer blanks provided.

Lowest pH Highest pH

_____ _____ _____ _____ _____

9. (10 points total) Catechol is a major component of plants and it is one of the major toxins in cigarette smoke. Using the structure at pH 7, shown below, **explain (5 points)** why it is more soluble in 0.1M sodium hydroxide than it is in pure water. **What intermolecular forces are involved (5 points)?**



catechol

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

10. (15 points) Draw the titration curve for the titration of 10 mL of a 0.2 M solution of leucine with 0.1 M sodium hydroxide. Clearly label the axes of your graph. 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 each endpoint, pH and volume at the final end point of the titration. The pKa values for the carboxy terminus and amino terminus are 2.36 and 9.60.

11. (10 points) An unconscious, 67 year old, 50 kg female is brought into the ER. Dr. Dewgi orders blood gases and blood pH to be determined. The results of the tests indicate that the patient has metabolic acidosis. Dr. Dewgi did not take his Chemistry II seriously, (he was too busy being awesome), so now you need to help him save his patient.

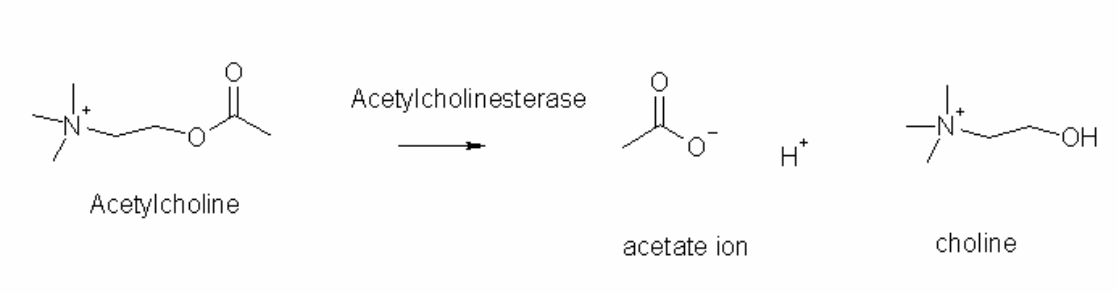
Normal values:	Patient values:
pH 7.4	pH 6.9
HCO_3^- 24 mM	
CO_2 (g) 5.12 mPa	CO_2 1.1
mPa	

a. Determine the amount of bicarbonate in the patient's blood.

b. Should this patient be given sodium bicarbonate? Why or why not?

12. (10 points) If 300 mL of a 0.15 M phosphate buffer at pH 6.9 has a new pH of 7.6 after some volume of 0.1M sodium hydroxide was added, how many mL of 0.1M sodium hydroxide was added?

13. (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 7.31 was incubated with acetylcholinesterase and the new pH was 6.87, determine the number of moles of acetylcholine present in the 10 mL sample.



14. (25 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.	Glu				
b.	Asn				
c.	Tyr				
d.	His				
e.	Trp				

15. (10 points) Draw the structure and calculate the pI for the following peptide, the carboxy terminus pKa = 3.4, the amino terminus pKa= 7.96: TPKQ