BCH 4053 **HOUR TEST 1** **NAME**_____
January 31, 2001

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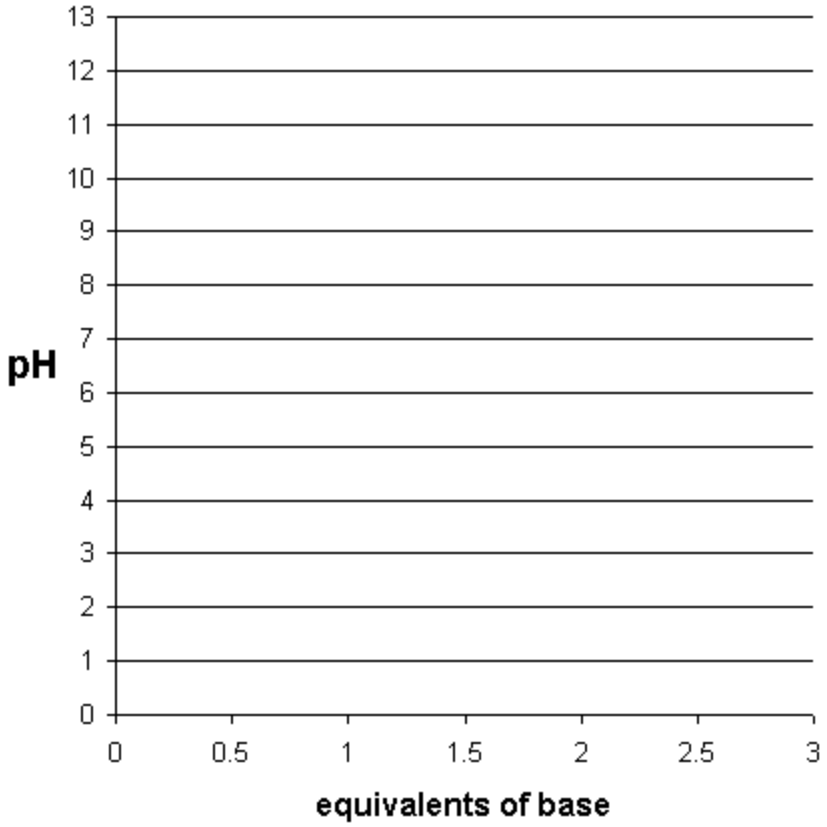
(10) 1. Vitamin C (ascorbic acid) is a diprotic acid, with dissociation constants: $pK_1 = 4.1$; $pK_2 = 11.8$. If vitamin C were excreted in the urine of a patient, and the urine had a pH of 4.5, what **fraction** of the vitamin would carry a negative charge? (Note: I am asking for a **fraction** and not a **ratio**).

(14) 2. Draw a titration curve for **cysteine** on the graph below.
(a) Locate and identify the points on the curve corresponding to **pK_1**, **pK_2**, and **pK_3**.
(b) Calculate the approximate **pI** value and locate its position on the curve.
(c) Indicate the pH region of the graph in which the **side chain functional group** is more than 75% charged.



(9) 3. **Underline** the following peptides which are negatively charged at pH 7.0. **Circle** each amino acid which is **aromatic**. Put an **X** through each amino acid that contains a **sulfur atom**.

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(12) 4. Fill in the following table with the appropriate $[H^+]$, pH, and $[OH^-]$ values:

Solution	**$[H^+]$**	**pH**	**$[OH^-]$**
2.1×10^{-3} HCl			
4.9×10^{-5} NaOH			
3.6×10^{-9} HBr			
0.05 M acetic acid ($pK_a = 4.8$)			

(12) 5. You have a solution of 500 mL of 0.24 M formate buffer with a pH of 4.45. **The pK of formic acid is 3.75.** To this solution you add 40.0 mL of 1.0 M hydrochloric acid. What is the final pH of the solution? (Show your work).

(7) 6. Draw the full structure of the following peptide and indicate on the structure the pK of each group with a dissociable proton. Calculate the pI of the peptide.

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(4) 7. Peptide A has a pI of 9.5. Peptide B has a pI of 6.0. Put a check by each of the following statements which is true.

____ Both peptides will bind to an anion exchange resin at pH 7.
____ Both peptides will bind to a cation exchange resin at pH 7.
____ Peptide A will bind to a cation exchange resin at pH 7.
____ Peptide B will bind to a cation exchange resin at pH 7.
____ Peptide A will bind to an anion exchange resin at pH 7.
____ Peptide B will bind to an anion exchange resin at pH 7.
____ Both peptides will bind to an anion exchange resin at pH 4.
____ Both peptides will bind to a cation exchange resin at pH 4.

(6) 8. In the hydrophobic effect, the association of non-polar groups in water is spontaneous. Therefore ΔG for the process is _____ (negative or positive?). The association occurs primarily because the water is more disordered in the state where the non-polar groups are associated. Therefore the overall ΔS for the process is _____ (negative or positive?). Lowering the temperature in this case would _____ (increase or decrease) the strength of the hydrophobic bonding? (Hint: How would ΔG be affected?)

(8) 9. What are the "biological standard states" for:

(a) water?

(b) oxygen?

(c) hydrogen ion?

(d) ATP?

Use the following standard free energies of hydrolysis to answer questions 10 and 11.

Compound	$\Delta G^{o'}$ (kJ/mol)	Compound	$\Delta G^{o'}$ (kJ/mol)
phosphoenolpyruvate	-62.2	glucose-1-phosphate	-21.0
acetyl phosphate	-43.3	glucose-6-phosphate	-13.9
ATP	-30.5	glycerol-3-phosphate	-9.2
Creatine phosphate	-43.3	Pyrophosphate	-33.6

(12) 10. One of the reactions of glycolysis producing ATP is the reaction of ADP with phosphoenolpyruvate as follows:

phosphoenolpyruvate + ADP $\rightleftarrows$ pyruvate + ATP

(a) Calculate $\Delta G^{o'}$ and **K'** for this reaction as written. (**R = 8.315 J/mol-K. Assume body temperature --37 ^{o}C or 310 K**)

(b) What would **Q'** and ΔG be for the reaction if the [ATP]/[ADP] ratio were 50 and the [phosphoenolpyruvate]/[pyruvate] ratio were 0.010?

(6) 11. Tell whether each of the following reactions is **spontaneous** or **non-spontaneous** as written.

_____ (a) glucose + acetyl-phosphate $\rightleftarrows$ glucose-6-phosphate + acetate

_____ (b) glucose-6-phosphate $\rightleftarrows$ glucose-1-phosphate

_____ (c) creatine phosphate + ADP $\rightleftarrows$ creatine + ATP