



CHEM 2770: Elements of Biochemistry Mid-Term EXAMINATION VERSION A

Date: October 29, 2014

Instructor: H. Perreault

Location: 172 Schultz

Time: 4 or 6 pm. Duration: 1 hour

Instructions

- Please mark the Answer Sheet using **PENCIL ONLY**.
 - Enter your **NAME** and **STUDENT NUMBER** on the Answer Sheet.
 - The exam consists of multiple choice questions. Enter your answers on the Answer Sheet.
 - There is only 1 correct answer for each question.
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1. If the free energy change ΔG for a reaction is +55 kJ/mol, the reaction is:

- A) at equilibrium **B) endergonic** C) endothermic D) exergonic E) exothermic.

2. ΔS is:

- A) A thermodynamic state function
B) the heat transferred at constant pressure and volume.
C) a measure of disorder in a system.
D) a measure of disorder change in a system
E) equal to $\Delta G - T\Delta H$

3. Table salt (NaCl) dissolves spontaneously in water at room temperature because:

- A) well ordered solid NaCl becomes disordered as Na^+ and Cl^- ions are solvated (ΔS positive).**
B) Na and Cl are very reactive with water, causing an exothermic effect (ΔH negative).
C) Na and Cl are very electronegative and tend to recombine.
D) Na^+ and Cl^- are held by H-bonds and water has high affinity for this system.
E) Table salt is unstable at room temperature and needs water to stabilize its crystals.

4. In micelles: ***This question is not counted, as the printing company skipped E, the correct answer 😊***

- A) polar ends form hydrophobic interactions with water.
B) nonpolar ends form hydrophilic interactions with water
C) hydrocarbon tails form hydrophobic interactions with water.
D) polar ends are hydrophobic and nonpolar ends are hydrophilic.

5. The molar concentration of protons in solution, $[H^+]$, corresponds to:

- A) $-\log[H^+]$ B) pH C) 10^{pH} **D) 10^{-pH}** E) $14 - [OH^-]$

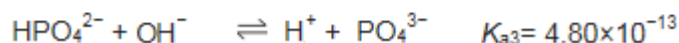
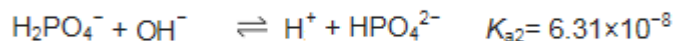
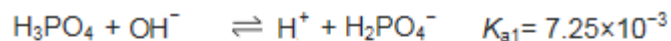
6. A cola drink at pH 2.5 contains about _____ times as much H^+ as orange juice at pH 4.3.

- A) 0.016 B) $10^{-8.5}$ C) 1.72 **D) 63** E) 32

7. When $pH = pK_a$ on a titration curve, this corresponds to:

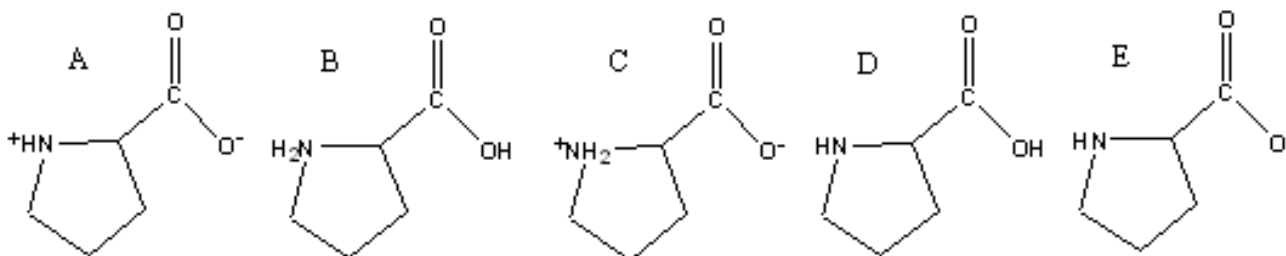
- A) The equivalence point
B) The centre of the buffering zone
C) The isoelectric point
D) The end of the titration
E) Neutrality of the pH

8. Given the following K_a values for phosphoric acid, which weak acid/conjugate base pair would be best as a buffer to approach physiological pH?



- A) H_3PO_4/HPO_4^{2-} B) $H_3PO_4/H_2PO_4^-$ **C) $H_2PO_4^-/HPO_4^{2-}$** D) HPO_4^{2-}/H_3PO_4

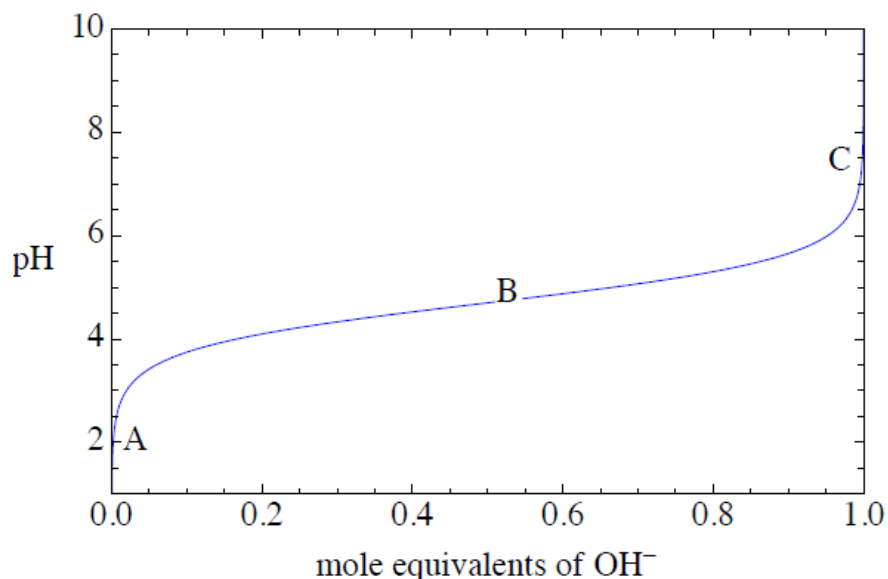
9. Titration of proline by a strong base, for example NaOH, reveals two pK' 's, $pK_1 = 2.00$ and $pK_2 = 10.60$. What is the main species present at pH 6.30? **The answer is C**



10. What is the pH of a serine solution in which the $-\text{NH}_3^+$ group (pK_a 9.2) is one-tenth dissociated?

- A) 8.24 B) 8.20 C) 9.15 D) 10.20 E) pK_a of carboxyl needed to solve problem

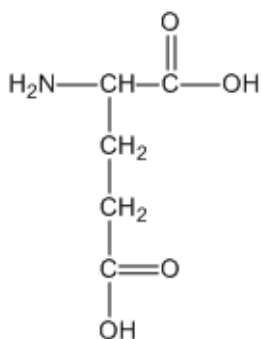
11. Which statement about the following titration curve is CORRECT?



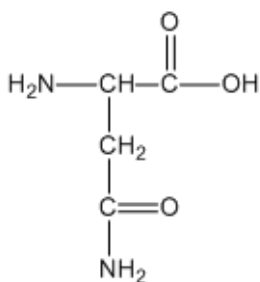
- A) Point "B" is the equivalence point.
 B) The pK_a of the compound is about 6.
C) At point "C" the fraction of conjugate base is high.
 D) At point "A" the compound exists mainly in the conjugate base form.
 E) The compound being titrated is an amino acid.

12. Which of the following amino acids has more than one chiral carbon? **The answer is D**

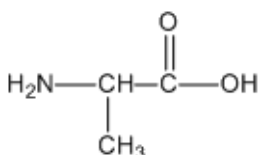
A) Glutamic acid



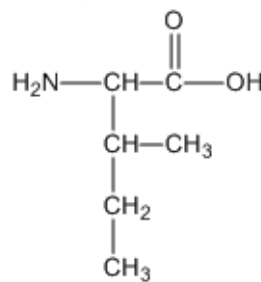
B) Asparagine



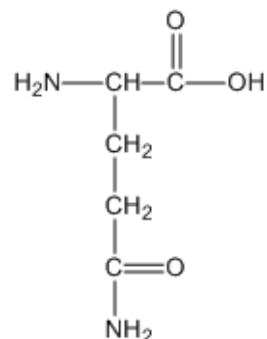
C) Alanine



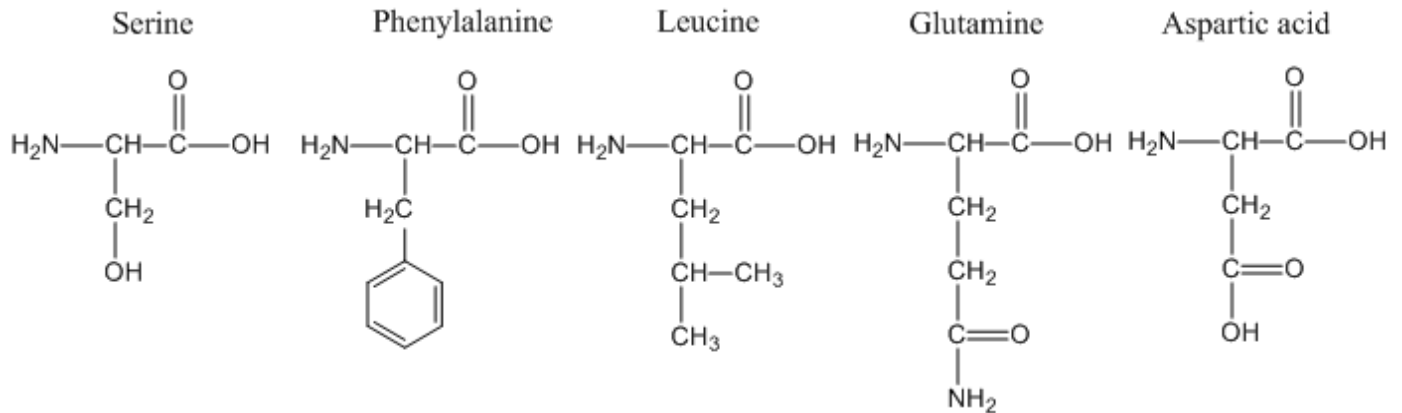
D) Isoleucine



E) Glutamine



13. Which 2 amino acids would most likely participate in the hydrophobic effect? **Answer: B**



- A) Ser and Gln B) Phe and Leu C) Asp and Gln D) Ser and Leu E) Asp and Phe

14. Identify the INCORRECT statement:

- A) Leucine and isoleucine are the D and L isomers of leucine.**
 B) The α -helix is one possible conformation of a polypeptide.
 C) Peptides can adopt many conformations because of rotation about single covalent bonds.
 D) Unfolding or denaturation of a protein usually leads to a loss of biological activity.
 E) In order to catalyze a reaction, enzymes undergo conformation changes to obtain the proper orientation of the active-site amino acids.

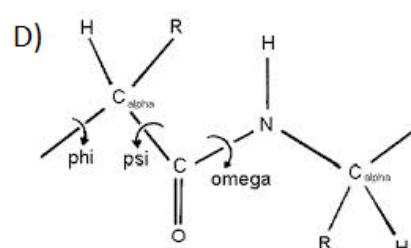
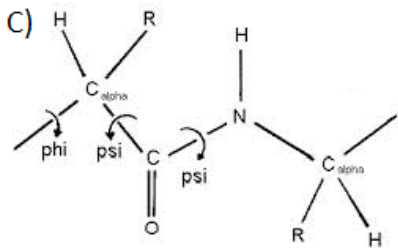
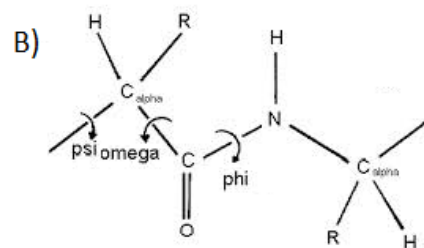
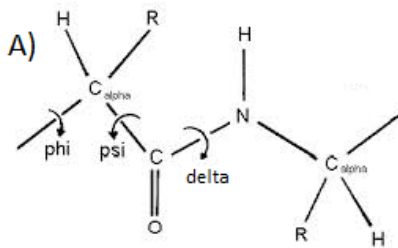
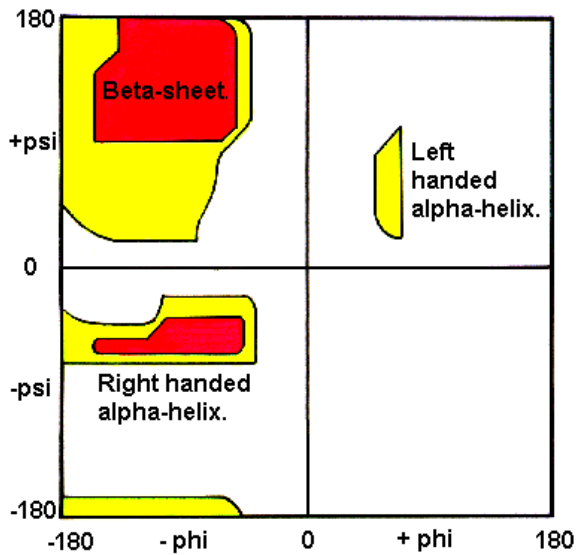
15. Which statement is true for beta pleated-sheet secondary structures?

- A) Amino acid side chains are found in the same plane as the beta sheet.
 B) All proteins contain beta sheets.
 C) Each amino acid forms H-bonds with the amino acid at relative position 4 down the chain.
D) Beta turns are necessary for antiparallel chains to interact through H-bonds
 E) Torsion angles psi and phi both equal -60° .

16. In amino acid analysis, ninhydrin performs which function?

- A) It is used to hydrolyze a protein into individual amino acid components.
 B) It acts as an ion exchange resin used to separate the individual amino acids.
C) It reacts with each amino acid producing a distinctly different colour used to measure the amounts of each amino acid
 D) It is used as a standard to calibrate ϵ in Beer's Law.
 E) Ninhydrin is an enzyme used to cut a protein into smaller peptides.

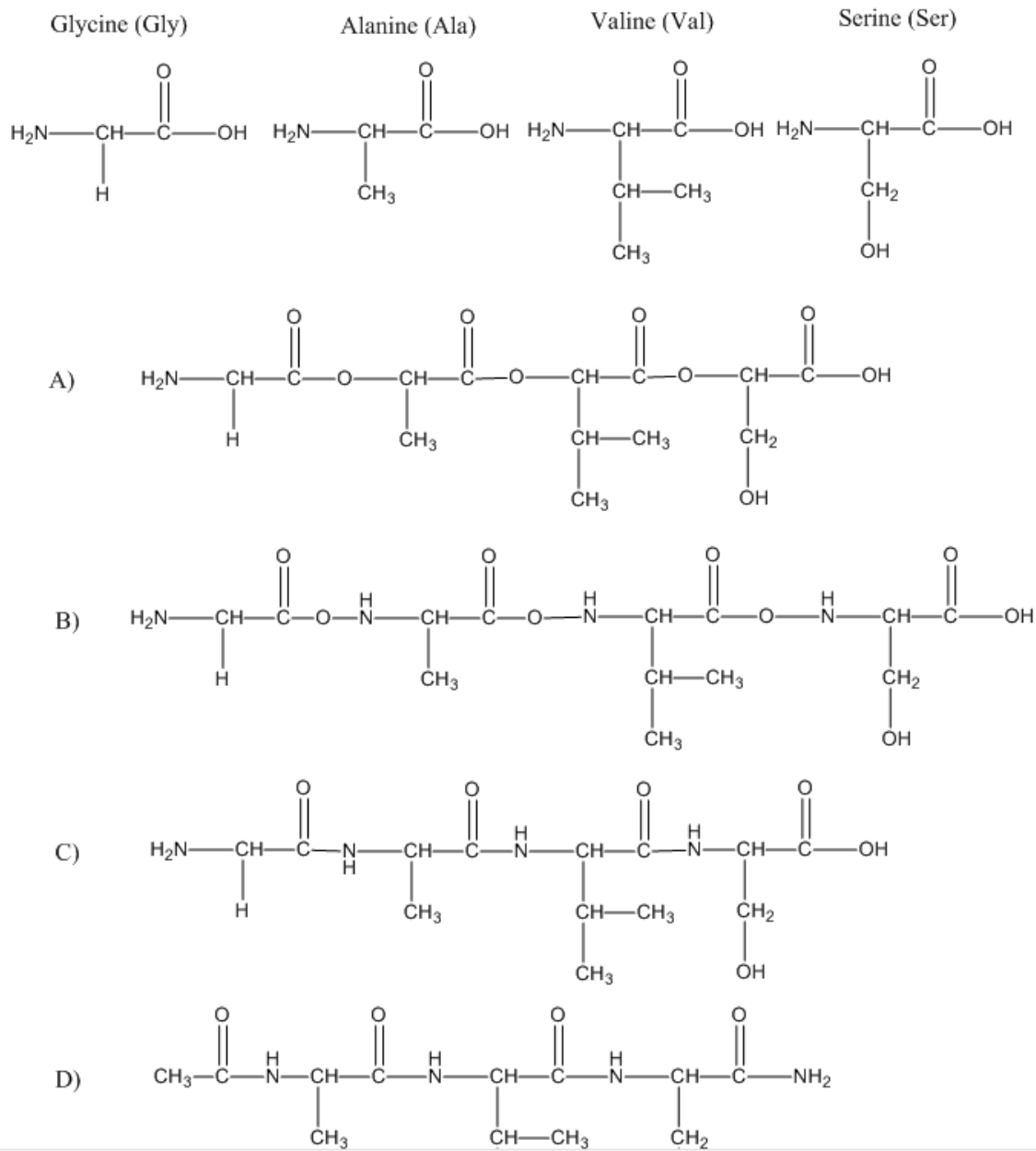
17. The diagram below is a Ramachandran plot. Which of the 5 molecular models corresponds best to the significance of this diagram when the torsion angle other than phi and psi is constant at 180° ? **D**



18. In a mixture of the five proteins listed below, which should electrophorese fastest in SDS-PAGE?

- A) cytochrome *c* $M_r = 13,000$
- B) immunoglobulin G $M_r = 145,000$
- C) calmodulin $M_r = 16,700$
- D) RNA polymerase $M_r = 450,000$
- E) serum albumin $M_r = 68,500$

19. Given the amino acids glycine, alanine, valine and serine, the peptide Gly-Ala-Val-Ser would look like: **C**



20. For any enzyme that follows simple Michaelis-Menten kinetics, when V_o of the reaction is 60% of V_{max} what is the substrate concentration?

- A) $[S] = 1.5K_m$ B) $[S] \ll K_m$ C) $[S] = 3K_m$ D) $[S] = 0.75K_m$ E) $[S] = K_m$

21. Identify the INCORRECT statement about enzymes:

- A) Enzymes are catalysts.
- B) Enzymes are highly specific, binding only one or a few substrate molecules.
- C) Enzymes will not catalyze a reaction if they are denatured.
- D) Enzymes accelerate reaction rates by binding substrates tightly.**
- E) Enzymes can be regulated.

22. The following data were obtained in a study of an enzyme known to follow Michaelis-Menten kinetics:

V_0 ($\mu\text{mol}/\text{min}$)	Conc. substrate (μM)
0.627	0.005
2.91	0.025

The V_{max} and K_m for this enzyme are approximately:

- A) 25 $\mu\text{mol}/\text{min}$ and 0.005 mM. *(all K_m units should be in μM)*
- B) 32 $\mu\text{mol}/\text{min}$ and 0.25 mM.**
- C) 16 $\mu\text{mol}/\text{min}$ and 0.25 mM.
- D) 16 mmol/min and 0.005 mM.
- E) 32 mmol/min and 2.5 mM.

23. Regarding enzyme-catalyzed reactions, only one statement is CORRECT:

- A) The rate of a reaction depends on the difference in free energy between the products and substrates.
- B) The rate of an enzyme-catalyzed reaction is unaffected by temperature.
- C) In an enzyme-catalyzed reaction the equilibrium constant K_{eq} is independent of the path taken by the substrates.**
- D) Forward rate constants are always equal to reverse rate constants.
- E) V_{max} is the same for all enzymes if they are at the same concentration.

24. An enzyme-catalyzed reaction is slowed down by an inhibitor. In the laboratory, the K_m value found is larger than without the inhibitor. V_{max} has not changed. What kind of inhibitor is it?

- A) Allosteric
- B) Allosteric-competitive
- C) Competitive**
- D) Non-competitive
- E) Allosteric and non-competitive

25. For the reaction:



The equilibrium constant K_{eq} is 0.5. Is this reaction:

- A) Catalytic **B) Endergonic** C) Exergonic D) Cannot determine

$R = 8.314 \text{ Joules/mol.K}$

$T = 298 \text{ K}$

Please hand in questionnaire + answer sheet.