



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

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.

1. The entropy S is:

- A) the substrate in an enzyme-catalyzed reaction
- 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 $\Delta G - T\Delta H$

2. 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

3. In micelles:

- 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.
- E) hydrocarbon tails are excluded from the water into hydrophobic domains.**

4. 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 repel each other.
- 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.

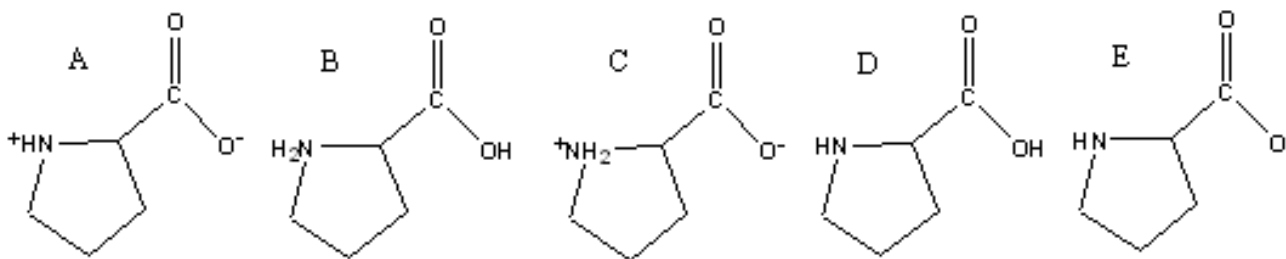
5. Orange juice at pH 4.3 contains about _____ times less H^+ as a cola drink at pH 2.5.

- A) 16 B) $10^{-8.5}$ C) 1.72 D) 32 E) **63**

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

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

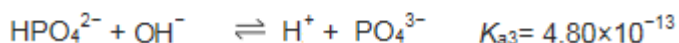
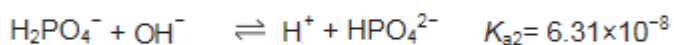
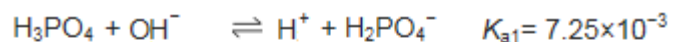
7. Titration of proline by a strong base, for example NaOH, reveals two pK' 's, $pK_1 = 2.00$ and $pK_2 = 10.60$. What is the main species present at pH 6.30? **Answer: C**



8. When there is a large pH jump on a titration curve, this corresponds to:

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

9. 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?

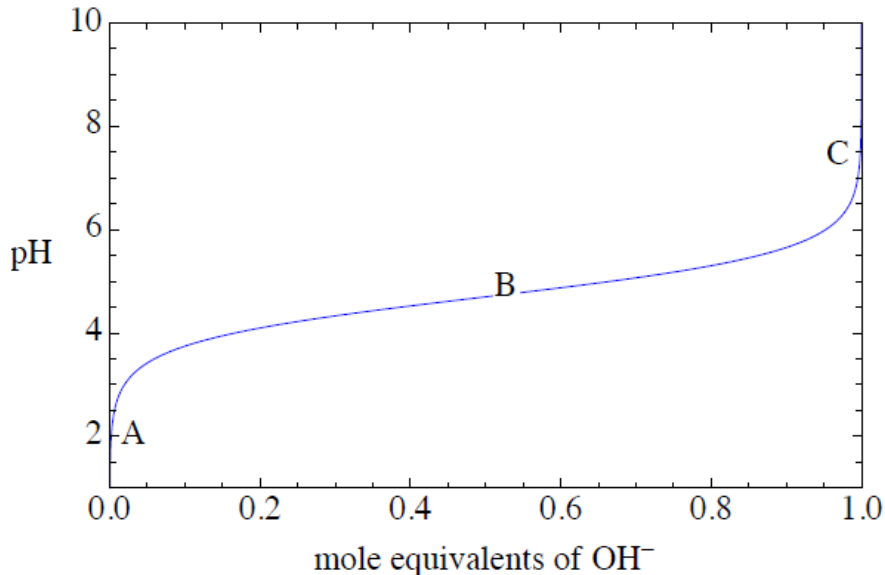


- A) **$H_2PO_4^- / HPO_4^{2-}$** B) H_3PO_4 / HPO_4^{2-} C) $H_3PO_4 / H_2PO_4^-$ D) HPO_4^{2-} / H_3PO_4

10. What is the pH of a serine solution in which the -NH_3^+ group (pK_a 9.2) is one-fifth dissociated?

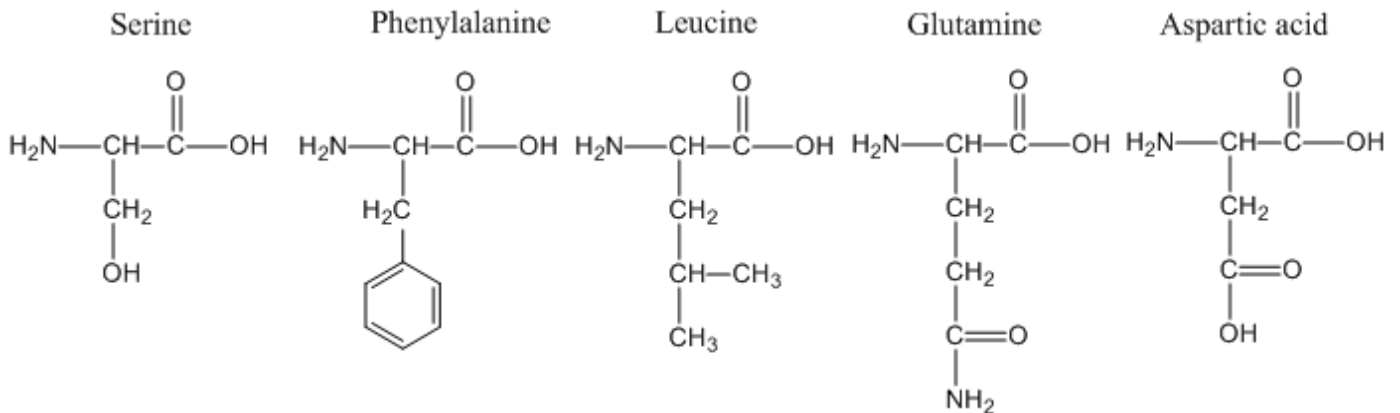
- A) 9.90 B) 8.50 C) 9.80 **D) 8.60** E) pK_a of carboxyl needed to solve problem

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



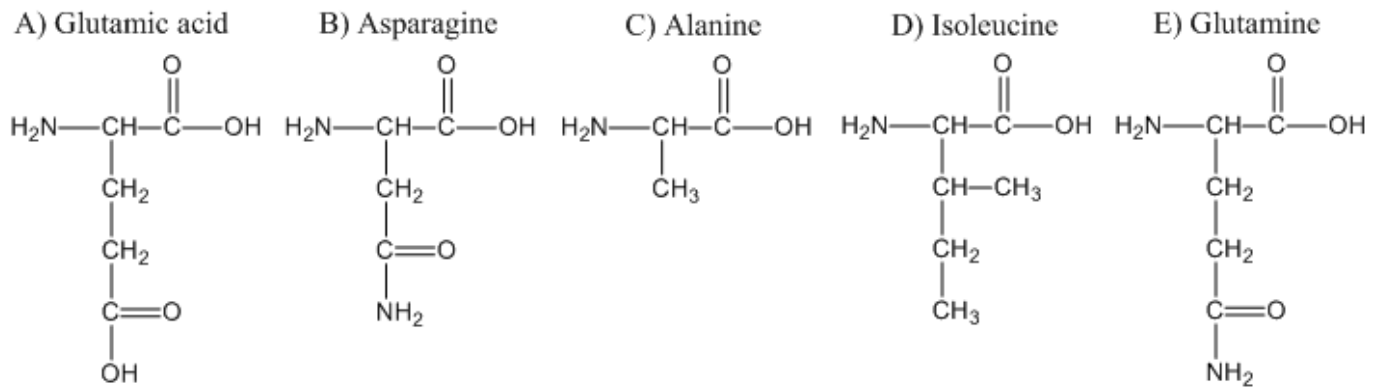
- A) Point "C" is the equivalence point.
 B) The pK_a of the compound is about 4.6.
 C) At point "C" the fraction of conjugate base is high.
D) At point "A" the compound exists mainly in the conjugate weak acid. (I accepted both D and E as "conjugate weak acid" does not make sense)
 E) The compound being titrated is an amino acid.

12. 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

13. Which of the following amino acids has more than one chiral carbon? **Answer: D**



14. Identify the CORRECT statement:

- A) β -sheets define the tertiary structure of a protein.
- B) The α -helix is the primary structure of a polypeptide.
- C) Peptides can adopt many conformations because of rotation about single covalent bonds.**
- D) Unfolding or denaturation of a protein usually does not lead to a loss of biological activity.
- E) Enzymes are very rigid proteins that cannot undergo conformation changes.

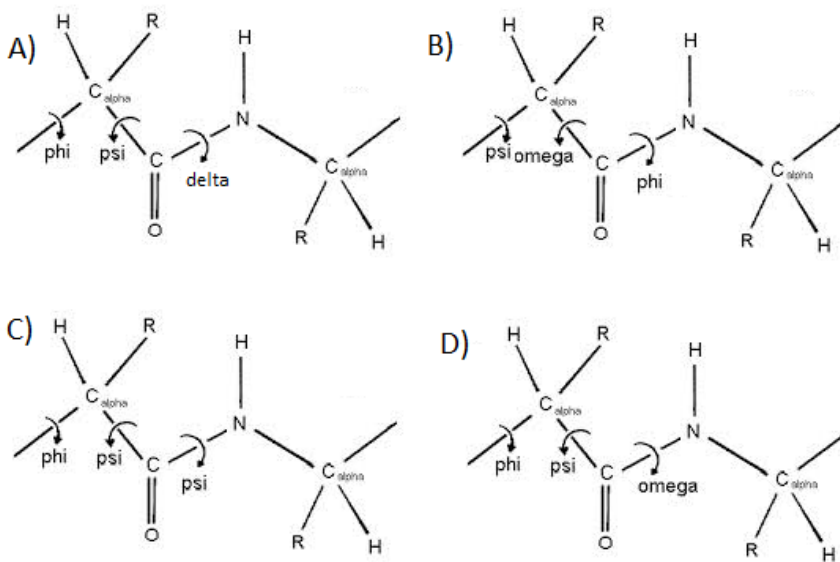
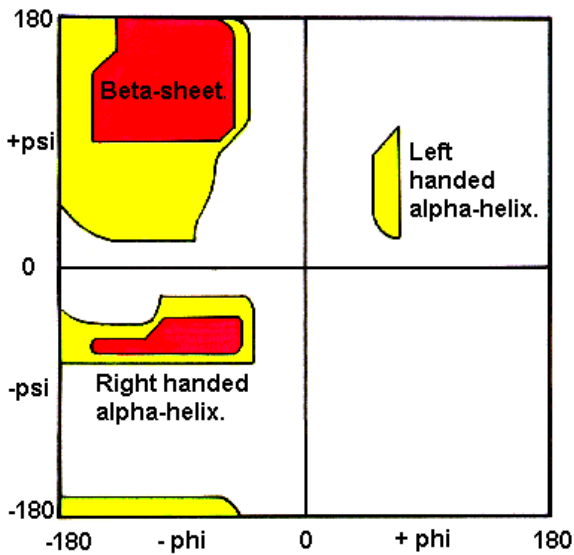
15. In amino acid analysis, trypsin performs which function?

- 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) Trypsin is an enzyme used to cut a protein into smaller peptides.**

16. 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 ψ and ϕ both equal -60° .

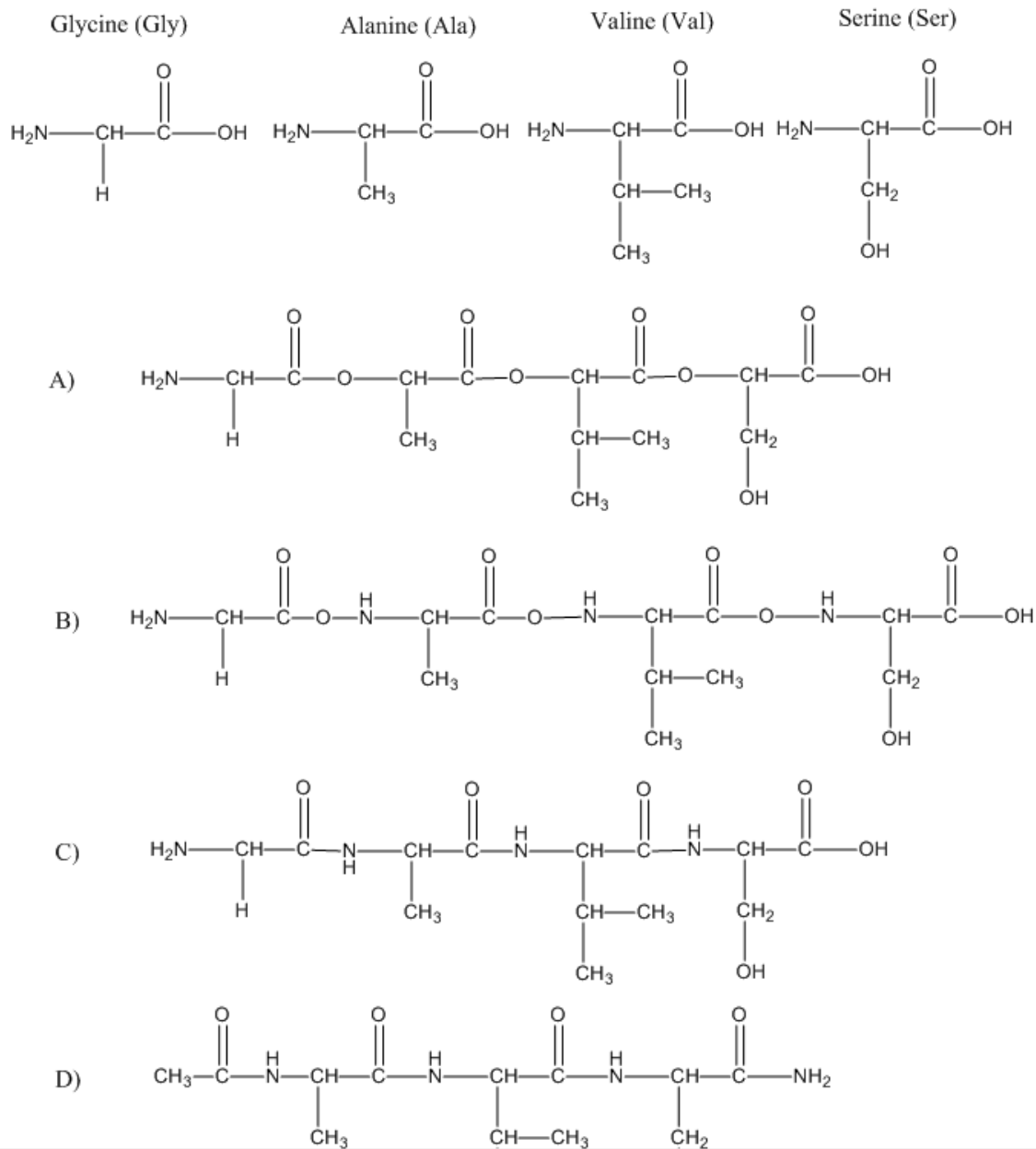
17. The diagram below is a Ramachandran plot. Which of the 5 molecular models corresponds best to the significance of this diagram when the torsion angle other than phi and psi is constant at 180°? **D**



18. In a mixture of the five proteins listed below, which should electrophorese slowest 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: **Answer: C**



20. For any enzyme that follows simple Michaelis-Menten kinetics, when V_o of the reaction is 40% of V_{max} what is the substrate concentration? **Question not counted because answer is $[S]=0.66K_m$.**

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

21. 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) 32 mmol/min and 2.5 mM. (here K_m units should be μM)
- B) 25 $\mu\text{mol}/\text{min}$ and 0.005 mM.
- C) 32 $\mu\text{mol}/\text{min}$ and 0.25 mM.**
- D) 16 $\mu\text{mol}/\text{min}$ and 0.25 mM.
- E) 16 mmol/min and 0.005 mM.

22. Identify the CORRECT statement about enzymes:

- A) All proteins can function as enzymes.
- B) Enzymes are not very specific, binding several types of substrate molecules.
- C) Enzymes will catalyze a reaction even if they are denatured.
- D) Enzymes accelerate reaction rates by binding substrates tightly.
- E) Enzymes can be regulated.**

23. An enzyme-catalyzed reaction is slowed down by an inhibitor. In the laboratory, the K_m value found equal to K_m without the inhibitor. V_{max} has decreased. What kind of inhibitor is it?

- A) Non-regulated
- B) Allosteric-competitive
- C) Competitive
- D) Non-competitive**

24. 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.

25. For the reaction:



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

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

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

$T = 298 \text{ K}$

Please hand in questionnaire + answer sheet.