

THE UNIVERSITY OF MANITOBA

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Mid-Term EXAMINATION

PAPER NO: _____

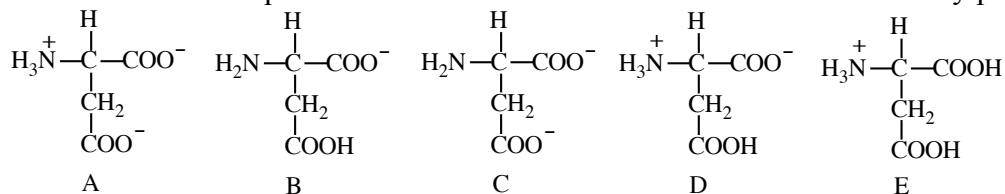
LOCATION: 100 / 225 St. Paul's CollegePAGE NO: 1 of 4DEPARTMENT & COURSE NO: CHEM / MBIO 2770TIME: 1 HOUREXAMINATION: Elements of Biochemistry IEXAMINER: J. O'Neil**Instructions**

- 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.
- **PLEASE READ ALL QUESTIONS CAREFULLY!**

1. Virtually all life on earth depends on energy **ULTIMATELY** from:
 - A) Hydroelectric power
 - B) Activation energy.
 - C) The Greenhouse effect.
 - D) The sun.
 - E) Enthalpy
2. The major essential atoms found in all life forms are:
 - A) Hydrogen, calcium, oxygen, and sodium
 - B) Hydrogen, helium, carbon, oxygen, iron and calcium
 - C) Hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulphur
 - D) Carbon, oxygen, iron, sodium, and nitrogen
 - E) Oxygen, silicon, calcium, beryllium, and nitrogen
3. All are true about hydrophobic interactions **EXCEPT**:
 - A) Hydrophobic interactions result from the strong tendency of water to exclude non-polar groups or molecules.
 - B) Hydrophobic interactions are important in the formation of detergent micelles and the folding of proteins.
 - C) Hydrophobic interactions result from hydrogen bonds between water and the hydrophobic molecules.
 - D) The preferential interactions between water molecules "exclude" hydrophobic substances from aqueous solution and drive the tendency of non-polar molecules to cluster together.
 - E) Hydrophobic interactions result in non-polar regions of biological molecules being buried in the molecule's interior to exclude them from the aqueous milieu.
4. A definition of *pH* is:
 - A) The negative logarithm to the base 10 of the hydrogen ion concentration.
 - B) The power of H.
 - C) $pH = -\ln_e[H^+]$.
 - D) H is enthalpy, the heat energy at constant temperature, pressure, and volume.
 - E) $pK_A = -\log_{10}[K_A]$
5. Buffers have all of the following characteristics **EXCEPT**:
 - A) They have relatively flat titration curves at the pH(s) where they buffer.
 - B) They resist changes in their pH as acid or base is added.
 - C) They are typically composed of a weak acid and its conjugate base.
 - D) They buffer best for polyprotic acids halfway between the two pK_a values.
 - E) They buffer where the amounts of conjugate base are nearly equivalent to the amounts of weak acid.

6. To 80 mL of a 0.1 M solution of isoleucine at $\text{pH} = \text{pK}_a$ for its carboxyl group was added X mL of 0.25M NaOH. The new pH was found to be equal to the pK_a for its amino group. What is the value of X?
- 32 mL
 - 0.025 mL
 - 8.0 mL
 - 40 mL
 - The problem cannot be solved without knowing the pK_a value.

7. Which of the forms of aspartate shown below CANNOT exist in solution at any pH?



8. Glutamic acid has $\text{pK}_{a\text{s}}$ at 2.2, 4.3 and 9.7. Calculate the isoelectric point for glutamic acid.

- 3.25
 - 5.90
 - 6.50
 - 7.00
 - 8.60
9. When preparing an acetate buffer at pH 4.5 with 0.01 M solutions of acetic acid ($\text{pK}_a = 4.8$) and sodium acetate, the volume of acetic acid needed would be _____ the volume of sodium acetate solution.
- Equal to
 - Less than half of
 - More than half of
 - About six times
 - About twice

10. What is the approximate fractional concentrations of $\text{HPO}_4^{2-}/\text{H}_2\text{PO}_4^-$ ($\text{pK}_a = 7.2$) at pH 7.5?

- 1/1
 - 1/2
 - 2/1
 - 1/10
 - 3/1
11. Which of the following pairs would be the best buffer at pH 10.0?
- Acetic acid and sodium acetate ($\text{pK}_a = 4.76$)
 - H_2CO_3 and NaHCO_3 ($\text{pK}_{a\text{s}}$ are 3.77 and 10.4)
 - Lactic acid and sodium lactate ($\text{pK}_a = 3.86$)
 - NaH_2PO_4 and Na_2HPO_4 ($\text{pK}_{a\text{s}}$ are 2.1, 7.2, 12.4)
 - Sodium succinate and succinic acid ($\text{pK}_a = 4.21$)

12. All of the statements about the classification of these amino acids are correct EXCEPT:

- Aspartic acid and asparagine are acidic amino acids.
 - Alanine and valine are neutral, non-polar amino acids.
 - Serine and glutamine are polar, uncharged amino acids.
 - Lysine and arginine are basic amino acids.
 - Tyrosine and phenylalanine are aromatic amino acids.
13. Which of the following amino acids has more than one chiral carbon?
- Serine
 - Lysine
 - Threonine
 - Cysteine
 - Aspartic acid

14. Explain which results would be expected for the breaking of hydrogen bonds and the exposure of hydrophobic groups from the interior during the unfolding process of a protein.
- A) Entropy change, ΔS , is zero
 - B) Enthalpy change, ΔH , is positive
 - C) The reaction is spontaneous
 - D) Enthalpy change, ΔH , is negative
 - E) Entropy change, ΔS , is positive
15. α -Helix and β -strand are components of _____ structure.
- A) Primary
 - B) Secondary
 - C) Tertiary
 - D) Quaternary
 - E) Pentanary
16. Where C_α is the α -carbon, N represents the amide nitrogen and C_o is the carbonyl carbon of amino acids in a peptide, the peptide backbone of a protein consists of the repeated sequence:
- A) $-C_\alpha-N-C_o-$
 - B) $-N-C_o-C_\alpha-$
 - C) $-N-C_\alpha-C_o-$
 - D) $-C_o-C_\alpha-N-$
 - E) None of the above
17. In the beta pleated-sheet, the R-groups of the amino acids ____?
- A) Are found above and below the plane of the sheet.
 - B) Cause only anti-parallel sheets to form.
 - C) Lie in the plane of the sheet.
 - D) Generate H-bonds to stabilize the sheet.
 - E) Stack within the interior of the helix.
18. Which reagent is specific in hydrolyzing only peptide bonds in which the carboxyl function is contributed by a Trp, Tyr, or Phe residue?
- A) Chymotrypsin
 - B) Carboxypeptidase
 - C) Trypsin
 - D) CNBr
 - E) None of the above.
19. Which amino acid acts as a helix breaker due to steric interactions between its side-chain and the carbonyl of the preceding amino acid?
- A) Histidine
 - B) Proline
 - C) Arginine
 - D) Serine
 - E) Tyrosine
20. The unique composition of collagen is accommodated in a structure called a(n):
- A) Triple helix.
 - B) Helix-turn-helix motif.
 - C) Coiled-coils.
 - D) Fibroin
 - E) β -pleated sheet.
21. All of the following functions of an enzyme are true EXCEPT:
- A) Enzymes help to catalyze nearly all metabolic reactions.
 - B) Enzyme activity is sensitive to enzyme and substrate concentration.
 - C) Enzymes are sensitive to temperature and pH changes.
 - D) An increased activity of an enzyme increases the amount of energy produced.
 - E) Enzymes are used as a catalyst to increase reaction rates many orders of magnitude.

22. AMP is an activator of allosteric Phosphofructokinase. It:
- Causes a shift to the right in the sigmoid V_0 vs. $[S]$ curve.
 - Increases the number of T conformations.
 - Decreases the cooperativity of the substrate.
 - Stabilizes the T-state, increasing $S_{0.5}$, and making the curve less sigmoid
 - Stabilizes the R-state, decreasing $S_{0.5}$, and making the curve more sigmoid.
23. The specific site on the enzyme where _____ binds and catalysis occurs is called the _____ site.
- Coenzyme; substrate
 - Substrate; active
 - Coenzyme; regulatory
 - Regulatory; active
 - None of the above
24. All are true for inhibitor I if it is a competitive inhibitor EXCEPT:
- It is structurally similar to the substrate.
 - EI does not give rise to E + P.
 - For a given $[I]$, V_0 decreases.
 - At some point S can displace all of I on E.
 - It binds a site other than the active site.

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

V_0 (mmol/min)	Substrate added (mM)
2	1
12	5
25	10
35	50
44	200
48	500

The K_m for this enzyme is approximately:

- 1 mM.
- 25 M.
- 10 mM.
- 50 mM.
- 25 mM.