

THE UNIVERSITY OF MANITOBA

October 21, 2009

Mid-Term EXAMINATION

PAPER NO: 1 LOCATION: 111 / 204 ArmesPAGE 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!**
 - The last page is scrap paper.
-

1. The set of biochemical reactions that specifically degrade nutrient molecules yielding energy are described as:
 - A) Catabolism.
 - B) Metabolism.
 - C) Condensation.
 - D) Canabolism.
 - E) Anabolism.
2. Identify the **CORRECT** statement about the laws of thermodynamics.
 - A) Entropy change, ΔS , is equal to the heat transferred at constant pressure and volume.
 - B) Energy is the capacity of a system to do work or release heat.
 - C) Enthalpy is a measure of the disorder of a system.
 - D) Heat is the transfer of temperature from a region of low heat to a region of high heat.
 - E) Cells remove free energy from sunlight / nutrients in their surroundings, increasing the order in their surroundings and decreasing the order within themselves.
3. Identify the most polar covalent bond:
 - A) C-H.
 - B) Hydrogen bond.
 - C) O=O.
 - D) O-H.
 - E) C-C---H-C.
4. Identify the process that is **NOT** driven mainly by entropy:
 - A) Protein folding.
 - B) Formation of a detergent micelle.
 - C) Melting of ice.
 - D) Dissolution of sodium chloride.
 - E) H-bond formation.
5. Identify the **CORRECT** statement about hydrogen bonding.
 - A) It is a covalent attraction between polarized molecules containing O-H, N-H, or F-H.
 - B) It is strongest when at a 90 degree angle.
 - C) C=O is a good H-bond donor.
 - D) NH is a good H-bond donor.
 - E) A H-bond is about 28 nm in length.

6. $10^0 = ?$
- 0.1
 - 0
 - 1
 - 2.718281
 - 10.
7. 100 mL of 0.072 M NaOH solution is added to 100 mL of pure water. What is the pH of the resulting solution?
- 12.5
 - 3.6
 - 1.4
 - 7.2
 - $10^{-0.072}$
8. pH = pOH when:
- A pure buffer is present.
 - $[HA] = [A^-]$
 - $[H^+] = [OH^-]$
 - $\log ([HA]/[A^-]) = 1$
 - $[H^+]/[OH^-] = 0$
9. Titration of methionine by a strong acid, for example HCl, reveals two pK_a 's. The titration reaction occurring at pK_2 ($pK_2 = 2.1$) is:
- $-\text{COOH} + \text{OH}^- \rightarrow -\text{COO}^- + \text{H}_2\text{O}$
 - $-\text{COOH} + -\text{NH}_2 \rightarrow -\text{COO}^- + -\text{NH}_2^+$
 - $-\text{COO}^- + \text{H}^+ \rightarrow -\text{COOH}$
 - $-\text{NH}_3^+ + \text{H}^+ \rightarrow -\text{NH}_2 + \text{H}_2\text{O}$
 - $-\text{NH}_2 + \text{H}^+ \rightarrow -\text{NH} + \text{H}_2\text{O}$
10. To 500 mL of a 0.1 M solution of Histidine at $\text{pH} = \text{p}K_a$ for its amino group was added X mL of 0.3 M HCl. The new pH was found to be equal to the pI of Histidine. What is the value of X?
- 83.3 mL
 - 166.6 mL
 - 249.9 mL
 - 333.2 mL
 - 1000.0 mL
11. A buffer solution is prepared by mixing 60 mL of 0.6 M sodium propionate and 40 mL of 0.2 M propionic acid. What is the pH of the buffer solution prepared? (pK_a for propionic acid = 4.88).
- 3.38
 - 4.22
 - 4.88
 - 5.53
 - 6.43
12. What is the pH of a solution of the amino acid taurine in which the $\alpha\text{-NH}_3^+$ group (pK_a 9.06) is 80% dissociated?
- 9.96
 - 9.66
 - 9.06
 - 8.96
 - 8.36

13. SDS Polyacrylamide Gel Electrophoresis:
- A) Separates molecules on the basis of molecular size.
 - B) Separates molecules by taking advantage of differences in their pI.
 - C) Separates molecules based on their different charges.
 - D) Separates molecules based on affinity for a ligand.
 - E) Separates molecules by differences in their solubility.
14. Which of the following amino acids contains an amide group in its side-chain:
- A) Lysine.
 - B) Glutamine.
 - C) Leucine.
 - D) Histidine.
 - E) Glycine.
15. Aspartame is:
- A) An amino acid.
 - B) A protein.
 - C) A peptide.
 - D) One of a pair of enantiomers with a fresh, citrus-like taste.
 - E) A detergent.
16. Which of the following peptides could be cleaved by both CNBr and Trypsin?
- A) Glu-Gln-Gly-Glc.
 - B) Trp-Tyr-Phe-Met.
 - C) Arg-His-Lys-Phe.
 - D) Leu-Ile-Val-Arg.
 - E) Pro-Met-Lys-Ala.
17. Identify the INCORRECT statement about the α -helix:
- A) The backbone carbonyl groups point toward the C-terminus and the NH groups point toward the N-terminus.
 - B) It is located in the lower left quadrant of the Ramachandran diagram.
 - C) It is held together by H-bonding between the C=O of residue i and the HN of residue $i+3.6$.
 - D) The height of one turn of helix is 0.54 nm.
 - E) The side-chains protrude from the sides of the helix.
18. In amino acid analysis the reagent Ninhydrin performs which function?
- A) It is an ion exchange resin used to separate the individual amino acids.
 - B) It is used to hydrolyse a protein into individual amino acid components.
 - 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) Upon reaction with the amino acids it yields a purple pigment used to quantify the amino acids.
19. Polymorphic proteins:
- A) Are proteins that contain secondary structure but no tertiary structure.
 - B) Have slightly different amino acid sequences but identical biological activities in different individuals within a species.
 - C) Are proteins containing one amino acid change that drastically alters the function of a protein.
 - D) Are proteins that take on many different shapes.
 - E) Are proteins that contain signal sequences that determine cellular location or export, chemical modifications, protein 1/2 life, *etc.*
20. When a globular protein folds it does all of the following EXCEPT:
- A) Forms secondary structures that maximize the H-bonding potential of the backbone.
 - B) Places hydrophobic side-chains on the inside of the protein.
 - C) Places hydrophilic side-chains on the outside of the protein.
 - D) Enhances biological function by allowing formation of holes and channels.
 - E) Maximizes water entropy.

21. Regarding the heme cofactor, which statement is INCORRECT:
- A) It is used by different proteins to carry oxygen and electrons.
 - B) It is bound by cytochrome C.
 - C) It is bound by myoglobin.
 - D) It is bound by hemoglobin.
 - E) It is bound by triosephosphate isomerase.
22. α -keratin:
- A) Is a soft gel and easily dissolves in water.
 - B) Contains an amino acid sequence with many copies of Gly-Xxx-Pro.
 - C) Is the primary constituent of hair, feathers, and nails.
 - D) Is a soft material made of stacked β -sheets.
 - E) Is a tough insoluble fibre made of three left-handed α -helices.
23. Identify the INCORRECT statement about enzymes:
- A) Enzymes are catalysts.
 - B) Enzymes accelerate reaction rates by binding substrates tightly.
 - C) Enzymes are marginally stable and can easily denature.
 - D) Enzymes are highly specific, binding only one or a few substrate molecules.
 - E) Enzymes can be regulated.
24. Regarding the equilibrium constant (K_{eq}) of a biochemical reaction:
- A) It is the product of the concentration of the products minus the product of the concentration of the reactants.
 - B) The free energy of a reaction is just a different way of expressing the equilibrium constant.
 - C) K_{eq} is lowered by an enzyme in order to speed up the reaction.
 - D) $\Delta G^o = \frac{R}{T} \cdot \ln_e(K_{eq})$
 - E) K_{eq} for a reaction depends on the sum of the free energies of the substrates and products.
25. Regarding biochemical reaction rate constants (k).
- A) In an enzyme-catalyzed reaction the forward rate of reaction is independent of the path taken by the substrates.
 - B) The rate of a reaction depends on the difference in free energy between the products and substrates.
 - C) The rate of an enzyme-catalyzed reaction is unaffected by temperature.
 - D) Forward rate constants are always equal to reverse rate constants.
 - E) The rate of an enzyme-catalyzed reaction depends on the free energy of the transition state.

SCRATCH