DATE: Oct. 22, 2002   Midterm EXAMINATION

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DEPARTMENT & COURSE NO.: 2.277/60.277   Time: 1 HOURS

EXAMINATION: Elem. of Biochemistry I   EXAMINER: Dr. Burton

GENERAL INSTRUCTIONS

- You must mark the answer sheet with pencil (not pen).
- Put your name and enter your student number on the answer sheet.
- The examination consists of multiple choice questions. Choose what you think is the best, correct answer and record your choice on the answer sheet. There is only **ONE CORRECT** answer.
- This exam will count for 25% of your final mark.

1.   Which of the following amino acids contains a sulfur atom?

A) proline B) tryptophan C) methionine D) isoleucine E) tyrosine

2.   Which of the following amino acids does NOT contain a nitrogen atom in its side-chain?

A) asparagine B) alanine C) lysine D) arginine E) histidine

3.   Which statement is **incorrect** about the classification of amino acids?

A)   At pH 7, lysine, arginine and tryptophan have positively charged R-groups.

B)   Alanine and valine have nonpolar, aliphatic R-groups.

C)   At pH 7, aspartate and glutamate have negatively charged R-groups.

D)   At pH 7, threonine, serine and cysteine have polar, uncharged R-groups.

E)   None of the above are incorrect.

4.   A 20 mL sample of HCl solution requires 14.4 mL of 0.1M NaOH solution for complete titration. What is the concentration of the HCl?

A) 0.72 M   B) 0.072 M   C) 0.0072M   D) 0.036M   E) 0.36M

5.   What is the pH of the HCl solution referrred to in question 4?

            A) 7.0   B) 1.1   C) 3.1   D) 11.1   E) 1.5

6.   To 200 mL of a 0.1M solution of alanine at pH=pK_a for its amino group, was added X mL of 0.2M
        HCl. The new pH was found to be equal to the pK_a for its carboxyl group. What is the value of X?

        A) 100 mL   B) 50 mL   C) 200 mL D) 75 mL E) the problem cannot be solved without knowing
        the pK_a values.

7.   0.05 mol of HCl were added to a solution containing 0.2 mol of sodium acetate. After mixing, the
        pH of the solution was found to be 5.18. What is the pK_a of acetic acid?

        A) 4.22   B) 4.40   C) 4.70   D) 5.04   E) 5.18

8.   75 mL of 0.1M NaOH were added to 100 mL of 0.1M aspartate solution, pH=pI. What is the new
        pH? pK_a values for aspartate are 1.88, 3.65 (R-group) and 9.60.

        A) 2.76   B) 4.13   C) 6.62   D) 7.38   E) 9.60

9.   The regular folding pattern of adjacent (contiguous) portions of the polypeptide chain is called _?

        A) primary structure   B) secondary structure C) tertiary structure
        D) quaternary structure   E) covalent structure

10.   The linear sequence of peptide-bonded amino acids in a polypeptide is called _?

        A) primary structure   B) secondary structure C) tertiary structure
        D) random coil structure   E) alpha-helical structure

11.   The peptide bond is planar because ?

A) the large >C=O group causes steric hindrance
B) the H in the >N-H group is small
C) free rotation is possible around the bond between the alpha carbon and the carbonyl (>C=O) carbon
D) the C-N bond has partial double bond character
E) H-bonds can form between polar R-groups

12.   Which of the following correctly depicts interchain H-bonding in the beta-sheet?

A) >N-H //// H-N<   B) >C=O //// H-C-   C) >C=O //// H-N<
D) >N-H //// H-R-   E) >C=O //// O=C<

13.   Which of the following statements about multisubunit (oligomeric) proteins is true?

A) all subunits must be identical
B) all subunits must be different
C) oligomeric proteins are more stable than other proteins
D) all oligomeric proteins contain an even number of subunits
E) the subunits in most oligomeric proteins are held together by weak, non-covalent forces

14.   Which of the following statements about protein structure is true?

A) proteins are generally loosely structured
B) In water-soluble proteins, hydrophobic (non-polar) amino acid side chains are usually buried and not exposed to water
C) In water-soluble proteins, hydrophilic (polar) amino acid side chains are usually buried and not exposed to water
D) proteins that contain alpha helical regions never contain regions of β-sheet
E) fibrous proteins are always exclusively alpha helical

15.   Which of the following statements about the fibrous protein silk fibroin are TRUE?

       1) Fibroin consists of stacked beta-sheets   2) Fibroin consists of right handed helices
       3) Fibroin has a high content of glycine 4) Disulfide bonds are important in stabilizing the structure
       of fibroin 5) The stacked beta-sheets of fibroin are held together by van der Waal's forces

       A) 1,2 & 5 B) 2,4 &5 C) 1, 2 &4 D) 1,3 & 5 E) 2,3 & 4

16.   The role of the enzyme in an enzyme-catalyzed reaction is to:

       A) ensure the product is more stable than the substrate
       B) make the overall free energy change for the reaction more favourable
       C) increase the rate of conversion of substrate to product
       D) ensure all the substrate is converted to product
       E) increase the equilibrium constant for the reaction

17.   Enzymes are potent catalysts. They:

       A) drive reactions to completion while other catalysts drive reactions to equilibrium
       B) are consumed in the reactions they catalyze
       C) can prevent the conversion of products back to substrate
       D) increase the equilibrium constants for the reactions they catalyze
       E) lower the activation energy for the reactions they catalyze

18.   Which of the following is a correct statement about K_m for an enzyme-catalyzed reaction showing a
       hyperbolic v versus [S] curve?

       A) the enzyme's active site is saturated with substrate when $[S] = K_m$
       B) If two different substrates can bind to the same active site, the substrate with the smaller K_m will
       bind more strongly
       C) the rate of reaction is equal to K_m multiplied by V_{max}
       D) K_m for the substrate is decreased in the presence of a competitive inhibitor
       E) the units of K_m are sec^{-1}

19.   For an enzyme which follows simple Michaelis-Menten kinetics, what is the V_{max} if $v = 33$ μmol/min when $[S] = K_m$?

A) 50 μmol/min   B) 66 μmol/min   C) 99 μmol/min
D) 110 μmol/min   E) 130 μmol/min

20. V_{max} for an enzyme-catalyzed reaction:

A) usually increases when pH increases
B) increases in the presence of a competitive inhibitor
C) is unchanged in the presence of a non-competitive inhibitor
D) is twice the velocity observed when $[S] = K_m$
E) is limited only by the amount of substrate supplied

21.   The kinetic data in the table below were obtained using an enzyme known to follow Michaelis-Menten kinetics:

[S] mM	0.8	2.0	4.0	6.0	500.0	1000.0
Velocity μmicromol /min	217	325	433	488	635	647

The K_m for the substrate of this enzyme is approximately:
A) 1 mM   B) 2 mM   C) 3 mM   D) 4 mM   E) 500 mM

22.   In another study on the same enzyme and substrate, but in the presence of an inhibitor, the following data were obtained:

K_m for the substrate = 4 mM   and V_{max} = 650 micromol/min

The inhibitor is _?_

A) competitive B) uncompetitive C) a weak base D) Allosteric
E) non-competitive

23.   An non-competitive inhibitor will change the kinetic parameters in an enzyme-catalyzed reaction showing simple Michaelis-Menten kinetics as follows:

A) Increase K_m leaving V_{max} unchanged   B) Decrease both K_m and V_{max}
C) Increase both K_m and V_{max} D) Decrease V_{max} leaving K_m unchanged
E) Decrease K_m leaving V_{max} unchanged

USE THE FOLLOWING DATA TO ANSWER QUESTIONS 24 and 25.
An enzyme-catalyzed reaction was carried out with a substrate concentration 1000 times greater than the K_m for the substrate. After 6 minutes, less than 1% of the substrate had been consumed and 16 µmol of product had been formed.

24.   If one quarter as much enzyme and twice as much substrate were used, how long would it take for the same amount of product (16 µmol) to be formed?

A) 1.5 min   B) 6 min   C) 18 min   D) 24 min   E) 36 min

25.   If the enzyme concentration was tripled and the substrate concentration halved, how long would it take for the same amount of product (16 µmol) to be formed?

A) 2 min   B) 3 min   C) 6 min   D) 12 min   E) 24 min

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