

Name _____

The use of calculators is prohibited on this exam. In drawing structures, neatness counts. The space provided for each question should be sufficient for your answers. Note that there are 102 points on this exam but the maximum score you can receive is 100. Use your time wisely.

Questions 1-11 are worth 3 points each. Circle your answer(s).

1. Which of the following are NOT tenets of the cell theory?
 - (a) All cells are complex and highly organized
 - (b) Cells can only arise by division from a pre-existing cell
 - (c) The cell is the smallest unit of life
 - (d) All organisms are composed of one or more cells

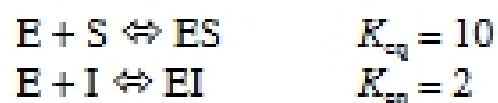
2. Which type of chemical bond is characterized by the sharing of electrons between atoms?
 - (a) Hydrogen bond
 - (b) Ionic bond
 - (c) Covalent bond
 - (d) van der Waals attraction
 - (e) Hydrophobic interactions

3. Which chemical group is found at the C-terminus of proteins?
 - (a) Amino
 - (b) Amide
 - (c) Carbonyl
 - (d) Carboxyl
 - (e) Carbon

4. Any reaction $A \rightleftharpoons B$ is at equilibrium when
 - (a) $[A] = [B]$.
 - (b) $\Delta G^\circ = 0$.
 - (c) $\Delta G = 0$.
 - (d) $\Delta G = \Delta G^\circ$.
 - (e) $RT = 0.616$

5. Which of the following is false?
 - (a) An enzyme catalyzes a large number of different reactions.
 - (b) Enzymes can not change the equilibrium of biochemical reactions.
 - (c) The temperature increase required to speed up a reaction by an appreciable extent is often huge.
 - (d) Reactions inside cells are often mediated by enzymes.
 - (e) Enzymes can often accelerate reactions to a much greater extent than can heat.

6. Protein E can bind to two different proteins, S and I. The binding reactions are described by the following equations and values:



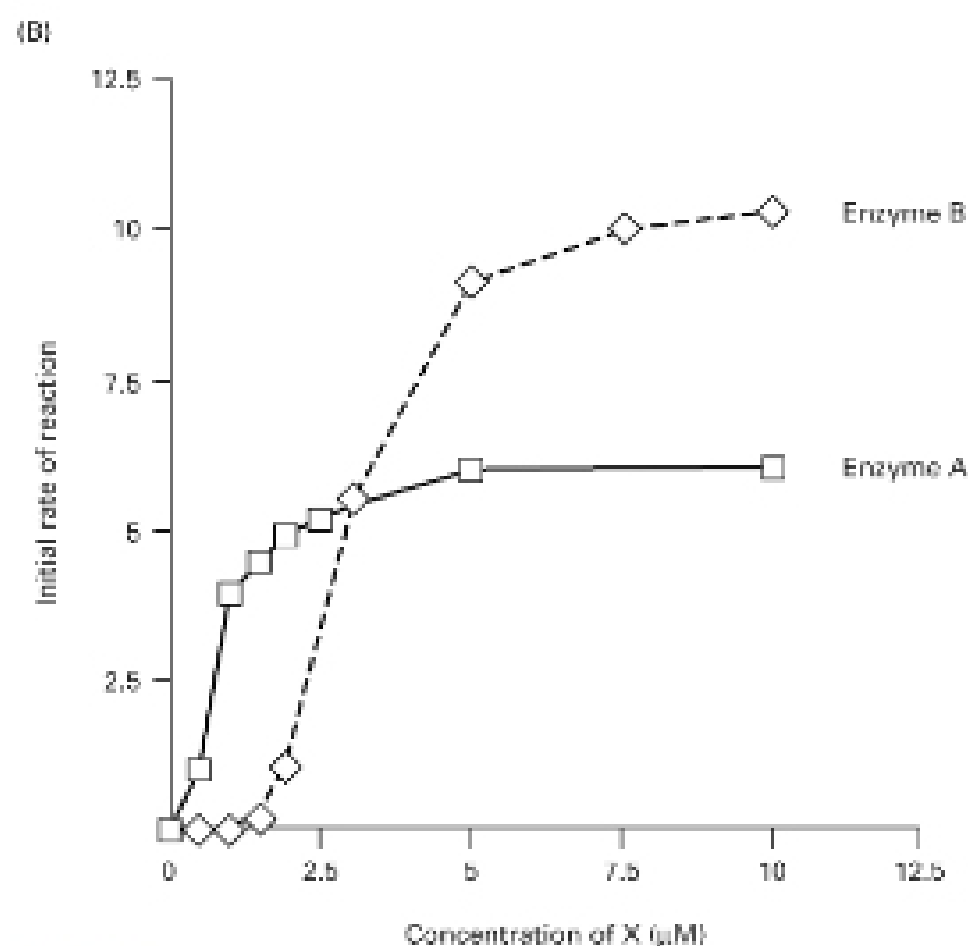
Given the equilibrium constant values, which one of the following statements is *true*?

- (a) The binding energy of the ES interaction is greater than that of the EI interaction.
 - (b) E binds I more tightly than S.
 - (c) When S is present in excess, no I molecules will bind to E.
 - (d) Changing an amino acid on the binding surface of I from a basic amino acid to an acidic one will probably make the free energy of association with E more negative.
 - (e) E is more specific for I than S.
7. Which type of interaction is responsible for α -helices and β -sheets in proteins?
- (a) covalent
 - (b) electrostatics
 - (c) van der Waals
 - (d) hydrophobic
 - (e) hydrogen bonds
8. Which statement is NOT true of mitochondria?
- (a) Mitochondria have an inner and outer membrane.
 - (b) Mitochondria contain their own DNA.
 - (c) Mitochondria are thought to have originated from bacteria.
 - (d) Mitochondria are not present in plant cells.
 - (e) Mitochondria generate chemical energy for the cell.
9. Which of the following is NOT true?
- (a) Enzymes can bring reactants together in the proper orientation for chemistry to occur.
 - (b) Enzymes can change the shape of substrates to increase the rate of a particular reaction.
 - (c) Enzymes require an input of energy from ATP for activation.
 - (d) Enzymes can form covalent bonds with their substrates.
10. The biological activity of a protein is determined by its:
- (a) peptide bonds
 - (b) amino acid sequence
 - (c) ability to form alpha helices
 - (d) ability to form beta sheets
11. Which statement is false?
- (a) Feedback inhibition is a negative feedback system for controlling enzyme activity.
 - (b) In feedback inhibition, an enzyme acting early in a reaction pathway is inhibited by a late product of that pathway.
 - (c) Feedback inhibition regulates the flow through biosynthetic pathways.
 - (d) Feedback inhibition is difficult to reverse and requires synthesis of new enzymes.

8 points (2 points each)

12. The product Y of an enzymatic reaction absorbs light at the wavelength 260 nm and the product Z of another reaction absorbs at 340 nm; the reactant X does not absorb light at either of these wavelengths. A spectrophotometer was used to measure the initial rate of production of Y and Z by the reactions shown below.

The initial rates were measured for several independent reactions, all containing equal amounts of enzyme A or enzyme B and differing amounts of substrate X. A graph was made of the initial reaction rate (v) plotted against the concentration of X ($[X]$). Given the data shown, are the following statements TRUE or FALSE?



- A. $V_{\max}(A) < V_{\max}(B)$.
- B. At $[X] = 10 \mu\text{M}$, the amounts of enzymes A and B limit the rate of reaction.
- C. $K_M(A) < K_M(B)$.
- D. If $[X] = 1 \mu\text{M}$ and both enzymes are present, most of the substrate will be converted to Y rather than Z.

5 points

13. What is the pH of a 10 mM solution of HCl (a strong acid)? _____