

Name \_\_\_\_\_

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) Cells can only arise by division from a pre-existing cell
  - (b) The cell is the smallest unit of life
  - (c) All cells are complex and highly organized
  - (d) All organisms are composed of one or more cells
  
2. Glycogen is composed of:
  - (a)  $\alpha$ -galactose
  - (b)  $\beta$ -galactose
  - (c) sucrose
  - (d)  $\alpha$ -glucose
  - (e)  $\beta$ -glucose
  
3. 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
  
4. Which chemical group is found at the C-terminus of proteins?
  - (a) Amino
  - (b) Amide
  - (c) Carboxyl
  - (d) Carbonyl
  - (e) Carbon
  
5. Any reaction  $A \rightleftharpoons B$  is at equilibrium when
  - (a)  $[A] = [B]$ .
  - (b)  $\Delta G = 0$ .
  - (c)  $\Delta G^\circ = 0$ .
  - (d)  $\Delta G = \Delta G^\circ$ .
  - (e)  $RT = 0.616$

6. A bacterium is suddenly expelled from a warm human intestine into the much colder world outside. Which of the following adjustments might the bacterium make to maintain the same level of membrane fluidity it enjoyed in the intestine?
- (a) Increase the length of the hydrocarbon tails in its membrane phospholipids.
  - (b) Increase the proportion of unsaturated hydrocarbon tails in its membrane phospholipids.
  - (c) Increase the proportion of hydrocarbon tails with no double bonds in its membrane phospholipids.
  - (d) Decrease the amount of fatty acids in the membrane.

7. At first glance, it may seem that living systems are able to defy the second law of thermodynamics. However, on closer examination it becomes clear that although cells create organization from raw materials in the environment, they also contribute to disorder in the environment by releasing:
- (a) water
  - (b) radiation
  - (c) heat
  - (d) proteins
  - (e) ions

8. 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*?

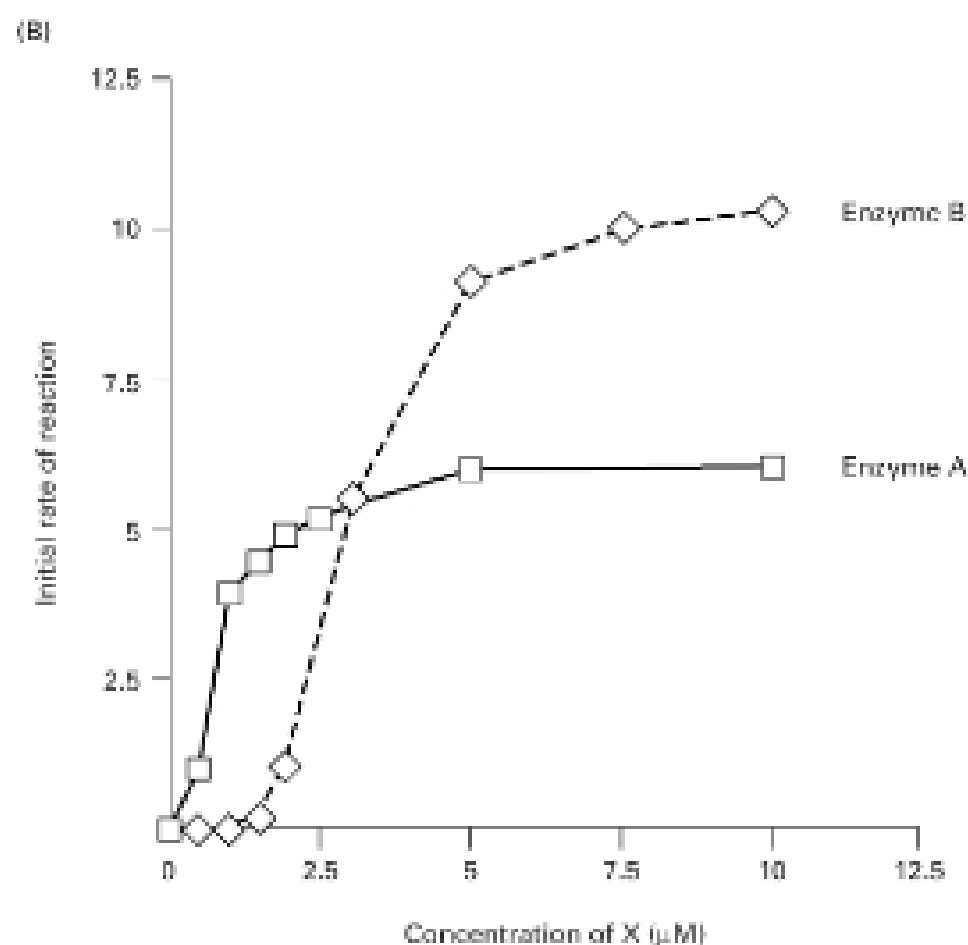
- (a) E binds I more tightly than S.
  - (b) When S is present in excess, no I molecules will bind to E.
  - (c) The binding energy of the ES interaction is greater than that of the EI interaction.
  - (d) Changing an amino acid on the binding surface of I from a basic amino acid to an acidic one will probably make the free energy of association with E more negative.
  - (e) E is more specific for I.
9. Which of the following is false?
- (a) Enzymes change the equilibrium of biochemical reactions.
  - (b) An enzyme catalyzes just one or a very small number of different 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.
10. Which type of interaction is responsible for  $\alpha$ -helices and  $\beta$ -sheets in proteins?
- (a) covalent
  - (b) hydrogen bonds
  - (c) electrostatics
  - (d) van der Waals
  - (e) hydrophobic

11. Which of the following statements is *true*?
- (a) Peptide bonds are the only covalent bonds that can link together two amino acids in proteins.
  - (b) The polypeptide backbone is free to rotate about each peptide bond.
  - (c) Nonpolar amino acids tend to be found in the interior of proteins.
  - (d) The sequence of the atoms in the polypeptide backbone varies between different proteins.

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, unlike the common substrate of the reactions. 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.  $K_M(B) = 10 \mu\text{M}$ .
- \_\_\_D. If  $[X] = 1 \mu\text{M}$  and both enzymes are present, most of the substrate will be converted to Z rather than Y.