

### I. True or False?

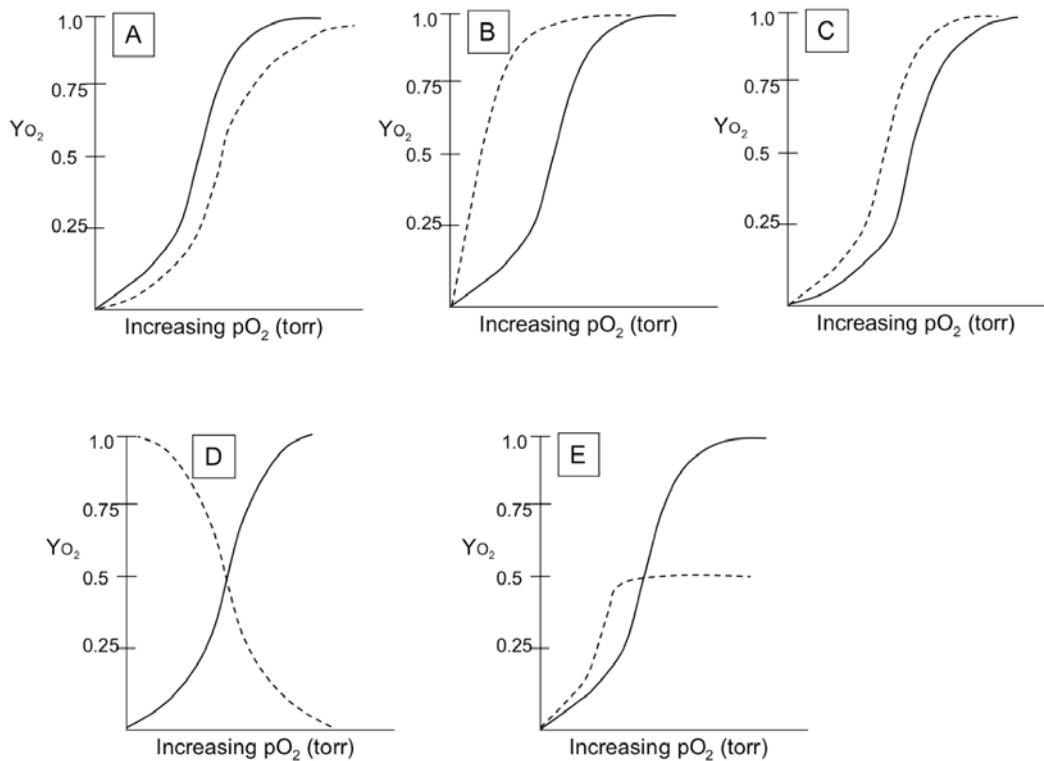
- T F 1. Myoglobin is characterized by a Hill coefficient that is a negative number.
- T F 2. DEAE-cellulose resin binds proteins that possess a net negative charge.
- T F 3. Enzymes can alter the reaction conditions to allow non-spontaneous reactions to occur.
- T F 4. Gel filtration chromatography binds proteins with a net charge of 0.
- T F 5. A catalyst acts by lowering the activation barrier for the reaction being catalyzed.

### II. Matching

Below are five graphs in which the solid line indicates oxygen binding to a pure homogenous hemoglobin solution. Choose which graph (“A – E”) best represents the following scenarios?  
*Note: “A – E” may be used more than once.*

\_\_\_\_\_ 6. The dashed line representing an increase in the pH of the hemoglobin solution.

\_\_\_\_\_ 7. The dashed line representing the oxygen binding curve of myoglobin.



**IV. Other multiple-choice questions. Choose the most correct answer.**

[#8 – 10]. The following table lists five newly isolated proteins with their molecular characteristics.

Protein Name	Molecular Weight (kDa)	pI
Protein “Andrew”	100	5.0
Protein “Cindy”	250	10.0
Protein “Katrina”	80	6.8
Protein “Rita”	15	4.5
Protein “Wilma”	45	9.5

8. You need to try and change the conditions to optimize purification. The first column that you decide to try is a DEAE-cellulose column which is equilibrated in a buffer at pH 7.0. Which of the proteins listed below will **NOT** bind to the column?
- A. Andrew
  - B. Cindy
  - C. Katrina
  - D. Both “A.” and “B.”
  - E. All of the above
9. In order to elute the bound proteins from the DEAE cellulose column in #8, you can use which of the following method (s)?
- A. Increase the salt concentration.
  - B. Decrease the pH of the buffer on the column.
  - C. Increase the pH of the buffer on the column.
  - D. Either “A.” or “B.”
  - E. Either “A.” or “C.”
10. Which of your proteins would migrate the furthest or the longest distance on an SDS-PAGE gel?
- A. Andrew
  - B. Cindy
  - C. Katrina
  - D. Rita
  - E. Wilma

11. Which one of these characteristics is **not** true for the  $\alpha$ -helix?
- A. There are 3.6 amino acids per turn.
  - B. There is a requirement for glycine every third amino acid residue.
  - C. A hydrogen bond forms between the carbonyl oxygen of the  $n$ th amino acid residue and the  $\text{—NH}$  group of the  $(n + 4)$ th amino acid residue.
  - D. Proline is typically not found in the  $\alpha$  helix.
  - E. It is right-handed.
12. The value of  $n$  in the Hill equation for hemoglobin is about \_\_\_\_\_ as great as the value for myoglobin.
- A. half
  - B. twice
  - C. three times
  - D. five times
  - E. ten times
13. Which of the following is not a ligand to the porphyrin ring  $\text{Fe}^{2+}$  ion in oxymyoglobin?
- A. His E7
  - B. His F8
  - C. Nitrogen atoms in the porphyrin ring
  - D. Oxygen
  - E. all are ligands
14. Conformation(s) that has (have) both a favorable hydrogen bonding pattern and  $\phi$  and  $\psi$  values that fall within the allowed Ramachandran conformational regions is (are) \_\_\_\_\_.
- A.  $\alpha$  helix
  - B. collagen helix
  - C.  $\beta$  sheet
  - D. None of the above
  - E. All of the above
15. The  $\phi$  and  $\psi$  angles for the  $\beta$ -strands in an area on a Ramachandran diagram corresponding to:
- A.  $\phi$  is negative and  $\psi$  is negative
  - B.  $\phi$  is positive and  $\psi$  is negative
  - C.  $\phi$  and  $\psi$  are both  $0^\circ$
  - D.  $\phi$  is negative and  $\psi$  is positive
  - E.  $\phi$  is positive and  $\psi$  is positive

- 16.** Which of the following properties is NOT a characteristic of enzymes?
- A. Enzymes theoretically stabilize the transition state of the reaction they catalyze.
  - B. Enzymes alter the equilibrium distribution of the substrate(s) and product(s) of the reaction they catalyze.
  - C. Enzymes reduce the activation energy of the reaction they catalyze.
  - D. Enzymes employ a wide variety of catalytic strategies.
  - E. Enzymes vary widely in their catalytic efficiencies.
- 17.** The key catalytic amino acids of the lysozyme active site in the free enzyme are:
- A. a glutamic acid and an aspartic acid; each of which has a protonated side chain.
  - B. a glutamic acid and an aspartic acid; each of which has an unprotonated side chain.
  - C. a glutamic acid with an unprotonated side chain and an aspartic acid with a protonated side chain.
  - D. an aspartic acid with an unprotonated side chain and an aspartic acid with a protonated side chain.
  - E. an aspartic acid with an unprotonated side chain and a glutamic acid with an protonated side chain.
- 18.** Chymotrypsin, a serine protease, preferentially cleaves a peptide bond adjoining a bulky non-polar side chain. This is because chymotrypsin's "specificity pocket":
- A. contains a sulfhydryl group that forms a disulfide bond with the substrate.
  - B. is lined with small hydrophobic side chains, leaving considerable room in the pocket and making it nonpolar.
  - C. contains a negative charge.
  - D. is mostly filled with large side chains.
  - E. contains a positive charge.