

CHEMISTRY 271/4 -- TERM TEST I

INSTRUCTOR: DR. P. JOYCE NAME: _____

I.D. # _____

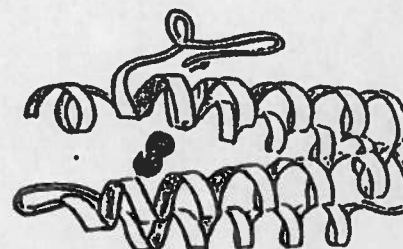
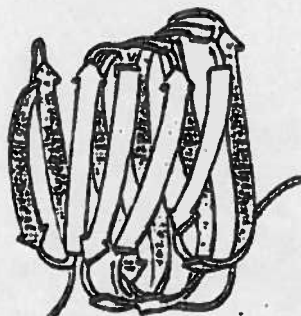
Answer all questions in the space provided. No additional papers allowed.

1) Below are ribbon drawings representing myohemerythrin and tomato bushy stunt virus domain 3. In these drawings clearly identify one region corresponding to:

A) α -helix (2 points)

B) anti-parallel β -sheet (2 points)

C) β -turn (2 points)



D) Hydrogen bonds serve to stabilize both α -helices and β -sheets. How does the hydrogen bonding network between the amide and carbonyl groups differ in an α -helix as compared to a β -sheet? (4 points)

2) Draw the structure and give the name and one letter code for one example of each of the following amino acid types: (10 points)

a) absorbs ultraviolet light (280 nm)

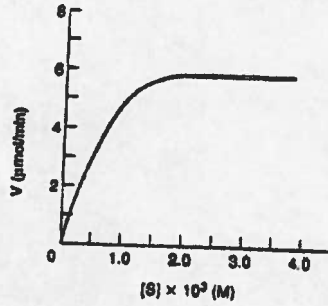
b) contains a nitrogen in its R group

c) hydrogen bond acceptor

d) negatively charged at pH 7

e) non-polar

3) From the following graph estimate an approximate V_{max} and K_M for enzyme X. Explain how you arrived at these values. Assume that the enzyme assay contains 0.1 nmoles of enzyme in a 50 mM phosphate buffer at pH 7.6 and 37°C. (6 points)



Based on this information what is the turnover number for enzyme X? (3 points)

4) Carbon dioxide (CO₂) is a biproduct of cellular respiration and must be removed from the tissue and cleared from the body at the lungs. Approximately 13% of the CO₂ transported from the tissue to the lungs is carried by hemoglobin. Describe how this is done and how the CO₂ is released from hemoglobin at the lungs. (6 points)

5) Both gel filtration chromatography and SDS-polyacrylamide gel electrophoresis can be used to separate proteins based on size. Briefly describe how these two techniques work. (6 points)

You are given a sample of hemoglobin and asked to determine its molecular mass. You use both gel filtration chromatography and SDS-PAGE and obtain the results shown below. Explain these differences based on what you know about these two techniques and the structure of hemoglobin. (4 points)

Technique	Gel filtration chromatography	SDS-PAGE
Apparent molecular mass (Da)	80 000	20 000

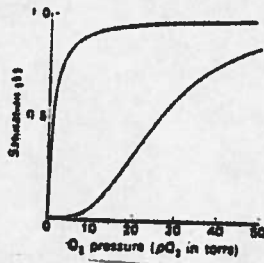
6) The following two oligopeptide segments were found to comprise highly ordered parts of the structure of a crystallizable protein.

I) ...ile-lys-ser-leu-phe-val-asn-met-ala-leu-tyr-glu-ile...

II) ...asp-gly-ala-gly-ser-gly-cys-ala-ser-gly-ala...

What type of secondary structures would you expect each of these segments to adopt? Explain and be specific. (4 points)

7) A) Identify the oxygen dissociation curves for myoglobin and hemoglobin on this figure. (2 points)



B) Indicate on the graph the effect that you would expect the addition of 2,3-bisphosphoglycerate (2,3-BPG) to have on each of these curves. Explain. (4 points)

C) An increase in blood 2,3-BPG levels in an individual with sickle cell anemia would result in increased cell sickling and all of the clinical symptoms related to this? Explain biochemically why this happens. (4 points)

8) The first step in glucose metabolism via glycolysis. $\text{Glucose} + \text{ATP} \rightleftharpoons \text{glucose-6-phosphate} + \text{ADP}$ is catalyzed by the enzyme hexokinase. This reaction has a standard free energy change (ΔG°) of -4.0 kcal/mol .

A) What would the free energy change (ΔG) of this reaction be under physiological conditions, *i.e.*, 55 mM glucose, 5 mM ATP, 0.1 mM glucose-6-phosphate, and 1 mM ADP assuming a temperature of 25°C . (Hint: The gas constant, R , is equal to 1.98 cal/mol K). (5 points)

B) Will this reaction proceed as written? Why or why not? (2 points)

9) In a healthy individual blood plasma has a pH of 7.40. A change of as little as 0.2 of a pH unit can result in serious medical consequences. One of the ways that blood pH is maintained is through a phosphate buffer ($pK_a = 7.2$).

A) What would the ratio of HPO_4^{2-} to $H_2PO_4^-$ be in blood at pH 7.4? (3 points)

B) How much of a change in pH would you observe if during anaerobic respiration the plasma levels of lactic acid increased by 3 mM? (Hint: Assume phosphate levels are 100 mM and the lactic acid dissociates completely. Also, ignore any buffering by other blood components). (4 points)

C) What change in pH would you have observed if no buffer was present? (2 points)