

This exam consists of two parts. Part I is multiple choice. Each of these 25 questions is worth two points. Answer the Part I questions on this sheet, below. Answer the Part II questions on the question pages.

Please use BLOCK CAPITAL letters like this --- A, B, C, D, E. Not lowercase!

- | | | |
|----------|-----------|-----------|
| 1. _____ | 10. _____ | 18. _____ |
| 2. _____ | 11. _____ | 19. _____ |
| 3. _____ | 12. _____ | 20. _____ |
| 4. _____ | 13. _____ | 21. _____ |
| 5. _____ | 14. _____ | 22. _____ |
| 6. _____ | 15. _____ | 23. _____ |
| 7. _____ | 16. _____ | 24. _____ |
| 8. _____ | 17. _____ | 25. _____ |
| 9. _____ | | |

GRADE:

Part I Total _____

Part II:

II-1 _____

II-2 _____

II-3 _____

II-4 _____

II-5 _____

Part II Total _____

Total, I & II _____

- A mixture of proteins is put through a Sephadex column, for gel filtration. The protein which elutes last will be
 - the most spherical
 - the largest
 - the smallest
 - the most positive
 - the most negative
- Suppose you have a biological preparation and you know it contains Avidin, with many other proteins, and that Avidin binds tightly to Biotin. What technique should you start with to purify the Avidin?
 - affinity chromatography
 - dialysis
 - ultracentrifugation
 - SDS PAGE
 - gel filtration
 - ELISA
- Home pregnancy tests detect small traces of the protein hCG, human chorionic gonadotropin in the urine. What technique is this based on?
 - gel filtration
 - affinity chromatography
 - ultracentrifugation
 - dialysis
 - SDS PAGE
 - ELISA
- Which of the following would be a negative allosteric modulator of Myoglobin?
 - 2,3 BPG
 - carbon dioxide
 - H⁺
 - all of the above
 - Mb has no allosteric modulators
- If a solution of Hemoglobin is oxygenated to half its capacity, what would you expect to find in the solution?
 - only Hb(O₂)₂
 - half Hb, half Hb(O₂)₄
 - equal amounts of Hb, Hb(O₂)₂, and Hb(O₂)₄
 - mono, di, and trioxy Hb
 - none of the above
- Where does 2,3 Bisphosphoglycerate bind to the Hemoglobin molecule?
 - it binds to the heme iron
 - to the COOH end of alpha chain
 - The E helices
 - at the opening of heme pocket
 - at the center of the tetramer
- If the standard free energy change for Gal-6-P → Gal + Pi is -19 kJ/mol, and that for 1,3 BPG → 3 PG + Pi is -49 kJ/mol, then what is the G^o for 1,3BPG + Glu → Glu-6-P + 3PG?
 - 68 kJ/mol
 - 49 kJ/mol
 - 30 kJ/mol
 - + 30 kJ/mol
 - + 68 kJ/mol
 - none of the above
- ATP hydrolysis is a high energy process compared to other phosphate hydrolyses because of (choose two correct answers):
 - charge repulsion
 - steric hindrance
 - breaking a phosphate ester
 - quantum tunneling
 - resonance stabilization

9. The Second Law of Thermodynamics states that for a spontaneous change in a system and its surroundings, what must increase?
A. entropy
B. enthalpy
C. empathy
D. free energy
10. In the discussion of Michaelis Menten kinetics in class, we learned that k_2 (or sometimes k_{cat}) is referred to as
A. the Michaelis constant
B. the gas constant
C. the turnover number
D. the catalysis constant
11. When we watch an enzyme consume substrate over a period of time, and it produces product at a constant rate over that entire time, we say the reaction is
A. zero order
B. first order
C. stalled
D. steatopygeous
12. The 2-epimer of D-glucose would be
A. D-allose
B. D-galactose
C. D-mannose
D. D-ribulose
E. D-fructose
- 13.* The structure below represents
A. stachyose
B. sucrose
C. lactose
D. cellobiose
E. maltose
14. The linkage (for example beta 1-6) of cellulose is the same as that of
A. sucrose
B. lactose
C. maltose
D. glycogen
E. amylose
15. A glycoside of Fructose would have to be
A. a hemiacetal
B. a hemiketal
C. an acetal
D. a ketal
E. an alpha anomer
16. A camel's hump contains mostly
A. sphingolipids
B. water
C. hydrophilic proteins
D. glycogen
E. triglycerides
17. A common fatty acid is Linoleic Acid, which has the structure
A. 18:0
B. 18:1 7
C. 18:3 9, 12, 15
D. 18:2, 6, 9
E. 18:2, 9, 12
F. 16:1, 8

18. Addition of a fatty acid to sphingosine produces a
A. ceramide D. sphingomyelin
B. ganglioside E. phosphatidate
C. cerebroside
20. The "fluid mosaic model" of membrane structure concerns the fact that the lipid bilayer membranes found in cells contain various
A. polysaccharides D. transmembrane proteins
B. steroid dimers E. none of the above
C. redox cofactors
21. Integral membrane proteins have an external "waistband" of amino acid residues which are
A. hydrophilic D. basic
B. acidic E. very small
C. hydrophobic
22. Stage II of Catabolism (in the Krebs scheme) gives how much ATP?
A. none C. a lot
B. a little D. can't tell
23. The ratio of NADPH to NADP⁺ in cells is generally kept
A. greater than one C. less than one
B. about one D. can't tell
24. What is Anabolism?
A. DNA repair D. All "energy reactions" in cell
B. building molecules E. none of the above
C. breaking down foods
25. After the test I plan to relax by
A. watching baseball D. studying for P. Chem.
B. watching SpongeBob E. drinking beer
C. reading Number Five F. all, some, or none of the above

Answer these questions here on the question pages.

1. a. Convert the peptide below into its one-letter codes.

(2) Ala-AsN-Gly-Glu-Leu-Ser = _____

b. Suppose you have a mixture of Histones (which we know are small proteins with many positively charged aa residues) and stomach enzymes (which are also small proteins but with many negative charges). And suppose that they are too similar in molecular weight for any of the "size" methods to work. How do you separate them as the first step in purification? Explain your choice.

(3)

c. Briefly explain how Isoelectric Focusing works.

(2)

d. Enzymes are sometimes controlled by "covalent modification" – give an example of how this happens (i.e. what chemical change occurs?). Also, in what kind of circumstance are you likely to see covalent modification of enzymes in human metabolism?

(3)

2. a. On the axes below, draw the loading curves for Hemoglobin and Myoglobin and label which is which. Also give the approximate P_{50} in torr for each curve.

(3)

- b. The "Bohr Effect" describes the allosteric effect of the breakdown products of Glucose, i.e. CO_2 and protons from Lactic Acid, on Hb binding. Show the loading curve of Hemoglobin in the presence and absence of these modulators.

(3)

- c. Briefly describe what goes wrong in Sickle Cell Anemia – address the molecular defect (what changes on the amino acid level?), the cell level (what happens to RBC?), and the clinical level (what happens to a person during an attack?).

(4)

3. a. The standard free energy change for $A \rightarrow B + C$ is -30.5 kJ/mol . Calculate the equilibrium constant for this reaction, given that $R = 8.314 \text{ J/mol K}$ and $T = 300 \text{ K}$. State equation, show work, circle answer.

(4)

- b. If the concentrations are as follows: $[A] = 9 \text{ M}$, $[B] = 6 \text{ M}$, and $[C] = 3 \text{ M}$, calculate the actual free energy change for the reaction given in part (a). You must state equation and show your work for full credit.

(3)

- c. A Michaelis Menten enzyme is found to have a V_{max} at a certain concentration = 50 mM/sec . This enzyme has a $K_m = 3 \text{ mM}$ with its substrate. Please calculate the initial rate when the substrate concentration is 2 mM . State equation, show work, circle answer.

(3)

4. a. Draw Sucrose in the Haworth projection.

(4)

b. Compared to α -D-Mannose, what are each of the following?

(4)

- | | |
|----------------------------|---------------|
| _____ α -D-Fructose | A. 2-epimer |
| _____ α -D-Glucose | B. 3-epimer |
| _____ α -D-Mannose | C. Anomer |
| | D. Isomer |
| _____ α -L-Mannose | E. Enantiomer |

c. Draw the α and β anomers of D-Galactopyranose in the Haworth projection

(2)

5. a. Draw a steroid nucleus (or cholesterol), and draw sphingomyelin

(3)

b. Identify the cofactors shown below:

(4)

c. Draw the "active" parts of TPP (Thiamine Pyrophosphate) and PLP (Pyridoxal Phosphate).

(3)