

Name _____

I.D. _____

Score _____

Exam 2, BICH 440, Section 500, Monday, October 28, 2002

Write your name on each page. Write concise answers to demonstrate effectively your mastery of the subject. Show your work in order to receive maximum credit where applicable.

gas constant R 8.315 J/mol-K

Faraday constant F 96.5 kJ/mol-volt

1. (15 pts) Eukaryotic messenger RNAs are "capped" at their 5' ends with an unusual structure that can be abbreviated:

7-MeGpppAp...

I'll give you the following hints to help you with the structure.

- a) The guanine base is methylated at position 7.
- b) The guanosine and adenosine ribonucleosides are linked together with a triphosphate chain using 5' carbons on each.
- c) The phosphate "to the right" of the A is on the 3' carbon.
- d) The atom that is methylated on guanine then carries a positive charge.

Draw the molecular structure of this "cap" (at pH 7). Do not "abbreviate" the phosphates.

2. (5 pts) Why do animals that live in cold climates generally have more polyunsaturated fatty acid residues in their fats than do animals that live in warm climates?

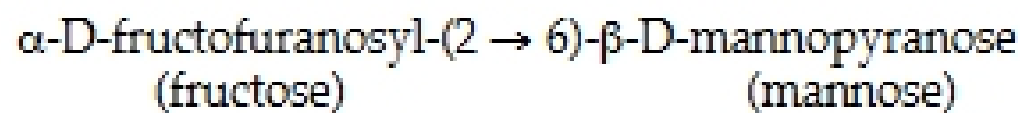
3. (6 pts) Given the following ribbon diagram of a protein structure:

(a) How many alpha helices?

(b) How many beta strands?

(c) What is the general name for this type of supersecondary structure?

4. (10 pts) Draw the structure of the following hypothetical disaccharide.



5. (15 pts) At the cellular membrane of some bacteria, oxidation-reduction reactions within the membrane generate a pH gradient of $\Delta\text{pH} = 1.0$ (interior higher by one unit) and a membrane potential of -120mV (interior negative). This "proton-motive" force can be used to synthesize ATP from ADP and phosphate inside the cell. Here is some more information that may be useful as you solve the problems below:

temp. = 37 C

[ATP] = 5 mM

[ADP] = 1 mM

[phosphate] = 2 mM

for ATP hydrolysis, $\Delta G' = -30.5\text{ kJ/mole}$

(other constants given on pg. 1)

- (a) How much free energy is made available by the pH gradient and membrane potential for the transport of protons INTO the cell?
- (b) As the protons are transported into the cell, ATP synthesis can be coupled to this process by the enzyme ATP synthase. At 100% efficiency, under the conditions listed above, how many protons must be transported to synthesize one molecule of ATP?