Review for Exam III
MEMBRANES, POLYUNSATURATED FATTY ACID OXIDATION, ATHEROSCLEROSIS
Chemistry 462
Spring 2003

Know types of membrane proteins (and one example of each type I - IV, including peripheral proteins)
Know what hydropathy index measures (hydrophobic (+ values) versus hydrophillic sequences (- values))
Difference between facilitated diffusion and active transport; symport and antiport transport
Differences between P, V, F types of active transport proteins. Know one example for each type.

Know pathway for oxidation of polyunsaturated fatty acids up to the formation of ROOH; know fate of ROOH
Vitamin E/Vitamin C protection against oxidation of polyunsaturated fatty acids

Know the general functions of the blood lipoproteins:
Chylomicra, (LDL, VLDL, IDL) and HDL
Atherosclerosis: how elevated blood cholesterol leads to hardening of the arteries

QUESTIONS

1. Describe two defects that lead to impaired uptake of LDLs.

2. If apoprotein B-100 is defective or not synthesized, what affect would this have on cholesterol metabolism in peripheral tissues (nonliver, heart, or muscle)?

3. If an membrane-spanning α-helix requires about 25 amino acids to span the ~30 D of a bilayer membrane, calculate the minimum molecular weight of a protein made up of 7 helical membrane-spanning regions (typical number of helices in many membrane-spanning proteins).

4. The hydropathy index (Kyte and Doolittle, "A simple method for displaying the hydropathic character of a protein." J. Mol. Biol., 157, 105-132 (1982)) for an amino acid is related to the free energy associated with its ability to partition into water from a hydrocarbon solvent in a separation system. A partition coefficient (Kp) can be defined (see below) where [AA] represents the measured concentration of an amino acid in water or in the organic solvent.

$$AA_{organic\ solvent} \quad o \quad [AA]_{water}$$

$$Kp = \frac{[AA]_{water}}{[AA]_{organic\ solvent}}$$

Hydropathy Indices

Alanine	1.8
Arginine	-4.5
Asparagine	-3.5
Aspartic acid	-3.5
Cysteine/cystine	2.5
Glutamine	-3.5
Glutamic Acid	-3.5
Glycine	-0.4
Histidine	-3.2
Isoleucine	4.5
Leucine	3.8
Lysine	-3.9
Methionine	1.9
Phenylalanine	2.8
Proline	-1.6
Serine	-0.8
Threonine	-0.7
Tryptophan	-0.9

AA examples:

If Kp is > 1, what is the sign of ΔG associated with this partitioning? _____ _____

If Kp is < 1, what is the sign of ΔG associated with this partitioning? _____ _____

Give the three letter abbreviations for two amino acids that would be expected to be have Kp values > 1 or < 1.

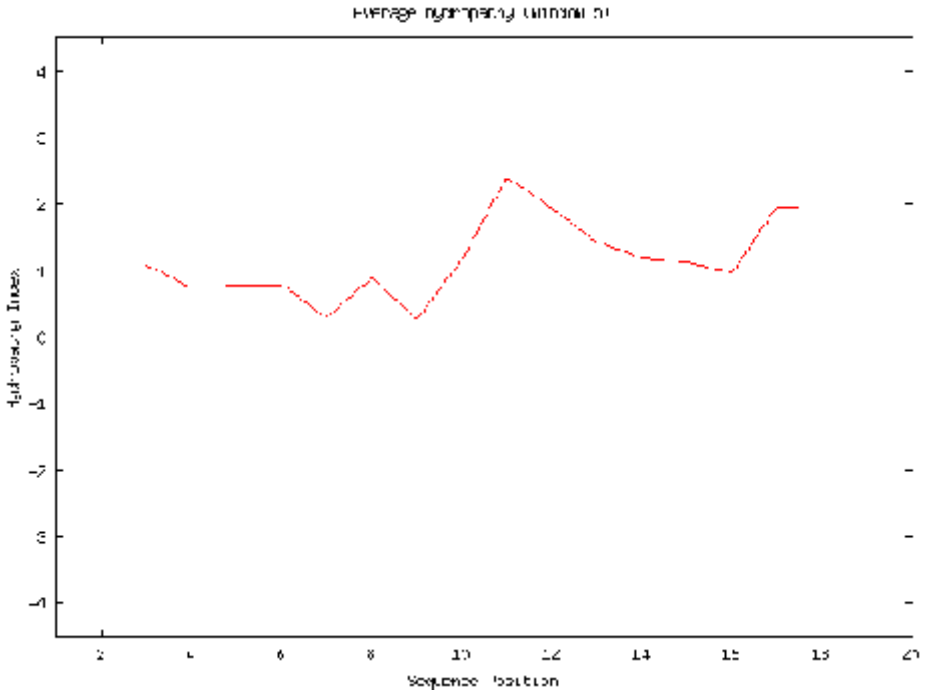
Using the information above and the hydropathy indices in the box at the left, provide an explanation for the differences between the indices for the following pairs of amino acids:

tyr and phe
lys and arg

Using the information above and the hydropathy indices in the box at the left, provide an explanation for the similarities between the indices for the following pairs of amino acids:

glu and asp
glu and gln

5. Examine the hydropathy index plot below and decide if this protein would be a membrane protein. Justify your answer.



6. Lemon fruit vacuoles acidify their vacuoles to pH 2.5, 3 pH units lower than typical plant vacuoles. What type of active transport protein (F, P, or V) is likely to be pumping the H^+ to acidify these vacuoles? ATP hydrolysis is required for H^+ transport, but the transport is not inhibited by vanadate (VO_4^{-3}).

7. Hydrogen ion is pumped into the stomach by a ATPase that is phosphorylated by ATP and inhibited by vanadate. What type of active transport protein (F, P, or V) is this one likely to be?

8. Explain briefly why Vitamin E cannot reduce the stabilized lipid radical that is the first intermediate in polyunsaturated fatty acid oxidation in membranes. What is thought to be the function of Vitamin E in preventing lipid peroxidation? In addition to your explanation, give a mechanism of polyunsaturated fatty acid oxidation up to ROOH to illustrate your answer. Indicate briefly what the fate of the ROOH is.

9. Circulating HDL particles can become oxidized, a process which diminishes their ability to remove cholesterol from the white cells called macrophages. Apply your knowledge of the function of the HDL particle and explain why the HDL oxidation contributes to atherosclerosis.