 Name Key

Biochemistry 5700
Fall, 2000
Exam 2

INSTRUCTIONS:

Do not begin until 10:30 AM. The in-class portion of the exam must be turned in by 11:20 AM. The in-class portion should have 8 questions and 6 pages. **ANSWER ANY 7 OF 8 OF THE QUESTIONS-Mark "DO NOT GRADE" on the one question you choose to skip. DO NOT answer all eight questions-if you do, cross the one out which you don't want graded.** Each graded question is worth 10 points. The take home portion contains two questions, worth a total of 30 points. The take home portion is due beginning of class Wednesday. Good Luck!!

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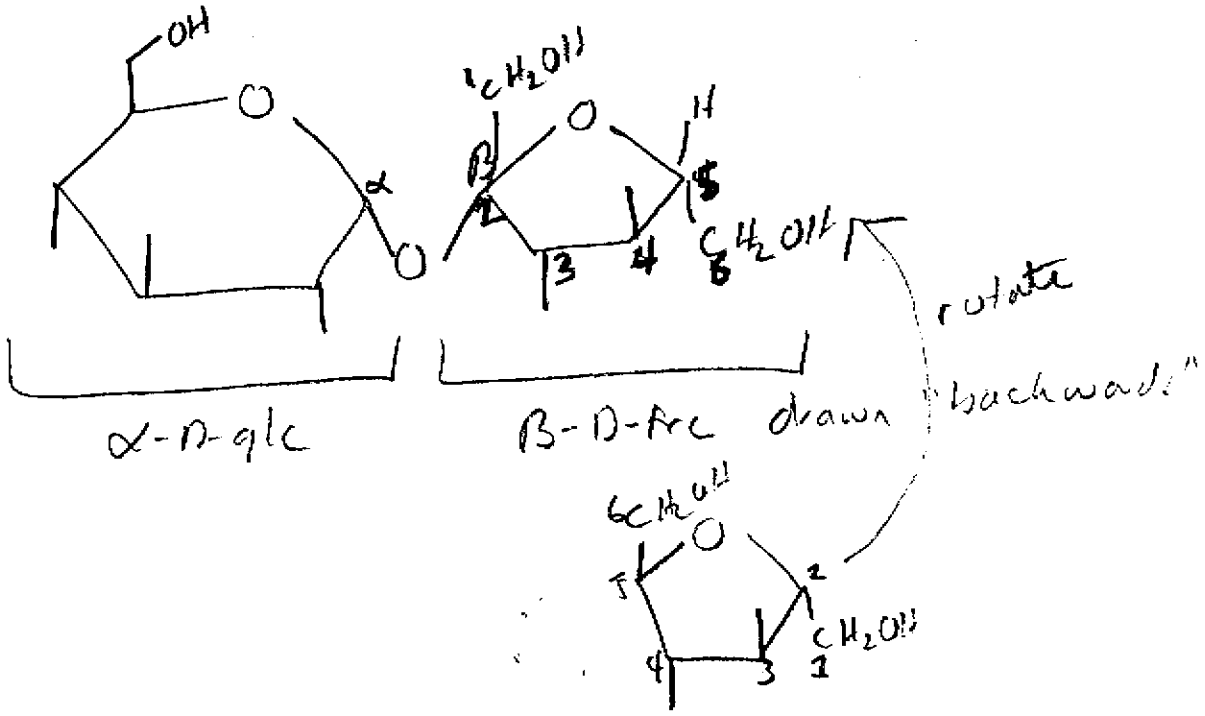
(1) Given that sucrose is the disaccharide O-α-D-glucopyranosyl-(1,2)-ß-D-fructofuranoside:
(a) draw the structure of sucrose.
(b) Is sucrose a reducing or nonreducing sugar? Explain why.

+6
+4

a)



b) nonreducing. Anomeric carbons, ie the hemiacetal or hemiketal carbons, are linked together via ether link, so no free anomeric C is present. So sugar cannot be oxidized at anomeric C's.

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(2) (10 points)
(a) Match these molecules with their biological roles.

(i) glycogen	ii	carbohydrate storage in plants
(ii) starch	iii	exoskeleton of insects
(iii) chitin	v	structural component of bacterial cell wall
(iv) cellulose	iv	structural component of plant cell walls
(v) peptidoglycan	vi	extracellular matrix of animal tissues
(vi) proteoglycan	i	carbohydrate storage in animal liver

(b) Describe the structural features of one of the molecules named above (ie type(s) of sugar(s), repeating units, type of linkage, branching, etc).

glycogen- linear polymer of α1,4-glc linkag
other linear polymer branch off
periodically via α1,6 linkages
α-linkages give main chain
a coiled 2° structure

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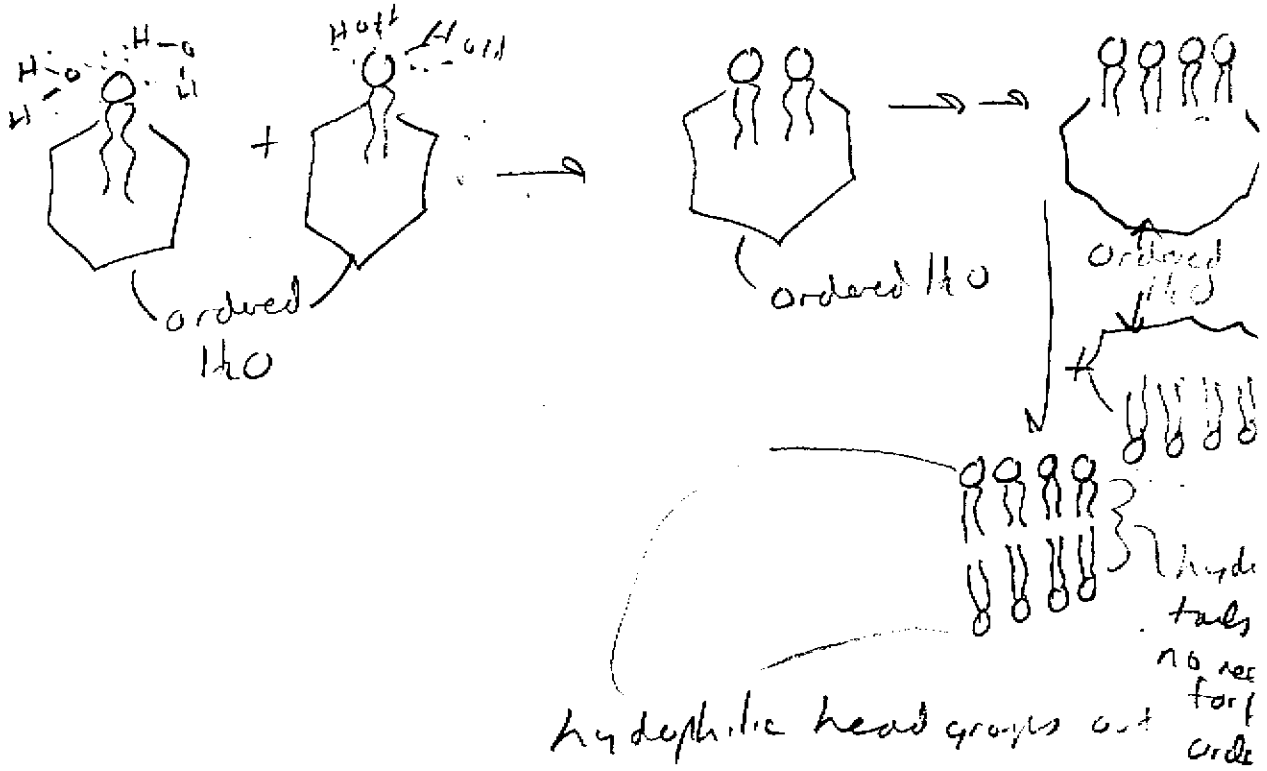
(3) (10 points) (a) Explain why phosphoglycerides are capable of spontaneously assembling into the bilayer structure found in biological membranes but triacylglycerols are not. (b) What are the forces that drive bilayer formation?

phosphoglycerides are amphipathic due to their polar head group attached to C3 of glycerol thru a phosphoester linkage. The polar head group can thus be solvated by water. the HC side chains aggregate in a process favored by the hydrophobic effect. the disordering of water as the ordered cages required for HC chain are shed.



triacylglycerides are effectively nonpolar - thus they form fat aggregates (droplets) that have no favorable interactions with water.

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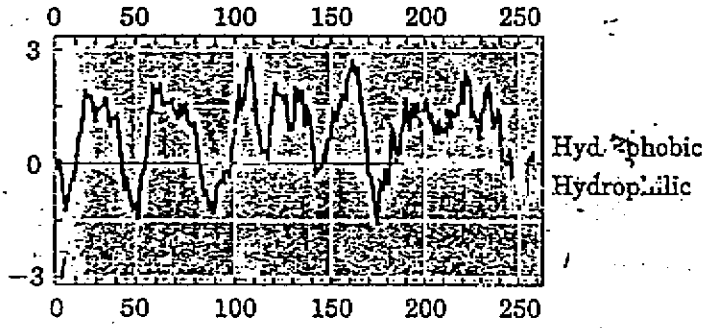
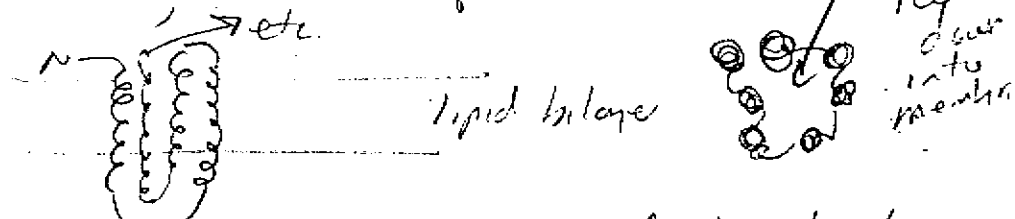
(4) The following is the hydropathy plot for bacteriorhodopsin:



(a) Explain the structural details of bacteriorhodopsin that can be deduced from the plot.
(b) What type of transporter is bacteriorhodopsin?
(c) Briefly explain the mechanism of bacteriorhodopsin-catalyzed proton transfer.

(a) The positive peaks on the plot indicate regions of protein with nonpolar AA content. ~7 such segments are present in length consistent with a transmembrane spanning α-helices. So the transmembrane domain of rhodopsin is a bundled group of α-helices, each of which spans



Core of transmembrane provides cofactor binding site & channel for H^+ transfer

b) primary active

c) absorption of visible light by the cofactor rhodopsin which is covalently linked to an AA side chain of protein, causes a trans/cis conf. change. This change in turn causes conf. changes within protein, which allows net movement of a proton via gen acid/base transfer, from one side of mem. to other

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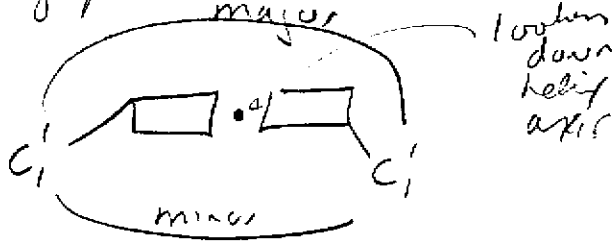
(5) Define the following terms as they relate to DNA structure:

(a) major groove

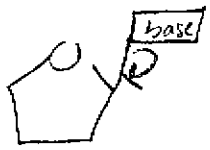
The side of DNA formed by the larger angle connecting the C_1' carbons of paired bases & the center of the helix axis



(b) minor groove

The side of DNA formed by the smaller ∠ defined as

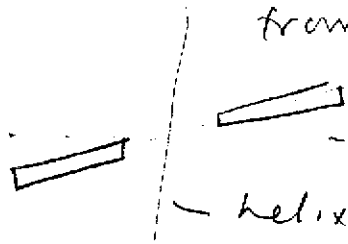
(c) glycosidic bond orientation



The orientation about the sugar/base N ether bond - angle is "anti" in B-DNA, with the base pointing away from suga

(d) base tilt

base pairs in double helix are tilted ~6° from ⊥ plane to helix axis



(e) sugar pucker

for ribose & deoxyribose, 1 of 5 C atoms lies out of plane of other 4:

In DNA C2' C is out of plane on same side as C5' carbon - hence C2' endo

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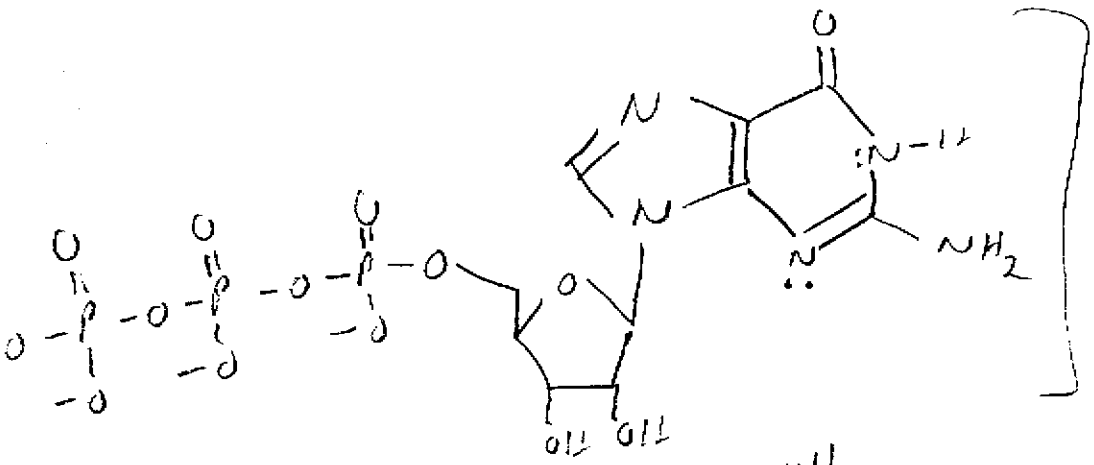
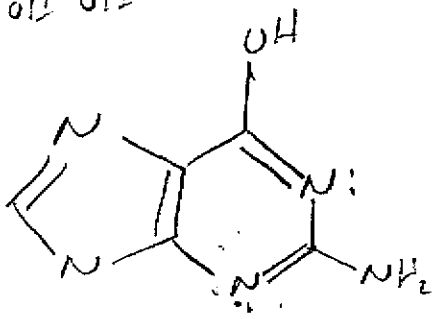
(6) (a) Draw the structure of guanosine-5'-triphosphate.
(b) Draw the enol tautomer of guanine.





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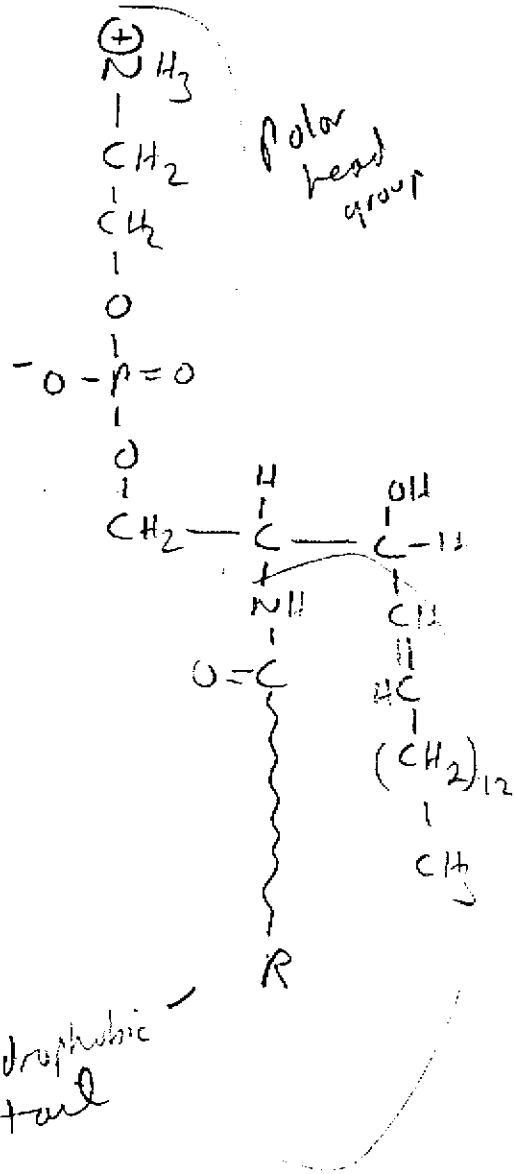
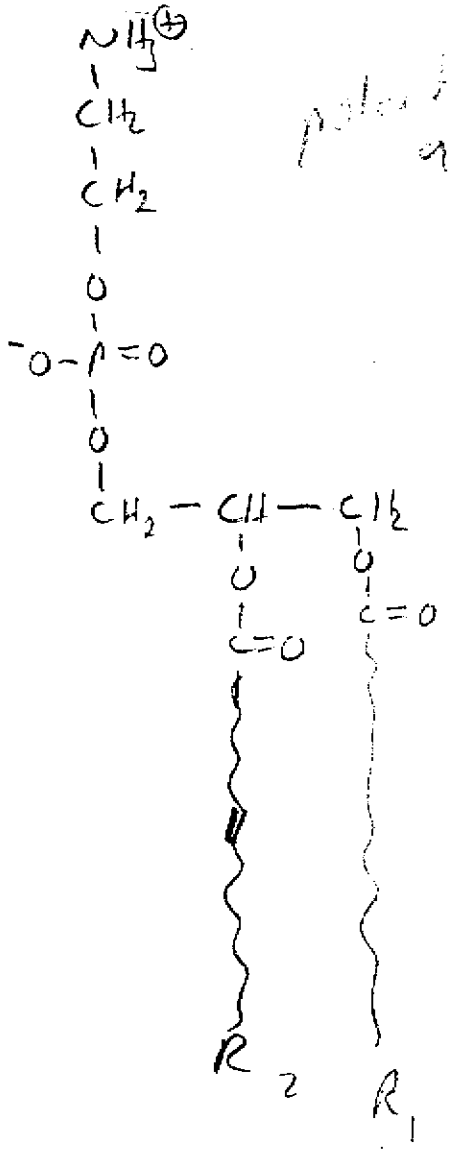
(7) Draw generalized structures (long chain hydrocarbons can be abbreviated) for phosphatidylethanolamine and sphingomyelin (containing ethanolamine) in orientations that highlight how the two different lipids can assume similar overall structures within bilayers.





Both assume $\overset{O}{\overset{\|}{C}}$ structure in membrane & may be used interchangeably.

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(8) What is the "transition temperature" for a membrane bilayer? How does cholesterol affect the fluidity of membrane bilayers above and below the transition temperature? Explain the biochemical basis for each effect.

The transition temperature is the temp. at which the lipid bilayer undergoes a phase change from liquid-crystalline (fluid) to para-crystalline (solid). There is little molecular motion in the para-crystalline form as motion of HC tails is frozen out.

Below trans. T cholesterol increases fluidity by interfering with the close packing of HC tails within the bilayer, thus preventing l→s transition.

Above trans. T cholesterol decreases fluidity by preventing unrestricted rotation of HC side chains & lipid diffusion. Thus, bilayer remains intact & doesn't dissolve