Tentative Correction scheme for essay questions 604229 C:\6e\6fe\6FECorVmLktbk.wpd

Kleine 1 (BIO 2140) **Question 1.** (10.0 points)
A) SECOND MESSENGERS 5.0 points

2 Name 4 of the second messengers seen in this course (0.5 points each for 4 messengers from table bellow are named)
1.5 Mention very briefly **how three of them are formed** (i.e. which enzyme catalyses the reaction) (0.5 points/each
0.3 for partial enzyme name/ partial source description)
1.5 and what **their roles** are

Messenger	Source / enzyme that catalyses the reaction	Effect / role
cAMP	Adenylyl cyclase or adenylate cyclase	Activates protein kinases (or PKA)
cGMP	Guanylyl cyclase	any of : Activates protein kinases, regulates ion channels, regulates phosphodiesterases
Ca ion (or Ca^{2+})	Ion channels in endoplasmic reticulum (ER)	Activates protein kinases , or PKC or activates Ca^{2+}-modulated proteins, or calmodulin
Inositol 1,4,5-trisphosphate (IP_3)	Phospholipase C (PLC) action on phosphatidylinositol* bisphosphate (PIP_2)	Activates Ca^{2+} channels
Diacylglycerol (DAG)	Phospholipase C (PLC) action on phosphatidylinositol (PI) or PIP_2	Activates protein kinase C or kinase
Ceramide	sphingomyelinase (SMase)	Activates protein kinases

* not acceptable phosphatidylinositol

B) SPONTANEOUS LIPID STRUCTURES 5.0 points
Many lipids spontaneously form specific structures in an aqueous environment.

2: **Explain <u>why</u> and <u>how</u> this occurs (2 points for answer similar to answer bellow)**

1 Why: This occurs in order to minimize contact between the hydrophobic lipid chains and The driving force is that water does not want to have an ordered structure with the lipid. Give 2 to anyone who says this and one of the other two concepts.
for 0.7: Occurs due to hydrophobic interactions between the amphipathic lipids
1 How: The hydrophobic tails(fatty acids)of the lipids isolate themselves away from the hydrophilic environment by clustering together, the hydrophilic (polar/ionized) heads orient towards the hydrophilic environment could be summarized as hydrophobic interactions

1.5 marks for one of these, something like both needed for 2

3 Forms (0.75 points for the name and 0.25 points for a small explanation):
1 --micelles (sphere with hydrophobic tails buried in the center)
2 --Lipid bilayers (like cell membranes or liposome)
3 --unilamellar vesicles (small circular membranes) [OK but not needed: multilamellar vesicles (multiple cell like membranes arranged one within the other)]

monolayer could replace one of these {**Monocouche :** est formée à **l'interface eau-air**, les têtes polaires étant au contact de la surface de l'eau et les queues hydrophobes au contact avec l'air).

Question 2. 10.0 points Describe the ROLE OF THE VARIOUS LIPIDS FOUND IN MEMBRANES in terms of MEMBRANE FLUIDITY AND FUNCTION.

When you get 10 marks as the following items stop grading

1 phospholipids
1 sphingolipids (can be replaced by gangliosides, cerebrosides)
1 cholesterol
0.5 glycolipids

1 phospholipids sphingolipids length and unsaturation of acyl chains cause fluidity
0.5 length : shorter more fluid
0.5 unsaturation: more is more fluid
0.5 the above is because less tight packing, or weak interactions, with these molecules
0.5 glycolipid (or gangliosides) confer cell specificity
0.5 cholesterol intercalates among acyl chains
1 above transition temperature: stiffens membrane
1 below transition temperature: increases fluidity
0.5 cholesterol widens transition phase temperature
0.5 lateral assymetry of lipids or proteins (patches)
1 transverse assymetry of proteins and lipids determines outside and inside functions

Kleine 3. Describe the STRUCTURE OF COLLAGEN. (Total Mark: 10)

Do up to 10 marks from:

Helix structure: Basic structural unit
1.5 3 intertwined helices give tropocollagen, {0.5 for word, 1 for explanation)
0.5 3.3 residues/turn
o.5 found in skin bone tendon teeth, blood vessels
0.5 Right handed
0.5 triple helix
0.5 composed of three
0.5 left handed helical chain,
0.5 chain is not alpha helix or beta sheet
1 about a third Gly
0.5 Gly must be at each 3rd amino acid
0.5 because it si small enough to be at centre of triple helix

0.5 high Pro
0.5 contains HyPro & HyLys
0.15 if Pro + HyPro = 30%
0.5 HyPro & Hy Lys made be posttranslational modifications
0.5 Sequence Gly-Pro-Pro/HyPro
1 NH of Gly makes a hydrogen bond with O of adjacent chain
1 interchain Lys-Lys (hydroxypryridinium) cross links [0.8 just for crosslinks}

Electron Microscope description:

0.5 for overlapping tropocollagen fibers
0.5 for bands
0.5 for stating that is electron microscope
0.5 sugars covalently bound to HyLys fill in gaps/ holes

0.5 in skin sheets of fibrils at different angles. tendons are parallel bundles

<u>1 mark each</u> FILL IN BLANKS QUESTIONS

50. The drawing is that of glutamic acid with the amino group and carboxyl groups fully protonated. (*the picture is on exam <Mezl*) Separately, draw the predominant forms of glutamic acid that would be found at pH 9 and at pH 10.

Glu^+	**Glu^-**	**Glu^{2-}**
Protonated form	**At pH 9**	**At pH 10**
$HOOC-CH_2-CH_2-CHNH_3^+-COOH$	$^-OOC-CH_2-CH_2-CHNH_3^+-COO^-$	$^-OOC-CH_2-CH_2-CHNH_2-COO^-$

0 if carboxyls are protonated.

51. The MOST important factor that determines the three-dimensional structure of a protein is _____.

Full mark for: The primary sequence or The amino acid sequence

or

Ans: rotation about each of the single bonds along the peptide backbone
Or
The nature of R-groups of their component amino acids

52. Phospholipase A2 (PLA2) catalyses a reaction involving phosphatidylcholine (PC) as substrate. The products of this reaction are _____ and _____.

Ans: Lysolecithin (lysophophatidylcholine), fatty acid

0.5 if Arachidonate/arachidonic acid

53. Phospholipase C catalyses the hydrolysis of phosphatidylinositol-4,5-bisphosphate to form the products _____ and _____.
Ans: Inositol triphosphate ($InsP_3$), diacylglycerol (DAG)

54. The following reaction:
glucose-6-phosphate + H2O ? glucose + orthophosphate
is catalyzed by this major class of enzymes: _____.
Ans: Hydrolases
or hydratase

55. Give the names of three lipids found in membranes; you may only name one of the glycerophospholipids: _____, _____, _____.
0.3 1) Cholesterol
0.4 2) One of : Phosphatidyl choline or phosphatidyl ethanolamine or phosphatidyl serine or phosphatidyl inositol, or anything on fig 8.6 (abbreviations are OK, e.g., PC, PE, etc...)
0.3 3) One of: sphingomyelin or sphingolipids or glycosphingolipids or gangliosides or sulfatides or ceramide based lipids, or a fat soluble vitamin (consider all answers)

Questions 56-60 are on structures that you need to see and are in the attached pdf file

56) Ans: B and D 0.5 each , -0.4 for wrong one

57) Ans: A, C, and E -0.3 for missing -0.2 for wrong one

58) Ans: D -0.5 for wrong one

59) Ans: cerebroside sufficient

60) Ans: sphingomyelin sufficient
Full Answer is Choline Sphingomyelin

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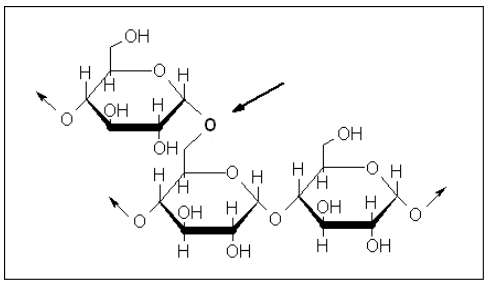
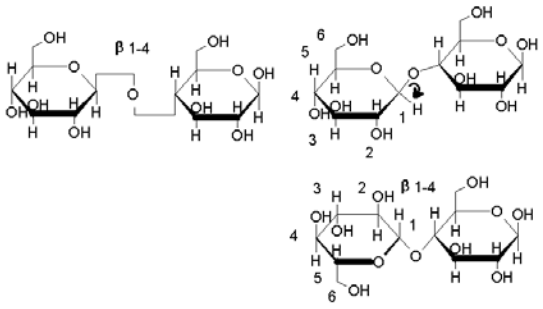
· Draw a representative element of **amylopectin, cellulose and glycogen** (draw just enough to show the sugars involved and the bonds). Describe the differences in the structures. Where are these molecules found and what is their role? Describe what you see when you look for amylopectin and glycogen with the electron microscope (approximate shape and size) and explain what is in the structures that you see under the electron microscope.

<u>representative elements</u> = 4

2



2



they can use the same one for amylo pec and glycogen (but only get 1 x 2 points!)
For amylopec and glycogen: sugar is 0.6, bond = 0.7, branch = 0.7
For cellulose: sugar= 0.6, bond = 0.7, dimer = 0.7 (if only upper right structure =0.5, if they discuss dimer but show left structure give 0.3)

<u>Describe the differences</u> = 2.5 *If they can not draw (above) but use the right words give them only half credit below*

0.5 amylopectin and glycogen α-1,4 bonds
0.5 branching: α-1,6 bonds
1 branching: amylo pec every 2-3 dozen residues, glycogen every dozen
(give just 0.4 if they only say glycogen is more compact)
0.5 cellulose: linear **β**-1,4
If they discuss number of residues in amylopectin and glycogen, you can use this to give them a break elsewhere

		<u>Where</u> and	<u>Role</u> =1.5
0.5	amylopectin,	plant	storage of glucose
0.5	cellulose	plant	structure
0.5	glycogen	mammal	storage of glucose

<u>amylopectin</u> <u>and glycogen with the electron microscope</u>=1

0.3 very large granules	small (barely visible) granules
0.7 1 um *accept anything up to 5 um*	0.1 um *accept up to 0.6um*

<u>explain what is in the structures</u>
<u>1</u> amylopec = many molecules; glycogen = 1 molecule (*this is Question 2.8.2b!*)
10 = total marks
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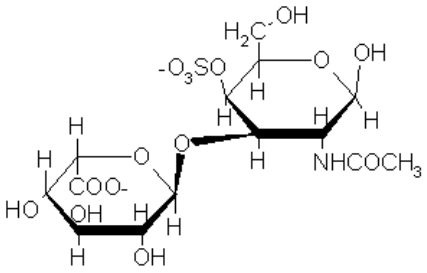
· Use words and the terminology that you learned in class to describe the structure below in an unambiguous manner. Take the sugar on the upper right of the structure, oxidize carbon 1 to the level of an acid and draw both the oxidized cycle and the linear form of the oxidized compound. Name both compounds.

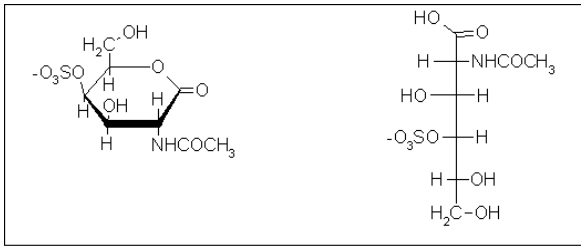


Correction scheme of **60412** practice structure of (pg S20), unknown first sugar
10= total

1 L hexose **sugar 1 = 3.5**
0.5 aldo pyranose
0.5 C6 oxidized to level of acid
1.5 Configurations: C2 opposite, C3 same, C4 opposite of reference atom
Some will say C2 =D, C3 = L, C4 = D Allow this
If they say configurations are **like** D-glucose with difference that C5 is the opposite, this is accepted. Anything about L-glucose is not! (fyi: the sugar shown is L-idose).
If some student decides to start with the carboxyl as carbon 1, we will have to accept (it is the unbiased IUPAC naming). Can the first person that gets this, work out an answer and send to all

1 linked α-1,3 (0.7 for α, 0.3 for 1,3) **link = 1**
to
0.5 β **sugar 2 = 2.5**
0.5 D
0.5 galactose
0.5 2 N acetyl
0.5 4 sulfo (accept sulfato, sulfate but give half for sulfhydryl, sulfide, etc...)
2.2 If they miss that this is galactose but give an ok description for Gal

0.5
1.5



oxidized sugar = 3

1 lactone or galactolactone (0.5, 0.3 for cyclic ester)
Galactonic acid (0.5,still 0.5 if just suffix,
0.3 if states linear form with C1 as acid)

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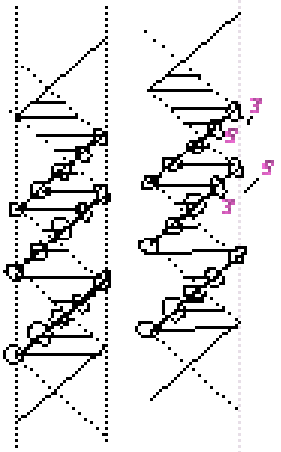
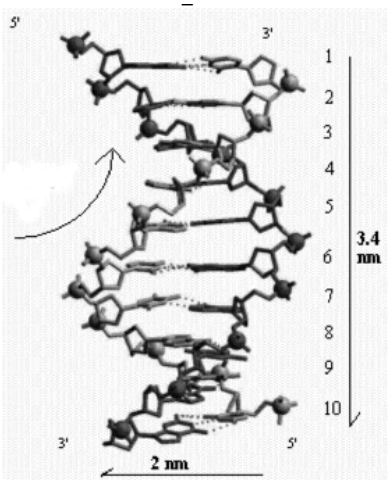
Draw the profile of DNA B (DNA seen from the side) and describe the structurally significant elements (important dimensions, charges, bonds, hydrophobic and hydrophillic elements, etc) or identify them on your drawing. Briefly (for 1 mark) explain what happens to this structure in a nucleosome.

They learned a drawing method (See lecture notes)
If they do either of the two on right consider it a success





4 Give **4 for that type of drawing**
2 if drawing does not show different groove size
1.7 if grooves not understood (same ones opposite each other)
proper numbering of strands not necessary
-0.5 if sugars not shown (but check their text)
-0.5 if bases not shown (but check their text)
1 if is just one strand (0 if they draw nucleosome)
3 if aspect ratio really weird
-0.5 if no dimensions on structure
-1 if dimensions identified wrong

2.5 for these required elements
1 for 2 dimensions (tolerate only 10% error!)
0.5 10 base pairs per turn
0.5 for right handed twist
0.5 big groove, little groove

2.5 for any of the following (worth 0.5 each)
antiparallel strands
complementary base pairs/ hydrogen bonded
negative phosphate charge on outside
phosphodiester bond
hydrophobic bases stacked on inside
hydophillic sugars on outside
plane of sugars parallel to helix axis
proper identification of strand direction

1 for nucleosome part of question
1 =In a nucleosome this structure does two wraps around a protein core
10 = total