31. The concentration of pure ethanol is approximately ..... M.

A) 20 B) 30 C) 40 D) 50 E) 60

32. An amino nitrogen is hydrogen bonded to an aldehyde oxygen. The distance between the the center of the nitrogen and the center of the oxygen is about:

A) 0.109 nm B) .016 nm C) 0.28 nm D) 0.36 nm E) 0.45 nm

33. Estimate the <u>total amount</u> of hydrogen ions present in all the blood in your body:

A) about 0.5 millimoles B) about 0.5 micromoles C) about 0.5 nanomoles
D) about 50 nM E) about 5 10^{-7} M

34. When c is in osmolar units (Osm), the osmotic pressure is proportional to :

A) cRT B) cRD C) cRT/D r^2
D) cR/D T E) cD/ $(q_1 q_2)$ r^2

35. The pH of 1 mL of 20 mM acetate buffer is 4. For this problem use a pK of 4 for acetic acid. When 5 microlitres of 1 N HCl are added to this solution, the pH will be about :

A) 3.9 B) 3.5 C) 3 D) 2.7 E) 2

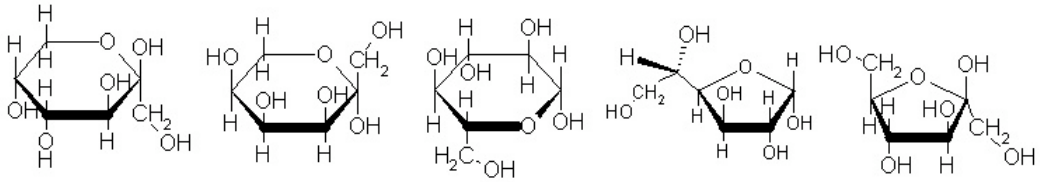
36. The buffering reaction in blood is due to the equilibrium between :

A) CO_3^{2-} and HCO_3^-
B) HCO_3^- and H_2CO_3
C) CO_2 and H_2CO_3
D) CO_2 liquid and CO_2 gas
E) HCO_3^- and fixed carbon

37. In a normal individual glucose is ..... % of blood.

A) 0.5 % B) 0.1 % C) 0.05 % D) 0.01 % E) 0.005 %

Use these structures as answers for the following questions



[I] [II] [III] [IV] [V]

38. ..... are aldoses

A) [I], [II], [III] B) [III] , [IV] C) [IV] , [V] D) [I] , [II] E) [I] , [V]

39. ..... has the L-configuration

A) [I], [V] B) [II] , [III] C) [II] , [IV] D) [II] , [V] E) [III]

40. Sugar [I] has a prochiral carbon at position :

A) 1 B) 1, 2, 6 C) 1, 6 D) 2, 3, 4 E) 5

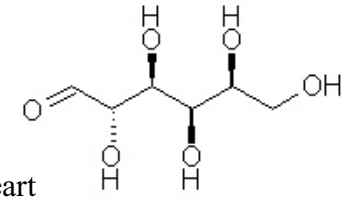
41. Sugar [I] is :

A) Glucose
B) Fructose
C) Mannose
D) An L-sugar but not one to know by heart
E) A D-sugar but not one to know by heart

42. Sugar [IV] is :

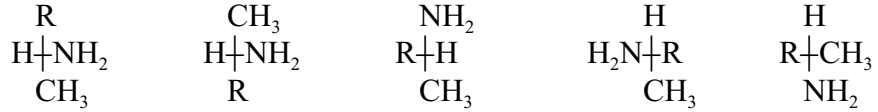
A) Glucose
B) Fructose
C) Mannose
D) An L-sugar but not one to know by heart
E) A D-sugar but not one to know by heart

43. The molecule on the right is:



A) D-glucose
B) L-mannose
C) D-galactose
D) An L-sugar but not one of the ones to know by heart
E) A D-sugar but not one of the ones to know by heart

44. The enantiomer/s of (I) is / are :



(I) (II) (III) (IV) (V)

A) II B) III C) IV D) IV et V E) II, III, IV et V

45. Ribose exists predominantly as a

A) furanose in solution and as a furanose in polysaccharides
B) pyranose in solution and as a furanose in polysaccharides
C) furanose in solution and as a pyranose in polysaccharides
D) pyranose in solution and as a pyranose in polysaccharides
E) pyranose in solution and as a lactone in polysaccharides

46. In sucrose, the bond between the subunits goes from :

A) C1 to C1. B) C1 to C2 C) C2 to C2 D) C1 to C4 E) C1 to C6

47. Glucose oxidase turns glucose into :

A) gluconic acid B) glucuronic acid C) glucolactone D) sorbose E) CO_2

48. Penicillinase

A) activates penicillin
B) destroys penicillin
C) is made up of D-amino acids
D) transports penicillin into bacteria
E) attaches penicillin to a polysaccharide on the membrane of bacteria

49. 5-methyl uracil is found in (Careful, imagine it or draw it) :

A) tRNA B) mRNA C) DNA
D) A and B E) A, B and C

50. In a purine nucleotide, this position of the base attaches to the sugar:

A) 1 B) 3 C) 7 D) 9 E) 5'

51. ..... does not contain sugar.

A) Adenosine B) Cytosine C) Guanosine D) Thymidine E) Uridine

52. If you drew cytosine as the enol form, it will have an OH on position .....

A) 2 B) 3 C) 4 D) 5 E) It can have the OH on any of these positions

53. Hydrogen bond between the two strands of a Watson-Crick helix :

A) N-H····O= B) N-H····N C) O-H···O D) A and B E) A, B and C

54. When discussing nucleotides, syn and anti refer to:

A) the configuration of the anomeric carbon
B) rotation around the bond that links the sugar with the base
C) lactim-lactam interconversions
D) the partial charge on the base
E) which atom of the base is linked to the sugar

55. If you took all the DNA in 10^5 of your cells and stretched it out as a Watson Crick helix it would stretch about :

A) 9 km (Height of Mont Everest) B) 300 km (Earth to orbit)
C) 10,000 km (North pole to equator) D) 400,000 km (earth to moon distance)
E) 50,000,000 km (earth to Venus)

56. A chromosome contains 5 10^5 nucleosomes. This chromosome is about ..... base pairs long.

A) 2 10^5 B) 1 10^6 C) 5 10^6 D) 20 10^6 E) 100 10^6

57. In a eukaryotic cell, mRNA is about .... of the total RNA.

A) 1% B) 10% C) 25% D) 50% E) 80%

58. A patient has an increased amount of a small molecule circulating in his blood. You analyze it and find that it is thymine linked to the sugar ribose. You propose that patient has

A) an increased breakdown of protein B) an increased breakdown of DNA
C) an increased breakdown of tRNA D) diabetes (high blood glucose)
E) an increased breakdown of hydrophobic molecules

59. A gene is expressed in brain but not in liver. You examine this sequence on gels. The normal result should be :

	Southern gel		Northern gel	
	brain	liver	brain	liver
A)	one band	the same band	one band	the same band
B)	one band	the same band	one band	no band
C)	one band	no band	one band	no band
D)	one band	a different band	one band	no band
E)	one band	a different band	one band	a different band

60. ..... makes DNA shine orange in UV light.

A) Cupric ion B) Ethidinium bromide C) Ninhydrin
D) Iodine E) Periodate

A1. Use the following information to calculate how many ATP molecules are produced by the complete oxidation of lauroyl-CoA. Show your calculations. Use complete sentences to explain each step of your answer. Take into consideration the ATP equivalents required to prime the substrate in your final calculation of absolute yield.

Relevant Information:

Complete oxidation of palmitoyl-CoA (16:0) involves seven rounds of β oxidation and yields :
7 $FADH_2$, 7 NADH, 8 acetyl-CoA.

Oxidation of the 8 acetyl-CoAs in turn yields: 24 NADH, 8 $FADH_2$, 8 GTP (yields *8 ATP molecules* in reactions catalyzed by nucleoside diphosphate kinase)

Oxidative phosphorylation of NADH yields 3 ATP molecules per NADH molecule.
Oxidative phosphorylation yields *2 ATPs* per $FADH_2$ molecule.

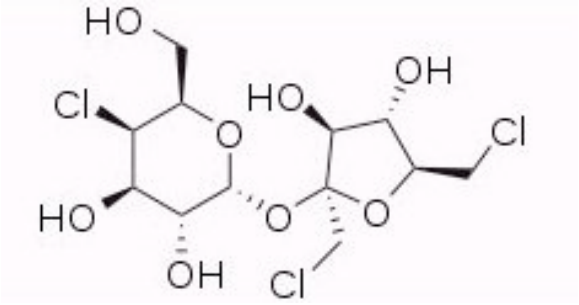
A2. How do hormones signal mobilization of stored triacyglycerols? Use complete sentences to explain each step of your answer.

B1. Plot the net electrical charge (Y axis) vs the pH (X axis) for histidine (4 marks). The pH values on the X axis should vary between 1 and 13. Clearly identify the 'approximate' pKa values and the molecular structures for the protonation reactions occurring at each transition zone within the plot (4

marks). The full chemical structure of histidine should be provided once at the very top of your answer (2 marks).

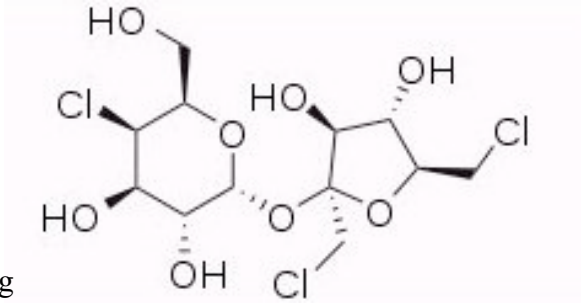
B2. Derive the Michaelis-Menten equation. In you answer you should clearly emphasize each of the underlying assumptions for the Michaelis-Menten model (5 marks). Simple algebraic reorganization of your equations does NOT require any justification, but you are expected to carefully explain any substitution among different equations (5 marks).

C1. Use only words and the sugar names that you learned in class to describe this structure (it's a sweetener called Sucralose) in an unambiguous manner (unambiguous means that it could be drawn by one your colleagues from your description).
Using the Haworth projection, draw the sugar on the right side of Sucralose in the pyranose form.



C2. Draw, as 3'-phosphates, a G-C base pair in Watson-Crick DNA; your diagram should show the configuration at each position of the sugar and ALL the atoms and hydrogen bonds of the bases. Use your figure to discuss the feasibility of making double stranded DNA that contains either a) 1-methyl Guanosine b) 7-methyl Guanosine or c) 9-methyl Guanosine.

Use only words and the sugar names that you learned in class to describe this structure (it's a sweetener called Sucralose) in an unambiguous manner (unambiguous means that it could be drawn by one your colleagues from your description).
Using the Haworth projection, draw the sugar on the right side of Sucralose in the pyranose form.



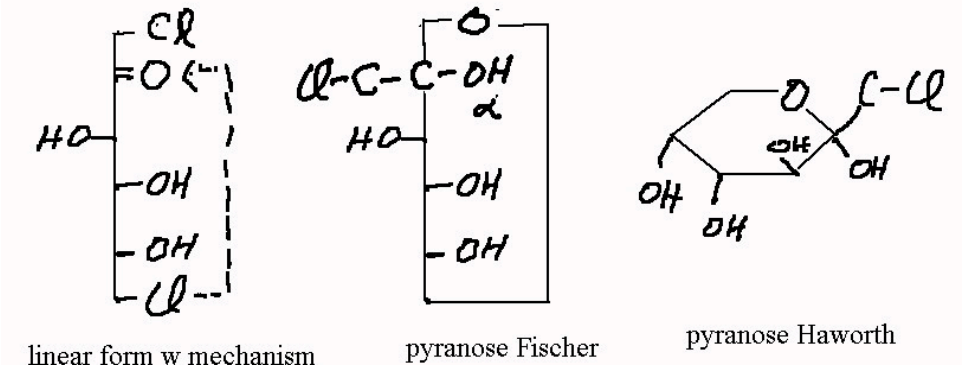
Grade = 4 for each sugar, 0.5 for bond, 1.5 for pyranose drawing
the symbol / separates options

1 ring: aldo (0.5) pyranose (0.5) if they say galactose w/o aldo give full marks
1 ref C: D
0.5 configs: OOS / galactose/Left, left, Right **in fischer**/ L,L,D
1 anomer: alpha
0.5 substituent: 4-chloro

0.5 bond: furanosyl-pyranoside or glycoside(0.25) and 0.25 for : 1 of pyranose/sugar on left to 2 of furanose/ sugar on right//anomer to anomer/alpha to beta/

1 ring: keto (0.5) furanose (0.5) if say fructose w/o keto give full marks
1 ref C: D
0.5 configs: OS / fructose/ left, Right **in fischer**/ L,D
1 anomer: beta
0.5 subs: 1,6-chloro

1.5 for *draw the pyranose form* full marks for structure on right (or other anomer)



give give full marks if C6 still has the Cl on it
1.2 if ring is right but several configs are wrong
1.1 if Cl is the ring atom instead of O! 0.8 if C6 joined directly to C2
1.2 if they do pyranose as Fischer projection (middle structure)
1 if they just do linear form with mechanism (left structure)
0 if cyclization is C1 to C5

Give an EXTRA 0.5 to any that raise the issue of the anomer form of the pyranose and another EXTRA 0.5 if they draw or explain both anomers

For the naive description, like "*sugar on right: C1: O to C5 and O to right to next sugar, C2: OH to right, C3:OH to left, C4:Cl to left, C5: O to right, C6: an OH. sugar on left:* etc..." give 6 for a perfect description (complete the correction scheme or add other creative description that you read to it) and go down from there.

FYI: -The full IUPAC name is 1,6-Dichloro-1,6-dideoxy-β-D-fructofuranosyl-4-chloro-4-deoxy-α-D-galactopyranoside

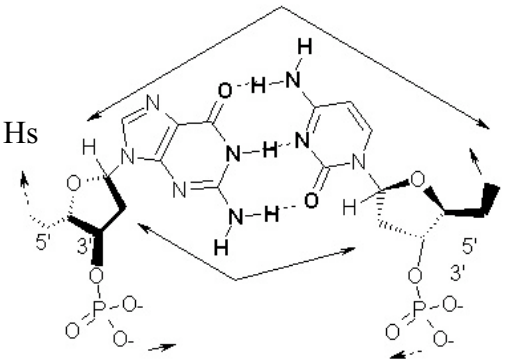
but students do not have to say dideoxy coz I simplified IUPAC and said that substituents replace OHs
- the cyclization is on page S24 in lecture notes

1) Dessinez, en forme 3'-phosphate, la paire de base G-C de l'hélice de Watson-Crick. Votre diagramme devra montrer la configuration à chaque position du sucre et TOUS les atomes et les liaisons hydrogène des bases. Servez vous de cette figure pour discuter s'il est possible de faire la synthèse d'un ADN bicaténaire qui contiendra de la a) 1-méthyle guanosine b) 7-méthyle

guanosine c) 9-méthyle guanosine.

1) Draw, as 3'-phosphates, a G-C base pair in Watson-Crick DNA; your diagram should show the configuration at each position of the sugar and ALL the atoms and hydrogen bonds of the bases. Use your figure to discuss the feasibility of making double stranded DNA that contains either a) 1-methyl Guanosine b) 7-methyl Guanosine or c) 9-methyl Guanosine.

Hs



Note: the bases are missing Hs on this figure
It's the one from lecture notes
But the problem says ALL atoms, thus the

at C 5,6 and at G 8 Must be shown
for full marks (see below)
Student does not have to draw sugars
in perspective or give numbering or
indicate grooves

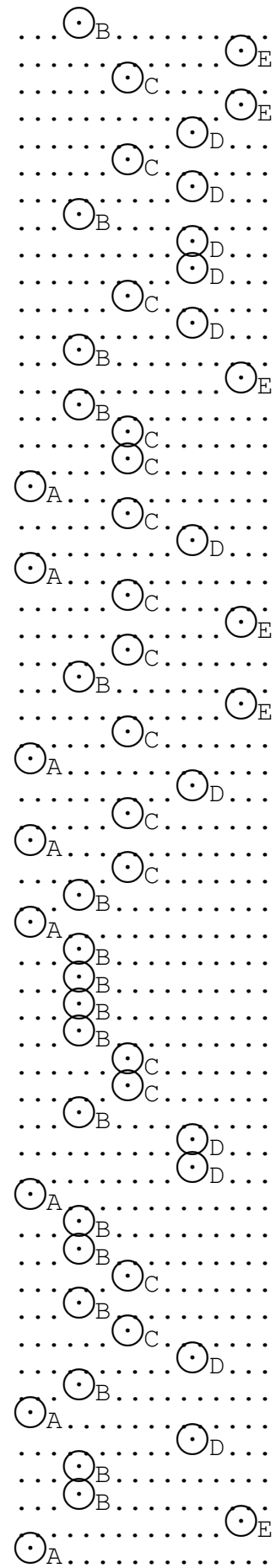
Principle: One of the bases can be drawn in the standard presentation- the other has to be flipped over

2 for G 1 for just atoms of base, 0.5 for Hs, 0.5 for double bonds
2 for C 1 for just atoms of base, 0.5 for Hs, 0.5 for double bonds
2 for H bonds only 1 if orientation of H bonds is wrong
-1 for every stupid hydrogen bond such as dotted line N···O
-1 if strands straight across from each other (> no big/little groove)

1.5 sugar (0.5 ring, 0.5 configurations, 0.5 attachment to base)
1.5 for phosphate (0.5 for structure, 0.5 for charge, 0.5 attachment point to sugar)

1= feasibility a) impossible = no H bond possible b) OK methyl fits in groove c) impossible: nucleoside not possible
10=total

Some may have memorized pairing yet have no idea of DNA! -3 for those that join the two phosphates. Less than 5 for question or -4 for those that have one base ABOVE the other!


1 ...B.....E
2 .....C.....E
3 ....E
4 .....D...
5 .....C.....
6 .....D...
7 ...B.....
8 .....D...
9 .....D...
10 .....C.....
11 .....D...
12 ...B.....E
13 ...B.....
14 .....C.....
15 .....C.....
16 A.....C.....
17 .....C.....D...
18 A.....C.....E
19 .....C.....
20 A.....C....
21 .....C.....
22 ...B.....E
23 .....C.....
24 ...B.....E
25 .....C.....
26 A.....D...
27 .....C.....
28 A.....C.....
29 ...B.....
30 A.....C.....
31 ...B.....
32 ...B.....
33 A.....B.....
34 ...B.....
35 ...B.....
36 ...B.....
37 ...B.....
38 .....C.....
39 .....C.....
40 ...B.....
41 .....D...
42 .....D...
43 A.....B.....
44 ...B.....
45 ...B.....
46 .....C.....
47 ...B.....
48 .....C.....D...
49 ...B.....
50 A.....D...
51 ...B.....
52 .....D...
53 ...B.....
54 ...B.....E
55 .....
56 A.....
57 .....C.....
58 ...B.....
59 ...B.....
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