

Biochemistry 5700
Fall, 2003
Exam 2
October 20, 2003

INSTRUCTIONS:

Do not begin until 10:30 AM. The exam must be turned in by 11:20 AM. This exam should have 9 questions and 7 pages. Answer **all** questions completely, concisely, and legibly in the spaces provided. FEEL FREE TO USE DIAGRAMS/FIGURES, WHEN APPROPRIATE, IN ANSWERING QUESTIONS. Good Luck!!

Bonus questions: 0 points extra credit, answer while waiting to start the exam.

(i) how much ruby red squirt would you have to consume each day to get bromoderma?

(ii) what future nobel laureate is celebrating his 29th birthday today?

Distribution for Exam 2**Statistics: Exam 2**

Graded out of: 100.00

Highest grade: 99.00

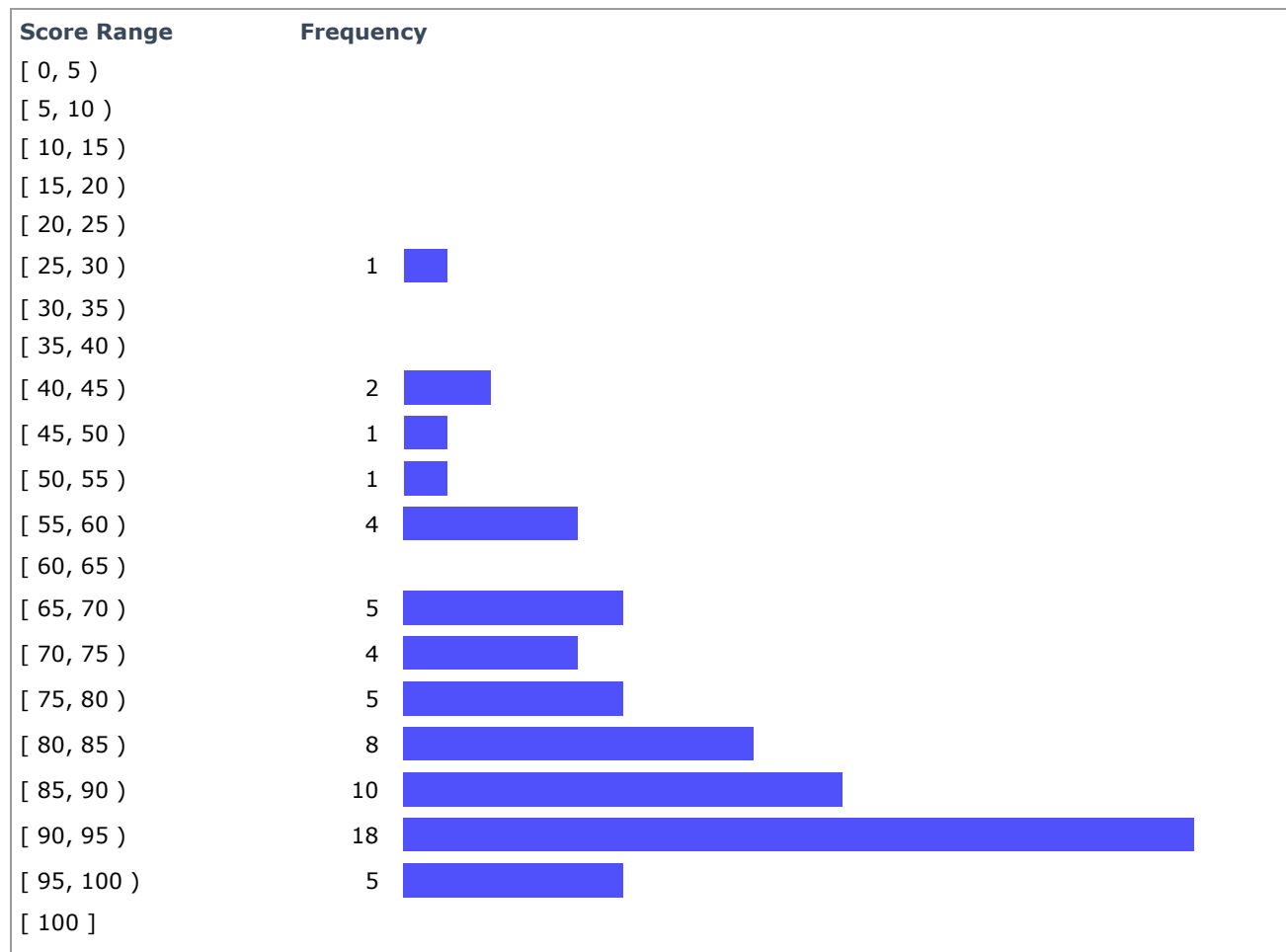
Mean grade: 79.77

Standard deviation: 15.65

Number of records: 64

Lowest grade: 28.00

Median grade: 85.00

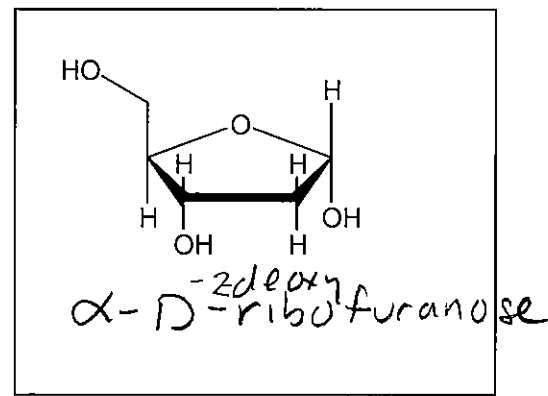
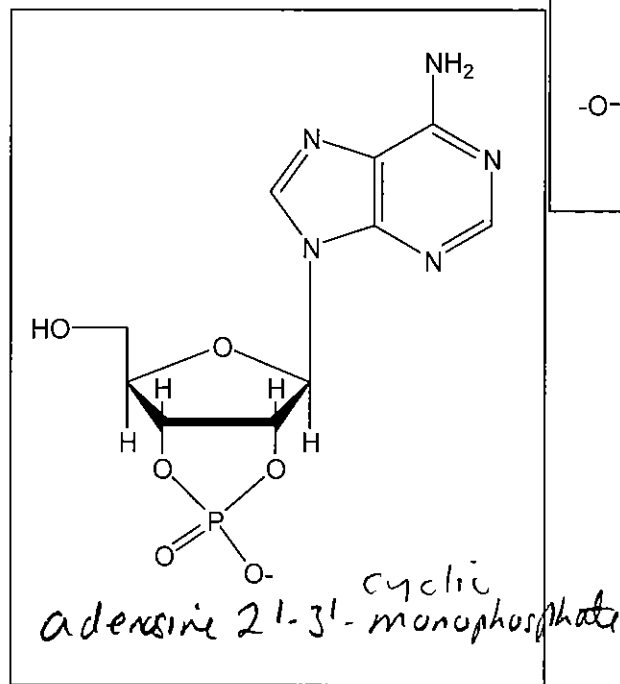
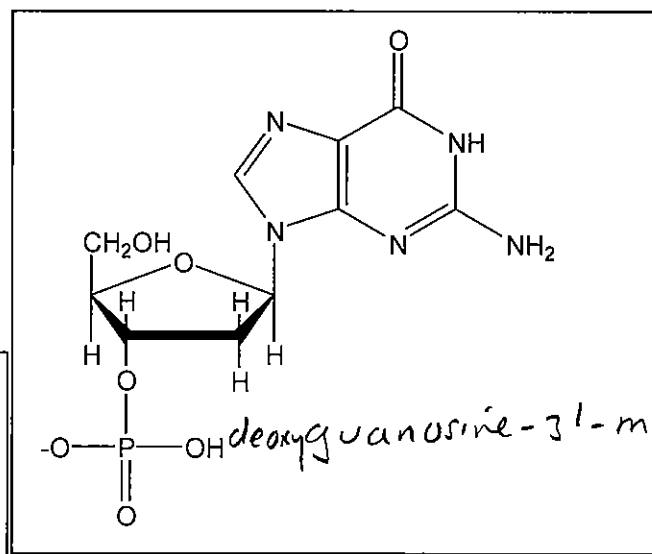
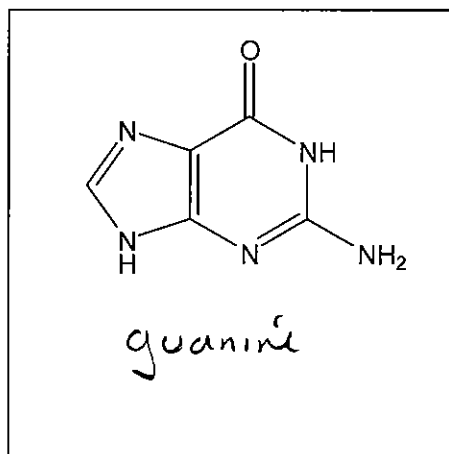
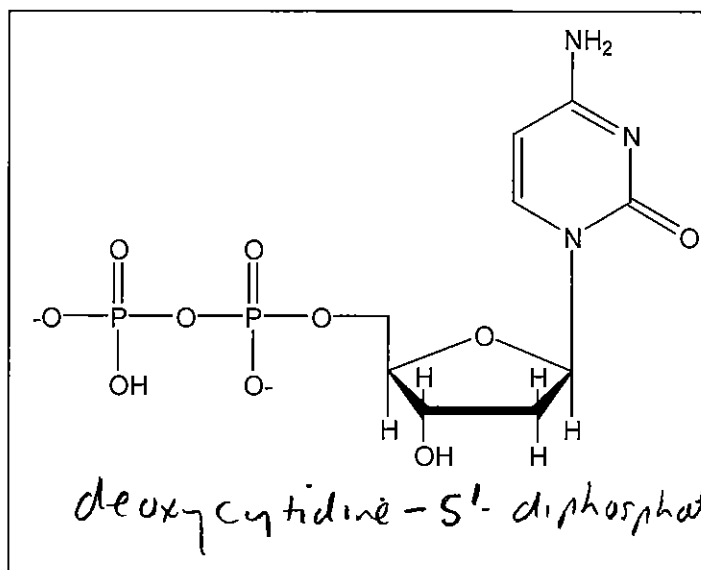
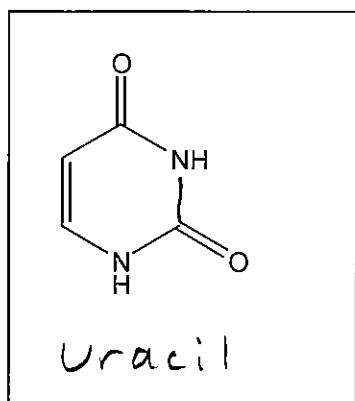
[Fewer Bars](#) [More Bars](#)

Key

(1) Definitions. 20 points.

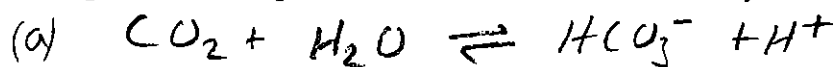
Name the unbranched form of starch	α -amylose
What is a more proper name for the lipid we call "fat"?	triacylglycerol
How many stereoisomers are possible for the family of D-ketoses with seven carbon atoms?	$2^{n-3}/2 = 2^{4-3}/2 = 2^{1/2} = 8$
Name the simplest carbohydrate that is an aldose	glyceraldehyde
Cyclic aldoses that are structurally identical except for the orientation of the hydroxyl group at the hemiacetal carbon are called what?	anomers
The compound resulting from the nucleophilic addition of an alcohol to a ketone is called what?	hemiketal
The combination of nitrogenous base bonded to ribose is called a _____	nucleoside
What type of bond joins a nitrogenous base and sugar?	N-glycosidic or N-ether
What is the orientation of the base to the sugar about this bond?	anti
The reaction of the side chain of lysine with acetone would produce what type of compound?	Schiff base; cationic imine
Which nitrogenous base is present in DNA but not RNA?	thymine
Name a carbohydrate that is achiral	dihydroxyacetone
What types of sugar linkages are found in glycogen?	α 1,4- & D-glc w/ α 1,6 branches
Name a role for lipids other than energy reserve and structural	- communication (hormone) - insulation
What is the repeating sugar unit and linkage in cellulose?	β 1,4-D-glc
What vitamin is associated with vision?	A
What vitamin is associated with regulating calcium uptake for bone formation?	D
What type of sugar pucker is present in B-DNA?	C' endo
What is the trivial name for the fatty acid abbreviated 18:1 Δ^9 ?	oleic acid
What is the chemical formula for palmitic acid?	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$; $\text{C}_{16}\text{H}_{32}\text{O}_2$

(2) (12 points) Provide proper and complete names (no abbreviations) for each of the compounds shown below. The names should be specific enough that you would draw the specific compound shown, and nothing else, given that name.



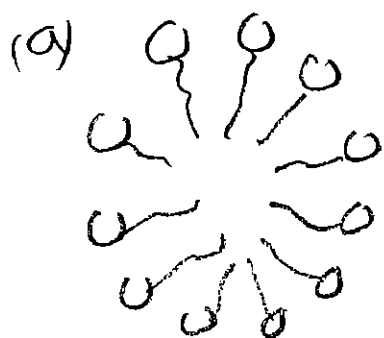
(3) 6 points (a) Write the balanced chemical equation for the reaction catalyzed by carbonic anhydrase.

(b) In a single sentence explain the role of zinc in carbonic anhydrase.

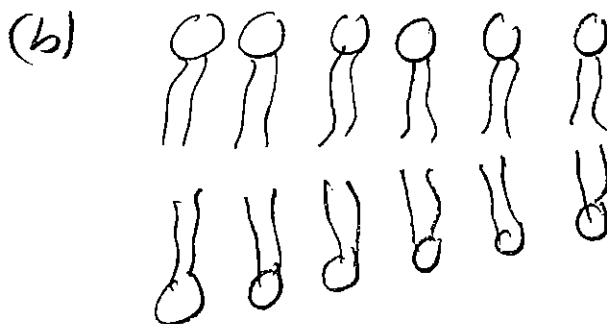


(b) Zinc binds H_2O , lowering its pK_a to generate hydroxide ion for nucleophilic attack on CO_2

(4) (8 points) Provide illustrations representing the structures of (a) a micelle and (b) a lipid bilayer. Indicate which types of lipid(s) are capable of forming these structures in aqueous solution.



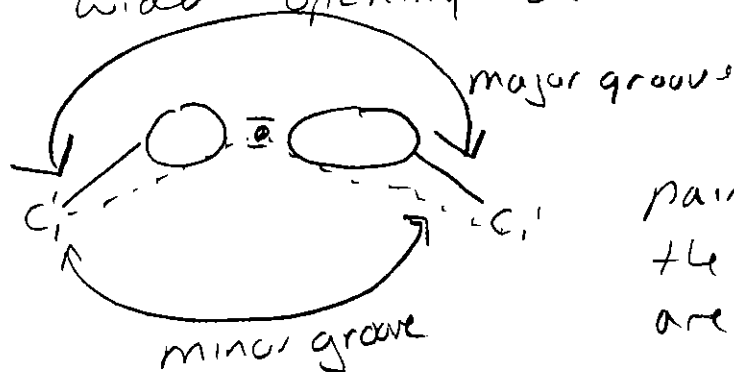
fatty acids



glycerophospholipids
sphingolipids

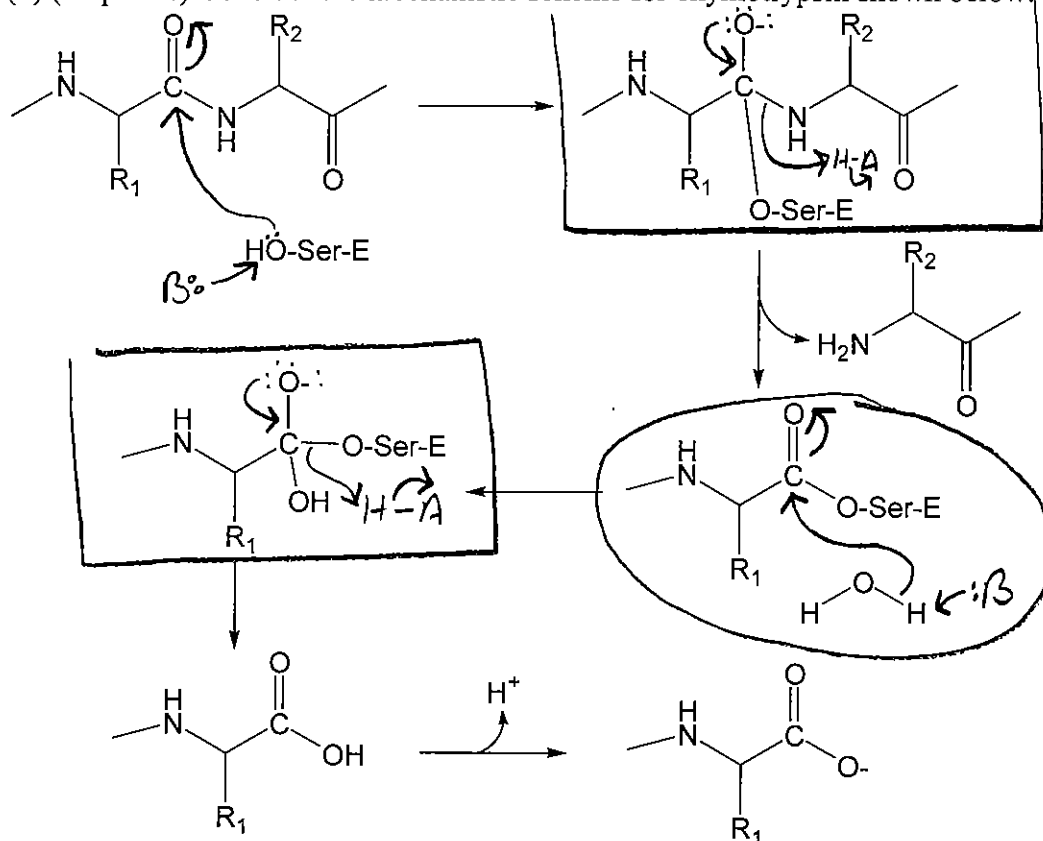
(5) (10 points) Clearly explain, in chemical terms, why DNA has a major groove and a minor groove.

asymmetry of base pairs results in a wide opening on one side of a base pair



as asymmetric base pairs stack on helix axis, the major & minor grooves are formed.

(6) (16 points) Consider the mechanistic scheme for chymotrypsin shown below.



(a) (6 points) add all necessary electron pushing arrows and general acids/bases (abbreviate bases as "B" and acids as "HA") required to complete the mechanism.

(b) (4 points) Circle any species that would be considered stable intermediate(s) in the mechanism, and put a rectangle around species that are unstable intermediates or transition states.

(c) (2 points) The identity of which of the following: R1 or R2 (circle one) is important in substrate specificity for chymotrypsin. What specific amino acid residues would be located at this position?

F, Y, W

(d) (4 points) What three amino acids are key to the catalytic activity of chymotrypsin? Briefly describe their functions.

Asp, His, Ser residues of the catalytic triad
 Serine is the nucleophile that attacks the carbonyl C of the peptide substrate to form acyl-E intermediate
 His is the general acid & base for the indicated acid/base reactions above.
 Asp forms a charge relay w/ His & Ser, modulating their acid/base properties

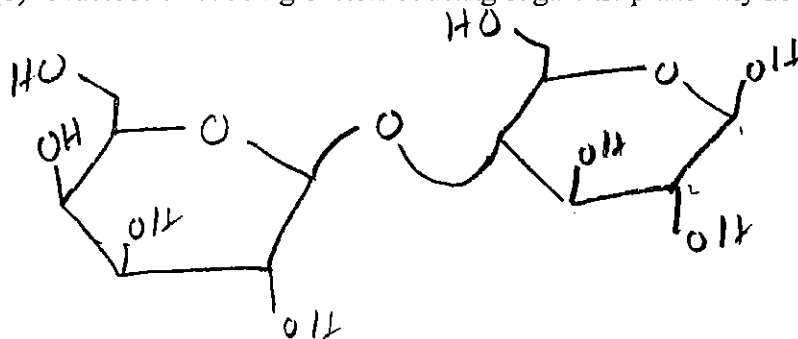
(7) (6 points) Match these molecules with their biological roles.

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

(8) 10 points. Given that D-galactose is a C4 epimer of D-glucose, and that lactose is the disaccharide β -D-galactopyranosyl-(1,4)- β -D-glucopyranose,

(a) draw the structure of lactose.

(b) Is lactose a reducing or nonreducing sugar? Explain why in a single sentence.

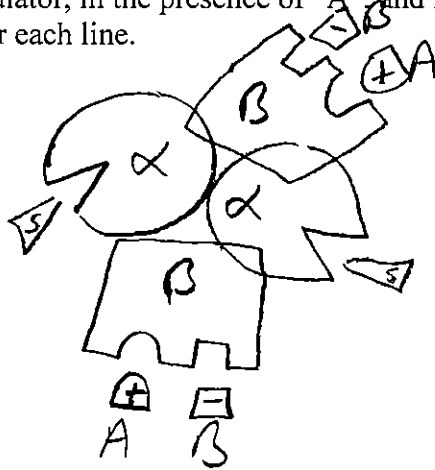


reducing. Anomeric C on glucose is unmodified

(9) (12 points) You have an allosteric enzyme with subunit structure $\alpha_2\beta_2$. Molecule A is a positive heterotropic modulator of the enzyme, while molecule B is a negative heterotropic modulator. Both modulators perturb $K_{1/2}$ but not V_{max} .

(a) Provide a diagram for the subunit structure of the enzyme, showing the ligand binding sites, that is consistent with the description given.

(b) On the plot below, draw and label the curves that would be observed for the enzyme in the absence of modulator, in the presence of "A", and in the presence of "B". Label the positions of V_{max} and $K_{1/2}$ for each line.



Substrate binding sites on α



β subunit = regulatory

$\oplus = (+)$ modulator

$\ominus = (-)$ modulator

