

Dr. Clark & Dr. Fu
April 20, 2007

EXAM III
(Chemistry 103)
(100 pts)

KEY

(Name)

Instructions:

Do not open this booklet until you are told to do so. Write your name on the front cover of your test and wait until you are told to open the exam. When you are instructed to begin, first scan over *all* the questions and make sure that you have 13 questions written on the next 6 pages. Clearly indicate your answers to multiple choice questions by circling the entire letter and answer combination.

If you run out of room on the front side of the page when answering a question, show the rest of your work on the back side of the page. Additional scrap paper is not allowed.

Equations and Constants:

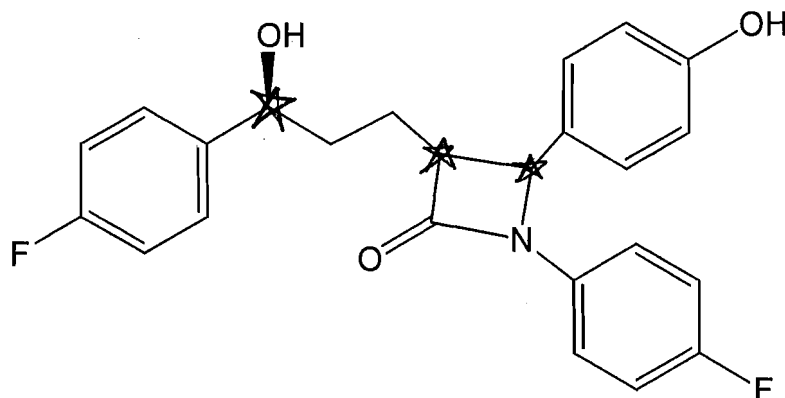
$$K_w = [\text{OH}][\text{H}_3\text{O}^+] = 1 \times 10^{-14} \quad \text{pH} = -\log[\text{H}_3\text{O}^+] \quad \text{pH} + \text{pOH} = 14.0$$

Density = mass / volume, Molarity = moles/volume
Avogadro's Number (N_A) = 6.022×10^{23} particles
1 mole of particles = 6.022×10^{23} particles

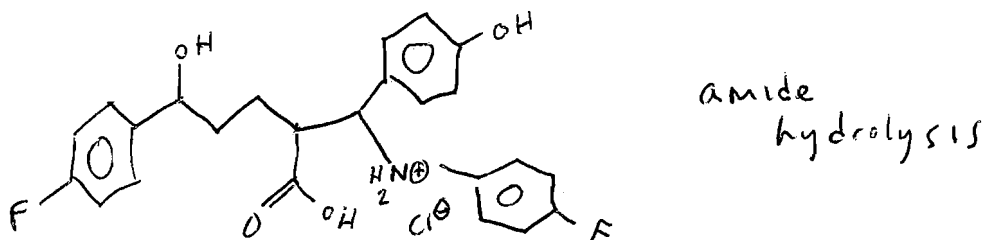
Hint: Do the problems you find easiest first. Show your work. Write legibly.

Partial credit will be given if you set the problems up correctly. (This includes multiple choice questions!)

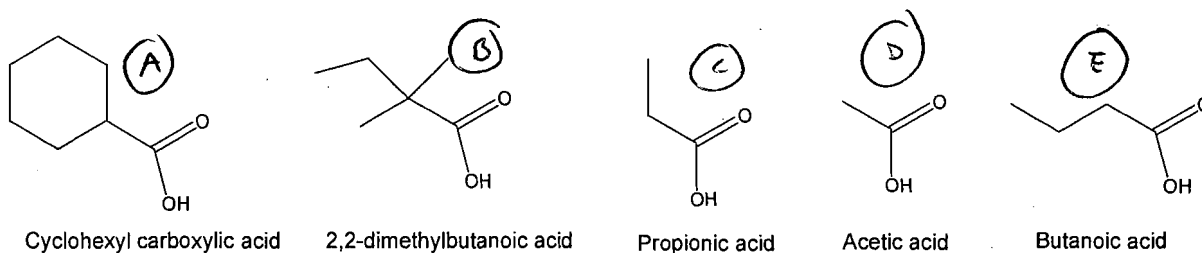
1. Zetia, whose structure is shown below, is the active substance in Vytorin. It is used to reduce absorption of cholesterol from dietary intake.



- (a) (3 pts.) Place a star on all of the chiral carbon atoms.
- (b) (3 pts.) The stomach is very acidic. What happens to Zetia when it encounters an acidic aqueous environment? Draw the structure of the resulting product if HCl is present.



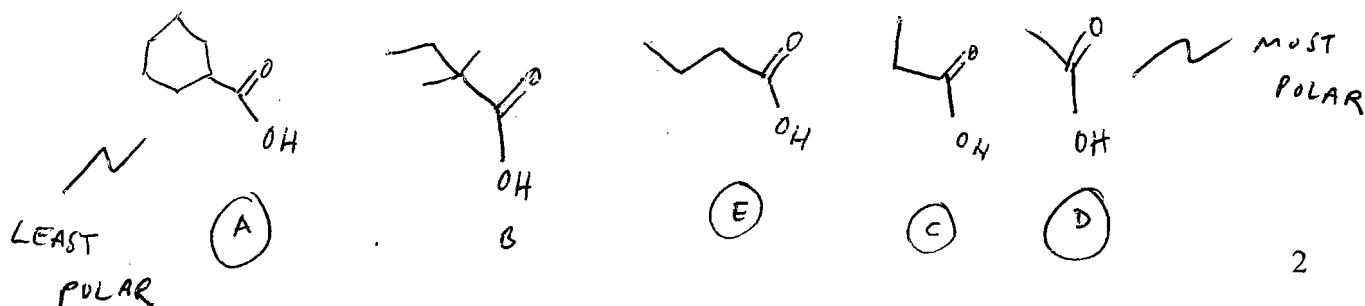
2. (5 pts.) Arrange the following carboxylic acids from the least water soluble to the most water soluble. Explain your choice in a few words.



Least soluble

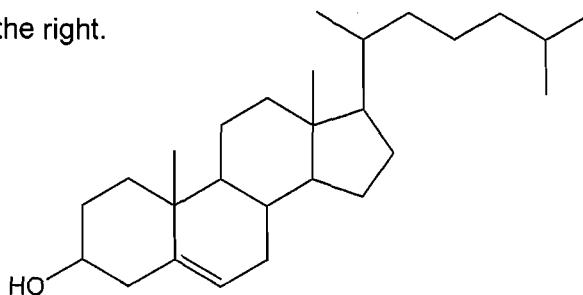


Most soluble



* RANKED BY DECREASING AMOUNT OF NON-POLAR CONTENT (SIZE HERE)

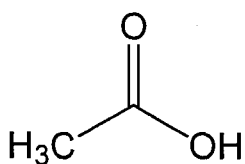
3. A molecule of cholesterol is shown to the right.



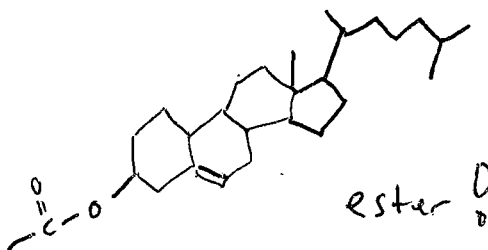
(a) (2 pts.) What type of lipid is cholesterol?

- (i) Wax
- (ii) Triacylglycerol
- (iii) Glycerophospholipid
- (iv) Steroid
- (v) Cephalin

(b) (5 pts.) If cholesterol is reacted with acetic acid in the presence of an acid catalyst, draw the structure of the resulting molecule. Also, indicate what new functional group is present in the molecule you drew.



Acetic Acid

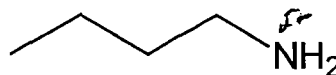
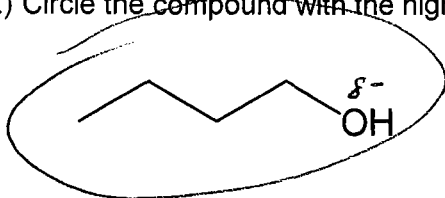


ester

(c) (3 pts.) According to your book, a three ounce serving of liver has the highest cholesterol content among several well-known cholesterol-containing foods listed. Explain why.

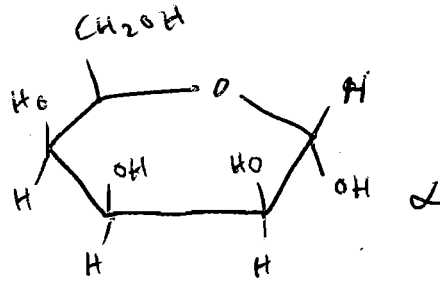
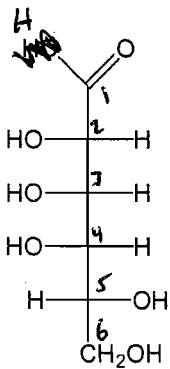
Cholesterol is made in the liver; therefore eating liver is a high local source of cholesterol

4. (4 pts.) Circle the compound with the higher boiling point. In a few words, explain your choice.



O is more electronegative than N, thus the alcohol is more polar than the amine

5. (a) (5 pts.) Draw the cyclic structure of α -talose, whose straight-chain structure is shown below.

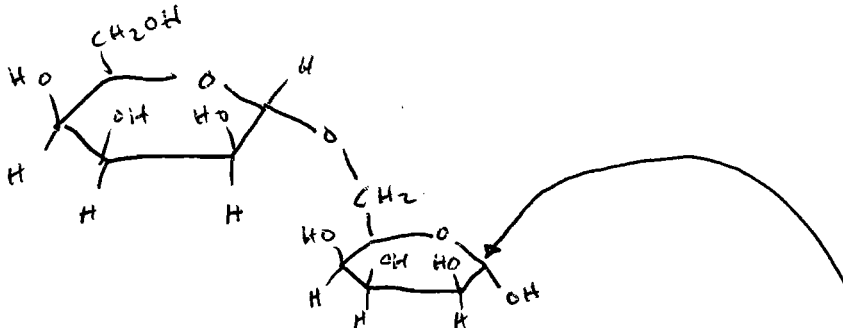


(b) (1 pts.) Is the structure of talose shown in part (a) the L-form or the D-form? **D**

(c) (2 pts.) The monosaccharide of talose shown in part (a) is a(n)

- (i) aldopentose.
- (ii) ketopentose.
- (iii) aldohexose.**
- (iv) aldoheptose.
- (v) ketohexose.

(d) (4 pts.) Draw a disaccharide made of two α -talose monosaccharides that are joined by an α -1, 6 glycosidic bond.

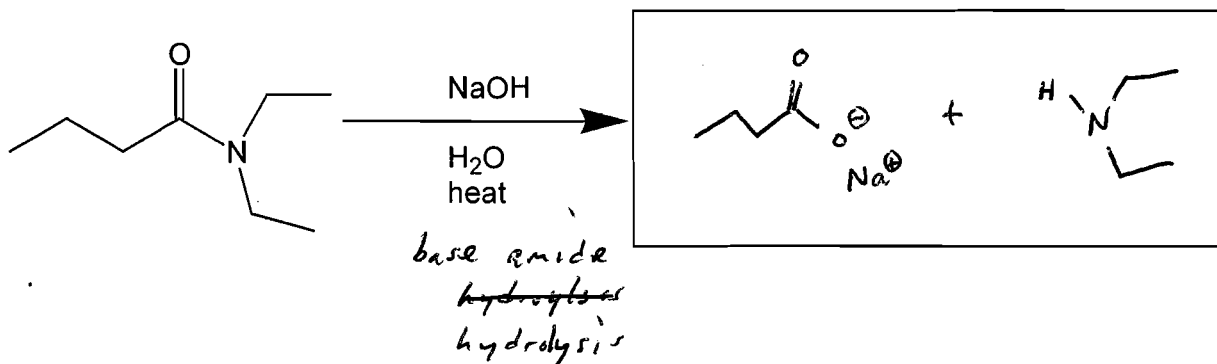
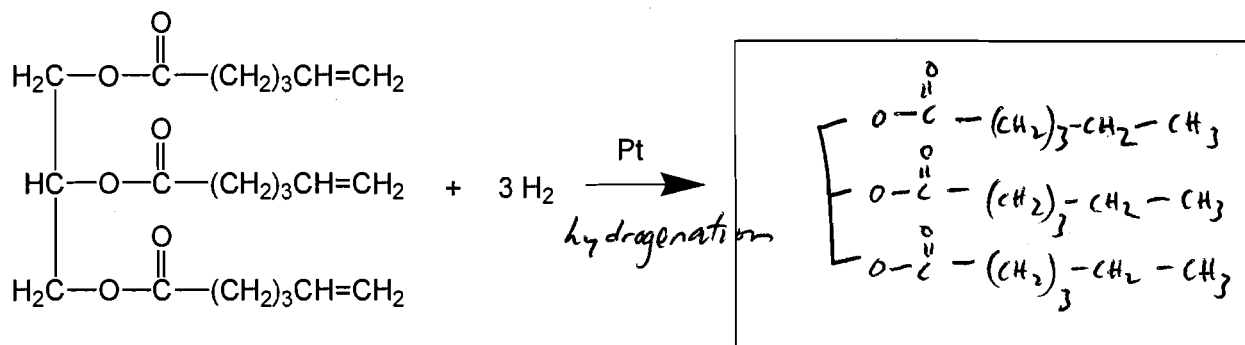
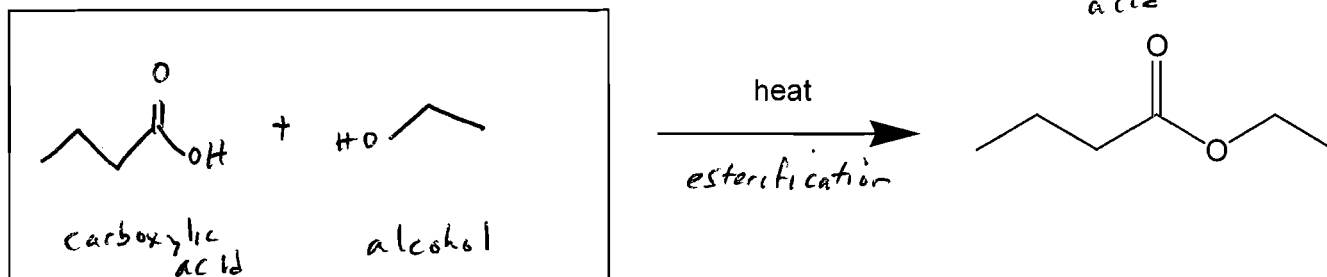
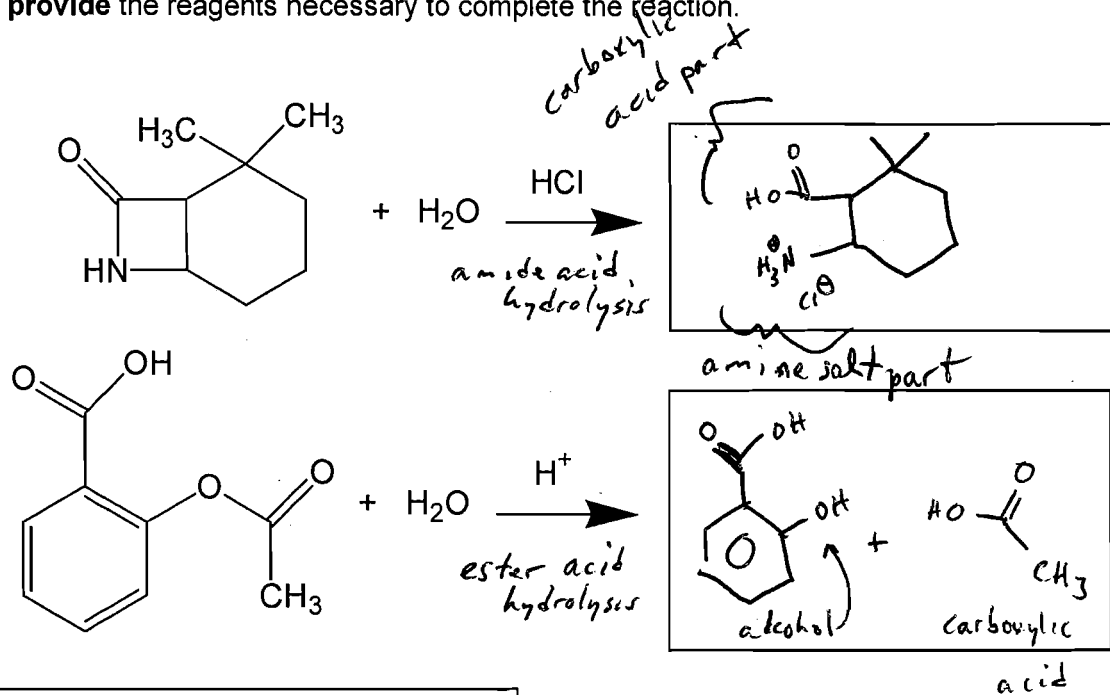


(e) (4 pts.) Is the disaccharide that you drew in part (d) a reducing sugar? Explain why or why not.

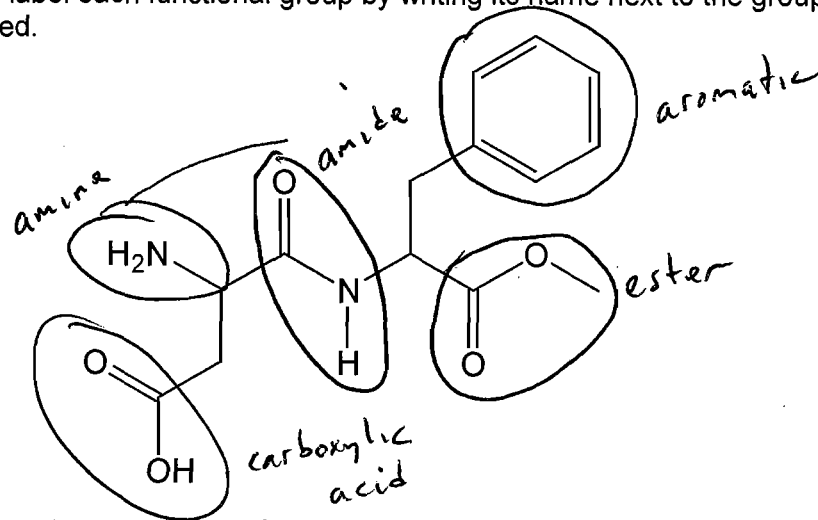
yes, the monosaccharide shown on the lower right can "open up" to the straight chain form b/c the anomeric carbon is not involved in a glycosidic bond. ~~It can~~ Since it can become an aldehyde this C group can then be oxidized to a carboxylic acid in the Benedict's Test.
 → thus it is a reducing sugar "

(f) (2 pts.) Cellulose is not digestible by humans because it contains glucose units linked by β -1,4-glycosidic bonds.

6. (20 pts.) For each reaction shown, **predict** the organic product or products formed or **provide** the reagents necessary to complete the reaction.



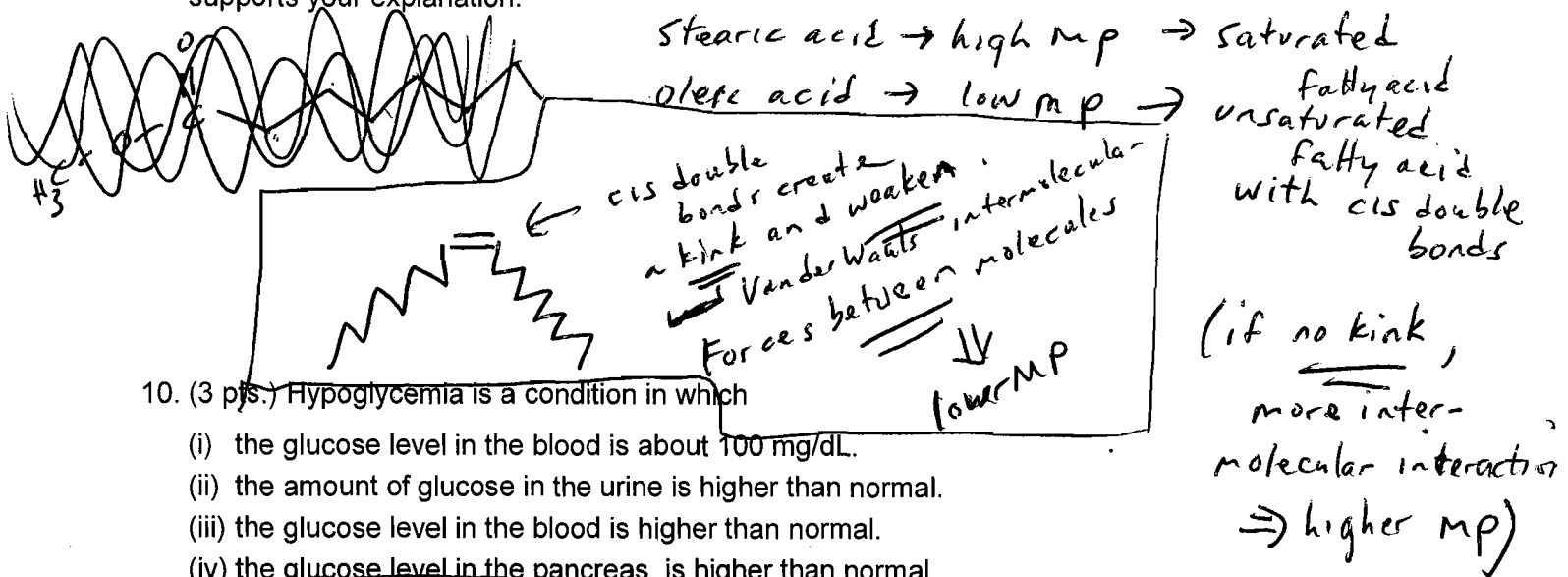
7. (10 pts.) Consider the structure of the sweetener, aspartame, whose structure is shown below. Place a complete circle around five of the functional groups that are present in aspartame. Clearly label each functional group by writing its name next to the group of atoms that you circled.



8. (3 pts.) Explain in a sentence or two explain how glycerophospholipids can interact with both polar and non-polar molecules.

These lipids have both a polar head group (specifically the phosphate amino alcohol chain) that can interact with H_2O and a non-polar part, which is the fatty acid side chains.

9. (5 pts.) Stearic acid is a fatty acid that contains 18 carbon atoms and has a melting point of 69°C . Oleic acid is a fatty acid that also contains 18 carbon atoms, but has a much lower melting point of 13°C . Briefly explain why the melting point of oleic acid is much lower than that of stearic acid. To receive full credit, your answer must include a diagram(s) that supports your explanation.



10. (3 pts.) Hypoglycemia is a condition in which

- (i) the glucose level in the blood is about 100 mg/dL.
- (ii) the amount of glucose in the urine is higher than normal.
- (iii) the glucose level in the blood is higher than normal.
- (iv) the glucose level in the pancreas is higher than normal.
- (v) the glucose level in the blood is lower than normal.

11. (3 pts.) Chiral drugs consist of only one enantiomer. The benefits of using a pure enantiomer, rather than a mixture, may include

- (i) higher potency (lower total dose of drug).
- (ii) elimination of side effects.
- (iii) reduced chances of drug interactions.
- (iv) All of the above.
- (v) None of the above.

12. (8 pts.) *Matching*: In the spaces provided, indicate which choice given on the right matches the description shown on the left. (*Note*: Some choices may not be used, and some choices may be used more than once.)

- | | | |
|--|-------------------------------|---------------------------|
| (a) <u>iii</u> a lipid that cannot be hydrolyzed | (i) ether | (xi) glucose |
| (b) <u>vi</u> the functional group of triacylglycerols | (ii) fat | (xii) alkaloid |
| (c) xii physiologically-active nitrogen compounds | (iii) steroid | (xiii) soap |
| (d) <u>vi</u> functional group known for its pleasant odor | (iv) wax | |
| (e) <u>ix</u> the process of converting unsaturated fats into saturated fats | (v) galactose | |
| (f) <u>vii</u> a triacylglycerol that is a liquid at room temperature | (vi) ester | |
| (g) <u>xiii</u> the product of reacting a triacylglycerol with a strong base and water | (vii) oil | |
| (h) <u>v</u> a monosaccharide that combines with glucose to form lactose | (viii) fatty acid | |
| | (ix) hydrogenation | |
| | (x) esterification | |

13. (5 pts.) An unknown compound that has a molar mass of 31 g/mol and possesses a "fishy odor" is capable of reacting with carboxylic acids when heated. Based on this information, determine and draw the structure of this unknown compound. Explain how you determined your choice.

a) fishy smell → amine

b) reacts w/ acid → amine
or alcohol

c) weighs 31 g/mol → must be small

