

Chem 11 Fall 2008 Examination #5 ANSWER KEY

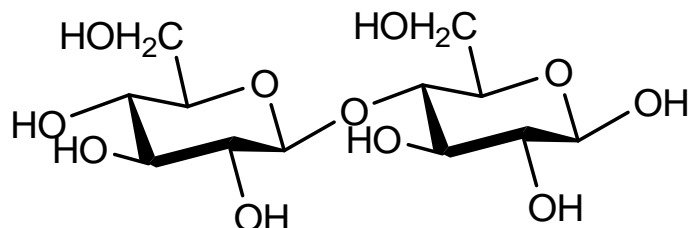
MULTIPLE CHOICE (20 pts. total; 2 pts. each)

- Denaturation changes which of the following protein structure(s)?
 - primary
 - secondary
 - tertiary
 - both b and c**
- Consider the four fatty acids described below and rank them in order of increasing expected melting points:
stearic acid (18:0) oleic acid (18:1) linoleic acid (18:2) linolenic acid (18:3)
 - stearic < oleic < linoleic < linolenic
 - stearic < oleic < linolenic < linoleic
 - linolenic < linoleic < oleic < stearic**
 - linoleic < linolenic < oleic < stearic
- Which of the following explains the insolubility of lipids in water?
 - lipids are polar molecules
 - the polar portion of lipids is much larger than the nonpolar portion
 - the polar portion of lipids is much smaller than the nonpolar portion**
 - the polar and nonpolar portions of lipids are of comparable size
- Triglycerides exhibit which organic chemistry functional group below?
 - alcohols
 - carboxylic acids
 - esters**
 - ethers
- What is the expected IUPAC name of glycerol?
 - 1,2-ethanediol
 - 1,2-propanediol
 - 1,3-propanediol
 - 1,2,3-propanetriol**
- Which of the following is TRUE of most fatty acids found in triglycerides?
 - they are unbranched**
 - they contain more than 20 carbon atoms
 - they contain an odd number of carbon atoms
 - none of the above

7. The disaccharide maltose is best described by which of the following?
- glucose and fructose held together by an $\alpha 1 \rightarrow \beta 2$ glycosidic bond
 - galactose and glucose held together by a $\beta(1 \rightarrow 4)$ glycosidic bond
 - galactose and fructose held together by an $\alpha(1 \rightarrow 4)$ glycosidic bond
 - two glucose units held together by an $\alpha(1 \rightarrow 4)$ glycosidic bond**
8. Starch, used for energy storage in plants, is comprised of two principal polysaccharides. Which of the following is TRUE?
- Starch is comprised predominantly of amylose.
 - Complete hydrolysis of amylose and amylopectin yields only D-fructose.
 - Amylose is comprised of α -1,4-glycosidic bonds.**
 - Amylopectin is comprised of β -1,4-glycosidic bonds.
9. Which of the statements below is FALSE concerning glycogen?
- Glycogen acts as the energy-reserve carbohydrate for animals.
 - It is a branched polysaccharide containing glucose and fructose units joined by α -1,4- and α -1,6-glycosidic bonds.**
 - Glycogen is found in the human body.
 - Glycogen is divided almost equally between liver and muscle.
10. Humans and other animals cannot use cellulose as food because:
- our digestive systems do not contain α -glucosidases, enzymes that catalyze the hydrolysis of β -glucosidic bonds.
 - our digestive systems do not contain β -glucosidases, enzymes that catalyze the hydrolysis of β -glucosidic bonds.**
 - our digestive systems contain neither α -glucosidases nor β -glucosidases.
 - cellulose is a linear polysaccharide of D-fructose units joined by β -1,4-glycosidic bonds.

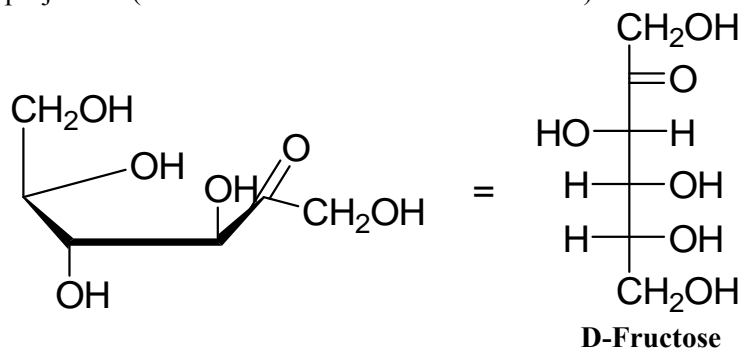
END OF MULTIPLE CHOICE

11. (10 pts. total) The structural formula for a disaccharide is given below:

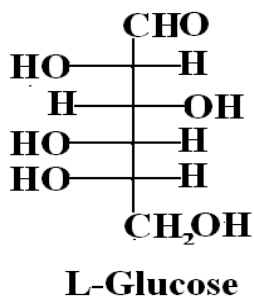


- A. (4 pts.) Name the two monosaccharide units in the disaccharide. **D-Glucose**
- B. (2 pts.) Describe the glycosidic bond. **β -1,4-glycosidic bond**
- C. (2 pts.) Is this disaccharide a reducing or a non-reducing sugar? Briefly explain.
Reducing sugar due to the presence of the hemiacetal at the anomeric carbon.
- D. (2 pts.) Will this disaccharide undergo mutarotation? Briefly explain. **Yes, because the anomeric carbon at the reducing end (hemiacetal) is free to interconvert between α and β configurations via the open chain aldehyde.**
12. (18 pts. total) Answer the series of questions posed below:

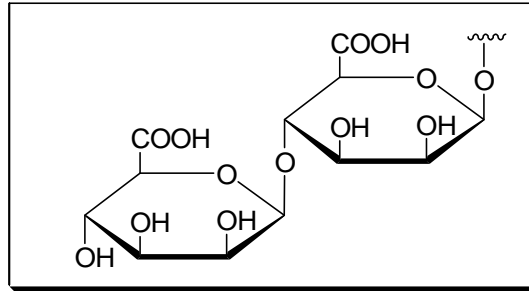
- A. (6 pts.) Convert the following Haworth projection to an open-chain form and to a Fischer projection. Name the monosaccharide you have drawn. Also name the cyclic Haworth projection (**α -D-fructofuranose shown on exam**).



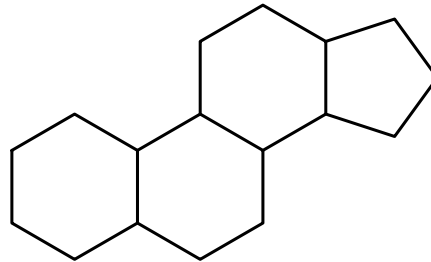
- B. (4 pts.) Label this monosaccharide as a D- or L-monosaccharide.



- C. (8 pts.) Seaweed contains alginic acid that is used as a thickening agent in ice cream. Alginic acid is a polymer of D-mannuronic acid in the pyranose form joined by β -1,4-glycosidic bonds. Draw structural formula for the repeating disaccharide unit in this polysaccharide:



13. (6 pts. total) Shown below is a four-ring structure. Answer the questions that follow:



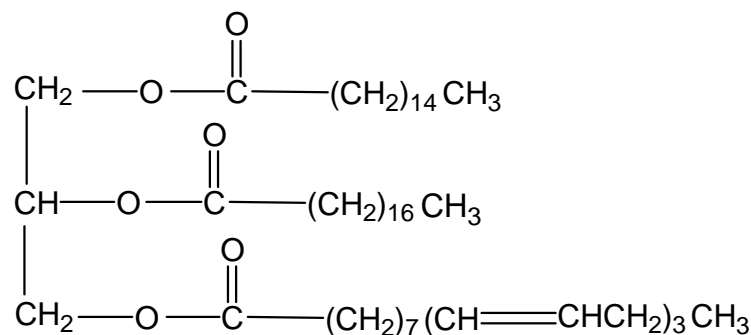
- A. (1 pt.) Which class of lipid compounds has this generic structure? **Steroids**
- B. (1 pt.) Name the most important compound belonging to this category.
Cholesterol
- C. (3 pts.) What are the benefits (name two) and drawbacks (name one) of the presence of this compound in the human body?

Benefits: a plasma membrane component in all animal cells; a precursor for the synthesis of other steroids like sex hormones.

Drawback: Elevated levels of blood serum cholesterol lead to plaque-like deposits on inner wall of arteries called atherosclerosis.

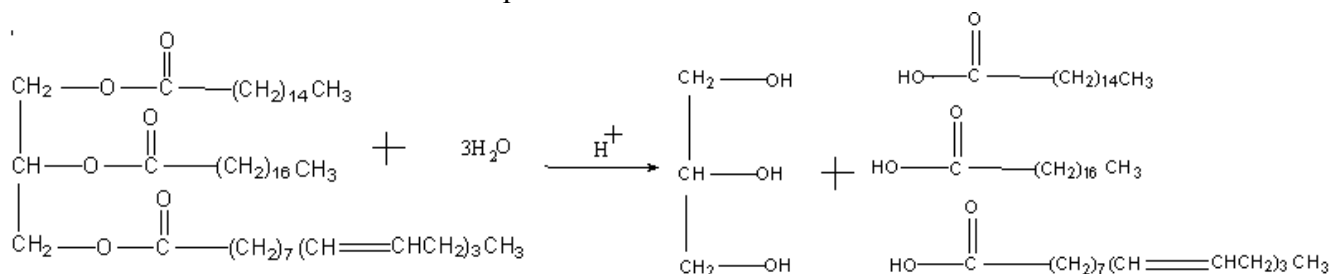
- D. (1 pt.) How is this compound transported? **Lipoproteins**

14. (8 pts. total) Answer the questions below that refer to the following structure:

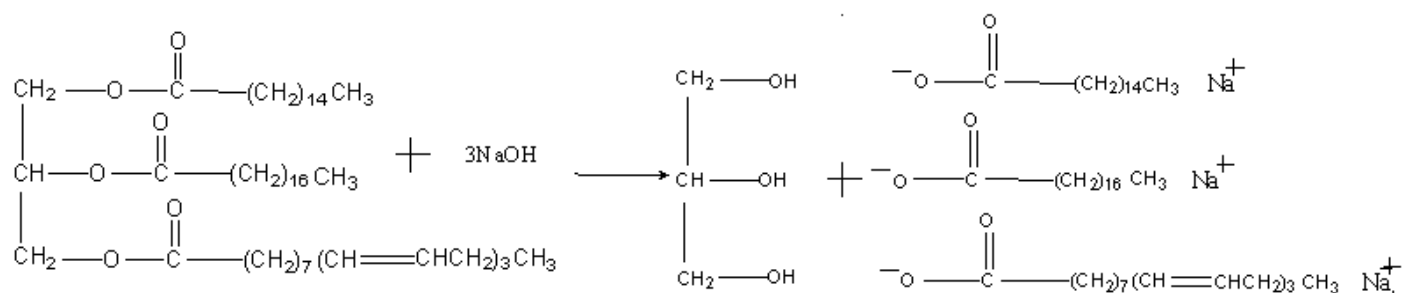


A. (2 pts.) Name the general category of this type of compound. **Triglyceride**

B. (3 pts.) What is the product of hydrolysis along with an acid catalyst? Show the reaction with an equation.

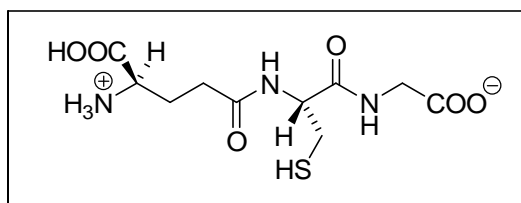


C. (3 pts.) Write the saponification reaction of the compound described in part A.

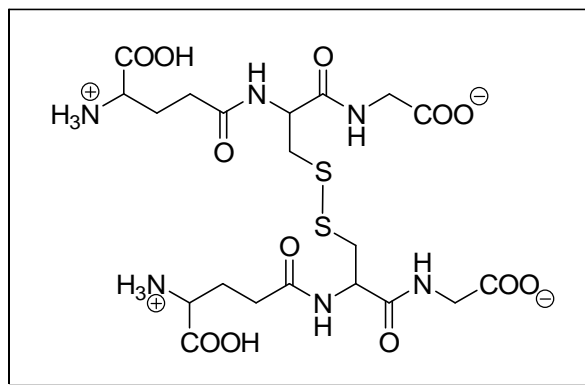


15. (18 pts. total) Glutathione is a naturally occurring tripeptide that acts as an antioxidant, an immune system booster, and a detoxifier in the body. It is made up of the amino acids Glu, Cys, and Gly. Glu is the N-terminal amino acid and Cys is NOT the C-terminal amino acid. *Glutathione structure is unusual in that the side chain carboxyl group of Glu is involved in bond formation with the second amino acid.* Answer the questions below related to this molecule.

- A. (5 pts.) Carefully draw the structure of the tripeptide of glutathione (including expected stereochemistry). **NOTE: $-COO^-$ was also accepted below at the N-terminus!**



- B. (5 pts.) What is the product of oxidation of two molecules of glutathione? Show the structure below.



- C. (2 pts.) Label the new bond that is formed as a result of the reaction in part B.
Disulfide bond

- D. (4 pts.) Are all the amino acids that make up glutathione optically active?

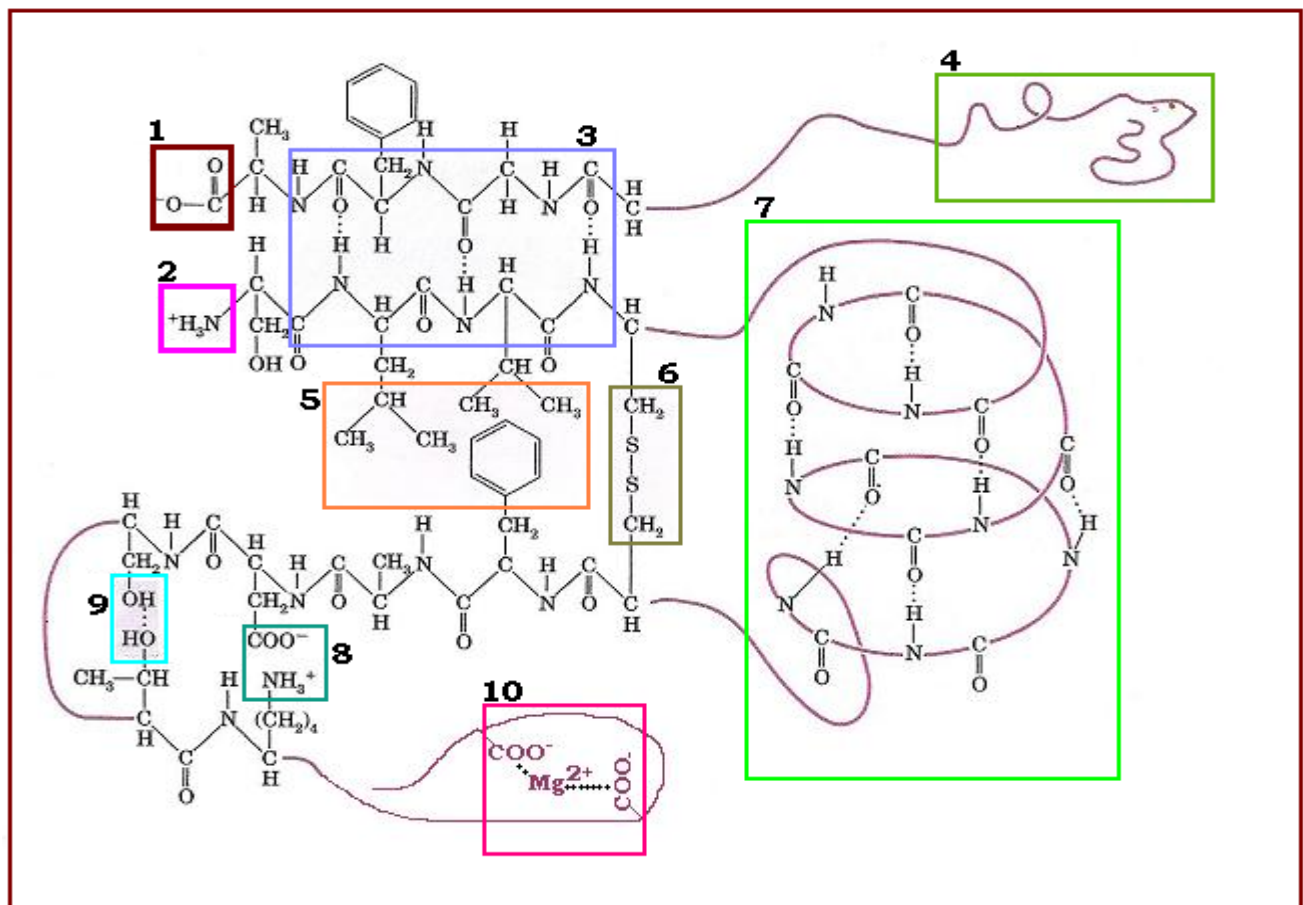
Circle: YES / **NO**

Explain your answer clearly. **Glycine is NOT optically active. It does not possess a stereocenter or chiral carbon.**

- E. (2 pts.) Name the REPEATING functional group you see in the tripeptide backbone of glutathione. What is this bond referred to in Biochemistry? **Amide functional group; peptide bond**

16. (20 pts. total) Below is a sketch of part of a protein structure. Select from the various choices below to label the numbered boxes with information you have learned.

- α -helix
- β -pleated sheet (antiparallel)
- β -pleated sheet (parallel)
- denaturation
- disulfide bridge
- hydrogen bond
- C-terminus
- hydrophilic interaction
- hydrophobic interaction
- metal-ion coordination
- peptide bond
- random coil
- salt bridge
- N-terminus



1. C-terminus 2. N-terminus 3. β -pleated sheet (antiparallel)
4. random coil 5. hydrophobic int. 6. disulfide bridge
7. α -helix 8. salt bridge 9. hydrogen bond
10. metal-ion coordination