

### Exam #3: Carbs & Fats Edition – Let's Get Cooking!

1. \_\_\_\_\_ 15 pts
  2. \_\_\_\_\_ 10 pts
  3. \_\_\_\_\_ 15 pts
  4. \_\_\_\_\_ 10 pts
  5. \_\_\_\_\_ 20 pts
  6. \_\_\_\_\_ 30 pts
- 100 pts

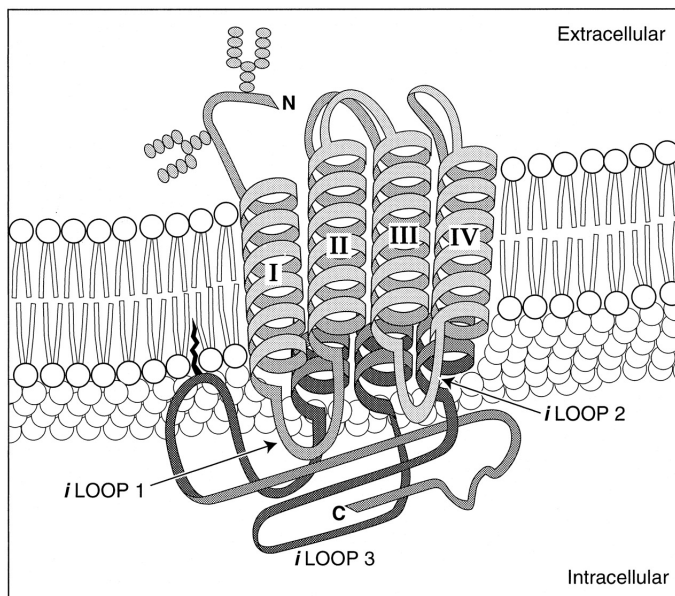
"I love science, and it pains me to think that so many are terrified of the subject or feel that choosing science means you cannot also choose compassion, or the arts, or be awed by nature. Science is not meant to cure us of mystery, but to reinvent and reinvigorate it."

Robert Sapolsky  
*Why Zebras Dont Get Ulcers* p. xii

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Note: In several places a category of lipid called phosphatidylcholine is mentioned. Choline is  $\text{HO}(\text{CH}_2)_2\text{N}^+(\text{CH}_3)_3$

1. (15 points). Consider the following cartoon diagram.



- What do the gray ovals on the extracellular side represent?
- What does the black lightning flash in the membrane represent?
- Give an amino acid residue and a corresponding functional group that would be suitable for connecting the black lightning to the protein.

2. (10 points). The table below gives the composition of several important cooking fats.

fat	saturated FA	monounsaturated FA	polyunsaturated FA
olive oil	14%	74%	11%
soybean oil	16%	23%	58%
butter	51%	21%	3%

Assume that you cook with these fats, that you digest the fats, and they enter your normal metabolic pathways.

- Which fat is likely to have the greatest negative impact on your health? Why?
- Which fat will have the greatest antioxidant capacity? Why?

3. (15 points). Give 2 cellular functions for lipids and 3 cellular functions for carbohydrates. For each function, give the name of a molecule or substance which is involved with that function as an example. Make sure your answers are distinct things and not different examples of nearly the same thing.

lipid 1:

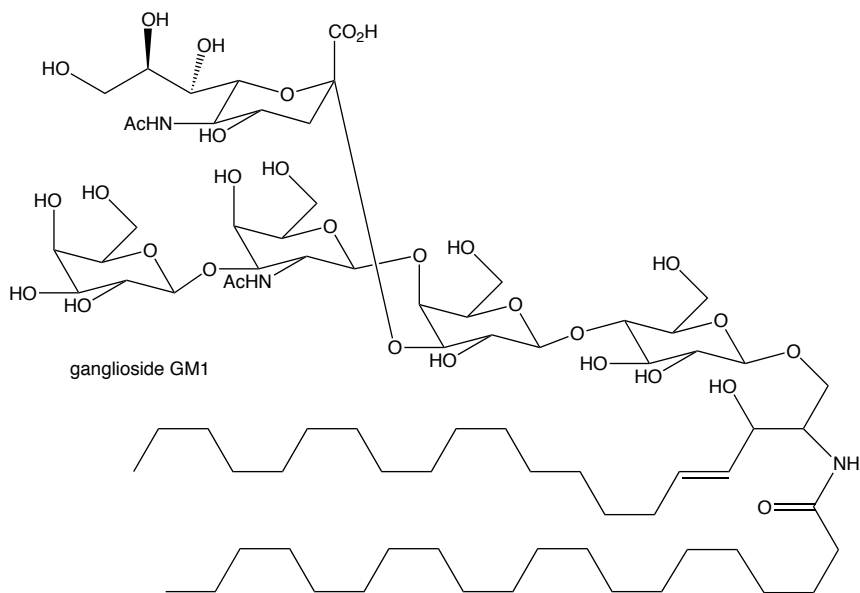
lipid 2:

carb 1:

carb 2:

carb 3:

4. (10 points). Gangliosides have been implicated in numerous diseases. A typical ganglioside is shown below.



(a) Categorize this lipid at a high level, such as "phosphatidylcholine" or "triacylglycerol." Be as specific as possible.

(b) Gangliosides readily form lipid rafts. Concisely explain how the structure makes this possible.

5. (20 points). Gram-positive bacteria have teichoic acid on their outer membrane/cell wall assembly, shown at right. Identify each of the following structural features or give a short answer as appropriate. If a requested feature is not present, write NP.

(a) Circle the portion of the molecule that would be located within the membrane.

(b) Circle an example of a phosphodiester.

(c) Give the letter of a deoxy sugar.

(d) Give the type of linkage between **B** and **A**.

(e) Are any of the sugars in this molecule reducing sugars? If so, give the letter(s).

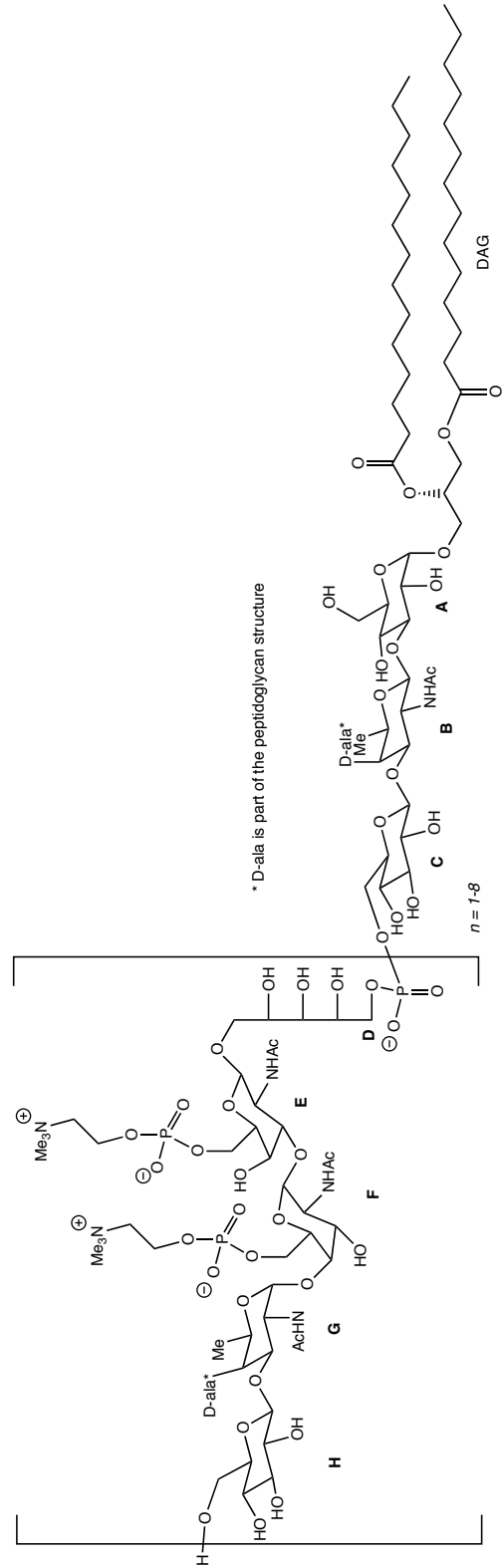
(f) Is ring **D** from the D- or L- stereochemical series?

(g) Give the letter of a sugar with an  $\alpha$  anomeric carbon.

(h) Ignoring any differences in the nature of the attached groups, what stereochemical term describes the relationship between **E** and **H**?

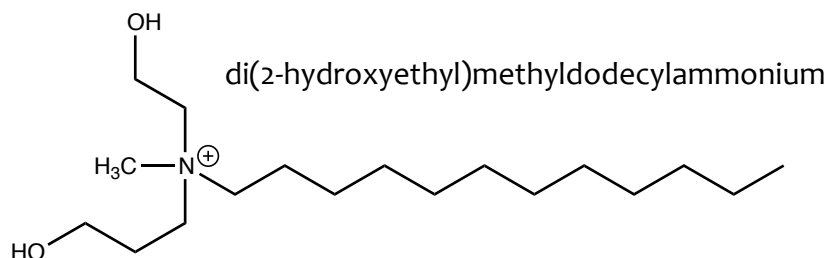
(i) At several places teichoic acid has a connection to the peptidoglycan layer. What is the significance of this?

(j) Circle an example of glycerol embedded in the structure.



6. (30 points). Chose and answer 3 of the following questions. Keep your answers concise and to the point. Rambling or "brain-dumps" will be marked down. Space to answer the questions is given below.

- (a) Flip-flop of lipids from one side of a membrane to the other is a slow process, but it does occur. Would the rate of flip-flopping be greater for phosphatidylcholine or cholesterol? Explain.
- (b) The following compound was found to leach out of typical lab plasticware.<sup>1</sup> Based upon its structure, is this compound likely to pose a problem when working with cells? Explain.



- (c) Triacylglycerols and phospholipids both contain esterified fatty acids, but only one can form micelles. Which one is it, and why is the other one not able to form micelles? Explain.
- (d) Oil & vinegar salad dressing is generally composed of soybean or corn oil (both triacylglycerols), and vinegar, an aqueous solution of acetic acid (along with some spices). Commercial salad dressings often contain lecithin, which is the common name for phosphatidylcholine. Why would this compound be added to oil and vinegar dressing? Explain.
- (e) Draw the structure of a phosphatidylcholine composed of 16:0 and 18:2( $\Delta^{9,12}$ ) fatty acids.

**Answers:**

option \_\_\_\_\_

option \_\_\_\_\_

option \_\_\_\_\_

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<sup>1</sup>Science vol. 322 pg 917 (7 Nov 2008)