

This Exam contains 14 questions and 100 pts in 6 pages. Budget 1 min/2 pts.

1. (8 pts) Please do **one** of the following two choices:

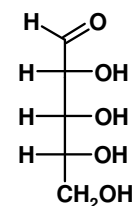
Choice A: A protein is treated with SDS and subject to polyacrylamide gel electrophoresis. In the stained gel on the right the unknown protein is in the **left** lane and the two standards, with molecule weights of 10 kDa and 100 kDa, are in the **right** lane. If the native molecular weight was determined to approximately 60 kDa, describe the quaternary structure of this protein.



Choice B: Briefly describe the process by which structures are determined using x-ray diffraction. Your answer should state the fundamental aspect of this technique that allows the determination of atomic structures.

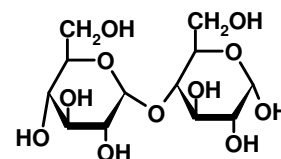
2. (6 pts) A five carbon monosaccharide is shown on the right.

- is this compound an aldose or ketose?
- Draw the cyclic, or ring form of this sugar (you can omit hydrogens in your drawing.)
- Indicate the anomeric carbon on your drawing.
- Is this sugar glucose, ribose, or fructose?



3. (2 pts) The disaccharide on the right is produced after partial hydrolysis of glycogen or starch. Correct the single error in its name:

β -glucopyranosyl-(1-4)- α -glucopyranose



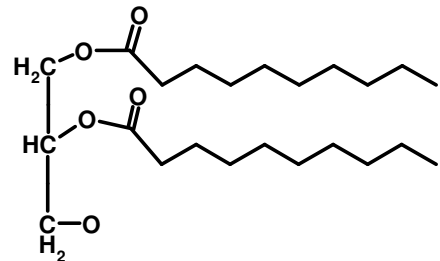
4. (8 pts) Please do **one** of the following two choices. You may answer the question with a sketch.

Choice A: Compare and contrast glycogen (or starch) to cellulose.

Choice B: Briefly describe the structure of bacterial cell walls.

5. (4 pts) The diagram on the right shows the partial structure of either a triglyceride or the phospholipid phosphatidic acid. Modify the diagram to complete the structure of **one** of the following two choices (please indicate your choice.)

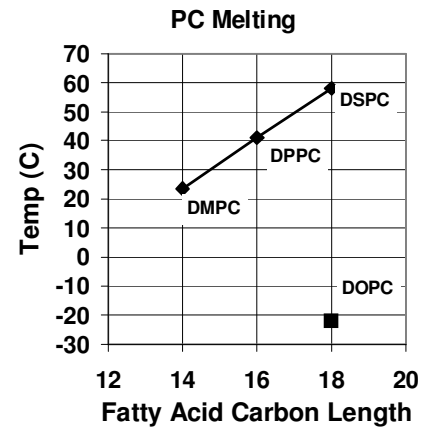
Choice A: triglyceride. **Choice B:** phosphatidic acid.



6. (10 pts) Please do **one** of the following two choices:

Choice A: The melting temperature of corn oil is approximately 10 C, while that of margarine which is made from the corn oil is about 30C. In what way was the corn oil modified to raise its melting temperature? Why did the melting temperature increase?

Choice B: The melting temperature of a series of phosphatidyl cholines is shown on the right, briefly explain this trend.



7. (12 pts) Please do **one** of the following two choices:

Choice A: Briefly describe the structural features of membrane proteins and energetic considerations that favor the insertion of the protein into the membrane. Your answer should discuss both mainchain as well as sidechain interactions.

Choice B: Fatty acids form micelles in solution while phospholipids form bilayers. .

- i) (8 pts) What is the major energetic force that causes these structures to form spontaneously? Briefly describe the molecular features of this force.
- ii) (2 pts) Briefly explain why different structures (micelles versus bilayers) are formed by the different compounds.
- iii) (2 pts) Explain why the CMC decreases as the length of the fatty acid increases.

8. (8 pts) Please do **one** of the following two choices:

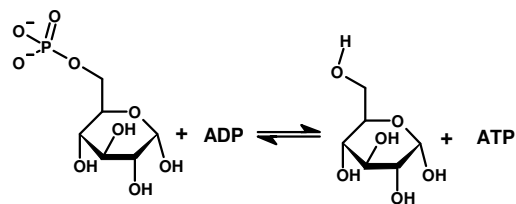
Choice A: Select **either** carbohydrates **or** fatty acids and briefly discuss the metabolic fate of the carbons from these compounds. Your answer should state which pathways are used and approximately where the carbon is released as CO₂.

Choice B: A person on a high protein/fat diet cannot maintain high levels of strenuous exercise without running out of energy, however they are perfectly comfortable doing less strenuous activities. Explain the metabolic basis of this observation.

9. (5 pts) Please do **one** of the following two choices.

Choice A: Is the reaction shown to the right catalyzed by a phosphatase, a kinase or a dehydrogenase? Briefly justify your answer.

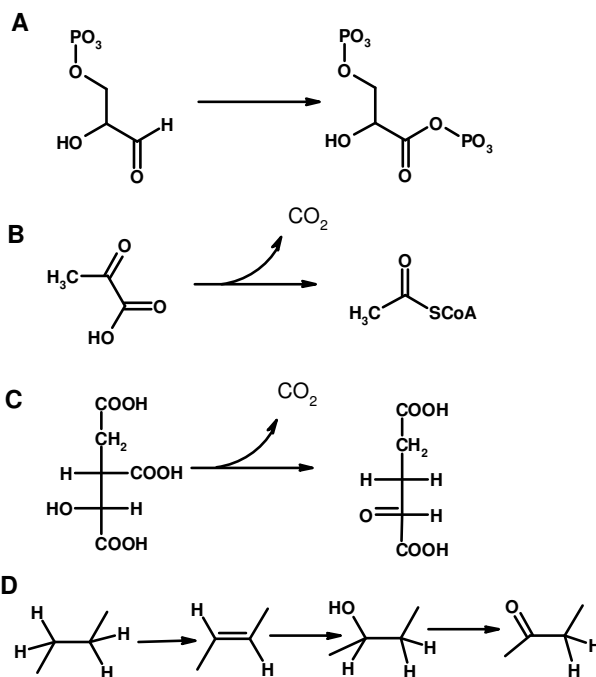
Choice B: What is the major difference between a product inhibitor and a feedback inhibitor? Give an example of one and explain its importance in regulation.



10. (6 pts) A number of biochemical conversions are shown to the right:

i) (2 pts) Give the name of the pathway in which **one** of these reactions occurs. *Write your answer next to the reaction.*

ii) (4 pts) What is the common feature of all of these reactions? i.e. how have the left compounds been changed by the reactions? What compounds are not shown in these reactions?



11. (5 pts) The concentration of sodium ions (Na^+) outside a cell is 100 mM, while the concentration inside the cell is 10 mM. The voltage difference across the membrane is -100 mV. Will the transport of sodium occur spontaneously, or is the system at equilibrium?

12. (12 pts) Please do **one** of the following three choices.

Choice A: The energy released by degradative pathways is directly captured on which types of compounds? Briefly explain how the energy on these compounds is converted to a hydrogen ion (proton) gradient across a membrane during electron transport.

Choice B: Briefly explain how the hydrogen ion gradient generated in choice A is converted to ATP by ATP synthase.

Choice C: Select **either** direct **or** indirect coupling and explain how coupling can be used to insure that a step in a metabolic pathway is spontaneous. How is the corresponding reaction in the reverse direction made to be spontaneous? Give one example to illustrate your answer.

13. (4 pt) Briefly explain how glucose is converted to ethanol by yeast (3 pts). What environmental conditions would enhance the production of ethanol (1 pt)?

14. (10 pts) Please do only one of the following three choices.

Choice A: Briefly describe how energy sensing is used to regulate energy production in the cell. Your answer should provide one example of a step that is regulated by energy sensing.

Choice B: Select any **one** of the following three hormones: glucagon, or epinephrine, or insulin, and answer all of the following questions.

- i) Under what conditions (e.g. blood glucose levels) would your hormone be released?
- ii) In the presence of your hormone, would the liver store glucose in glycogen or release glucose from glycogen?
- iii) Briefly describe the molecular events that are responsible for the storage or release of glucose from glycogen under the influence of the hormone you have chosen. Your answer should include a brief discussion of changes in protein phosphorylation levels of the enzymes involved in glycogen synthesis and degradation.

Choice C: Select any **one** of the following three hormones: glucagon, or epinephrine, or insulin, and briefly describe how glycolysis and gluconeogenesis are regulated by this hormone. Your answer should indicate which steps in these pathways are regulated and the interplay between F2,6P levels, hormones, and the regulation of these steps.