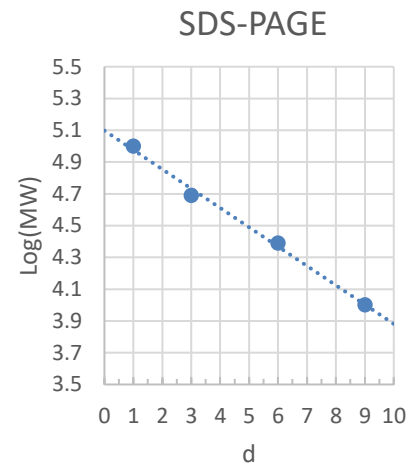
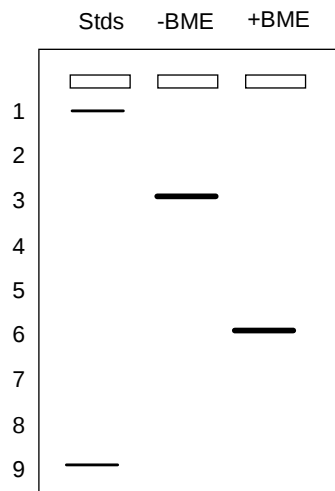


Instructions: This exam has 15 questions on 6 pages, for a total of 100 points. On questions with choices, all of your attempts will be graded and you will be awarded the highest grade. Please use the space provided or the back of the preceding page.

1. (12 pts) You are studying an enzyme whose predicted molecular weight (based on the amino acid sequence) is 25 kDa. You hypothesize that it may be a homodimer, with the subunits joined by a disulfide bond, e.g. α - α .

You run an SDS page gel without and with BME (shown on the right). Your standards are 10kDa and 100kDa. Does this gel **fully** support your hypothesis? Why, or why not?

(log 25000=4.4, log 50000=4.7)



2. (6 pts) Please do **one** of the following choices:

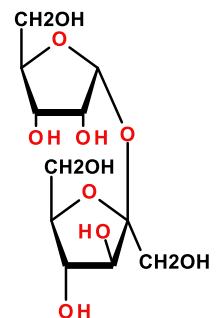
Choice A: How does X-ray diffraction allow the determination of the atomic structure of molecules?

Choice B: How can a Ramachandran plot be used to determine whether a structure is correct or not?

3. (8 pts) Please do **one** of the following choices:

Choice A: Draw the following sugar. β -glucopyranosyl (1-4) α -galactopyranose (galactose is an epimer of glucose at carbon 4).

Choice B: Name the sugar shown on the right.



4. (6 pts) Complete the following table, comparing cellulose, glycogen, and bacterial cell walls.

	Monosaccharide(s)	Linkage	Biological function
Cellulose			
Glycogen			
Bacterial Cell walls			

5. (6 pts) Please do **one** of the following choices

Choice A: What structures do fatty acids and phospholipids spontaneously form in water and what “force” drives this formation?

Choice B: How is a triglyceride similar to a phospholipid? How are they different? (a sketch of the chemical structure of each is an acceptable answer).

6. (8 pts) Please do **one** of the following choices:

Choice A: Explain why corn oil is a liquid at room temperature, but margarine that is made from corn oil is a solid at that temperature.

Choice B: What effect does cholesterol have on the melting properties of lipid bilayers and why is this important biologically?

7. (8 pts) Please do **one** of the following choices.

Choice A: Both alanine and valine are non-polar, however a protein that contains only alanine will not spontaneously insert into a membrane, but a protein that contains valine will. Why?

Choice B: Briefly describe why the K^+ channel will allow K^+ ions through a membrane, but not sodium.

8. (4 pts) Select **one** of the two enzymes and briefly describe the reaction that it catalyzes. Indicate your choice.

Choice A: Kinase

Choice B: Phosphatase

9. (2 pts) Indicate the cellular location of the following compounds or pathways or events using the following key:

C=cytosol, MM=mitochondrial Matrix, IM = Mitochondrial inner membrane

Triglycerides _____

AcylCoA (fatty acid activation) _____

AcetylCoA _____

Electron transport _____

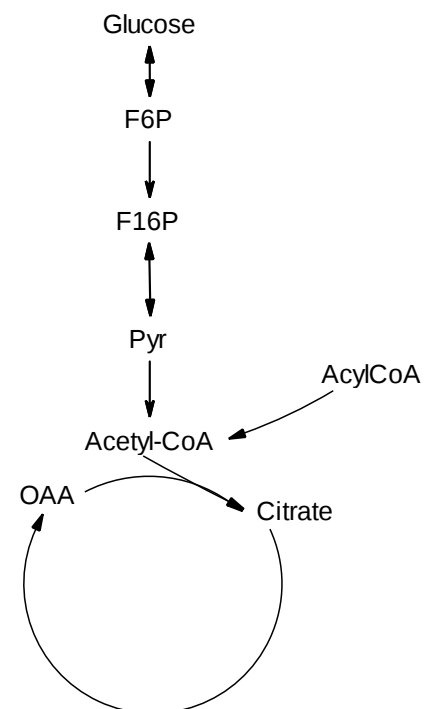
10. (10 pts) Pathway Energetics (do all parts):

i) Indicate the locations where the following are generated on the diagram to the right (4 pts)

a) NADH (6 locations)

b) CO_2 . (3 locations)

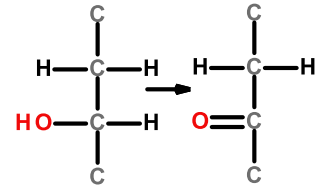
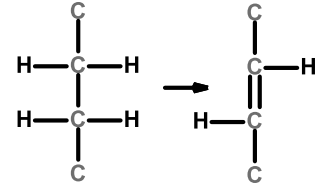
ii) **Briefly** explain how the energy in NADH is converted to ATP (6 pts)



11. (8 pts) Please do one of the following choices:

Choice A: Redox chemistry

- i) Select any **one** of the reactions shown on the right and determine whether it is an oxidation or a reduction. *Justify your answer, either by electron counting or balancing.*



- ii) What is the general name of the enzyme that catalyzes this reaction?

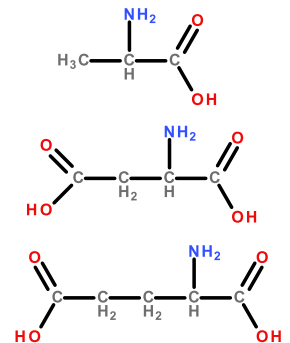
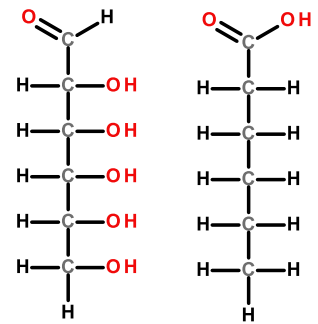
Choice B: Anaerobic metabolism

- i) What compound is required by glycolysis that is regenerated by electron transport complex I when O_2 is available?
- ii) How does the cell regenerate this compound when oxygen is absent? You can discuss either mammals or yeast.

12. (6 pts) Please do one of the following choices. Please indicate your choice.

Choice A: Why are fats higher in energy content than sugars, i.e. hexanoic acid can generate more ATP than a six carbon aldose. You can answer this question by:
i) a discussion of the pathways that fatty acids and glucose are oxidized, or ii) discussing the oxidation state of these two compounds, relative to CO_2 .

Choice B: Describe how the amino acids alanine, aspartic acid and glutamic acid are oxidized to CO_2 .



13. (2 pts) Please do one of the following:

Choice A: When calculating the Gibbs free energy for transport, ΔG° is assumed to be zero, why?

Choice B: What does the term $ZF\Delta V$ represent in the formula for the Gibbs free energy?

14. (6 pts) Select **either** direct **or** indirect coupling and briefly discuss how it is used to make a pathway spontaneous. Regardless of your choice you should discuss the relationship between coupling, Gibbs free energy, and the spontaneous direction of the reaction. The following equation may be helpful:

$$\Delta G = \Delta G^\circ + RT \ln[B]/[A]$$

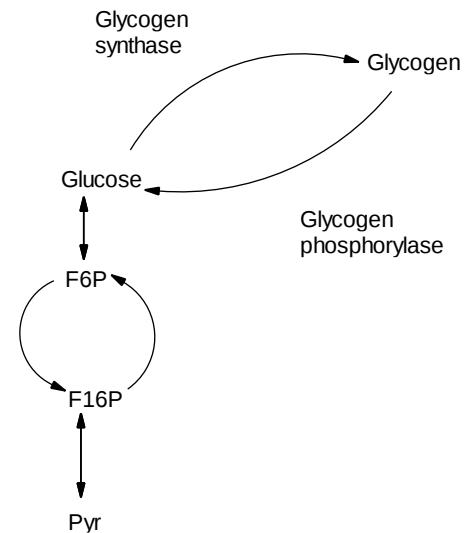
15. (8 pts) At carnival you ate way too much cotton candy (e.g. glucose) than you should have. Do both parts i and ii.

i) Briefly describe the steps in hormonal regulation of glycogen metabolism, e.g. which hormone is released, are proteins phosphorylated or not, which enzymes are is active? The diagram may be helpful to illustrate your answer (4 pts)

ii) Now do **one** of the following two choices:

Choice A: Under these conditions the liver cell may undergo glycolysis. Briefly discuss how F26P regulates glycolysis to allow this to happen (4 pt).

Choice B: Under what conditions will the liver cell actually undergo glycolysis? You should discuss how the key enzyme is regulated by adenosine compounds (ATP, ADP, AMP). Which of these compounds (ATP, ADP, AMP) is acting as a feedback inhibitor of glycolysis? (4 pt)



Bonus 1: Coaches often advise runners to “carbo load” to provide energy during the race. Why?

Bonus 2: Marathon runners, even if they do “carbo load”, deplete the stored energy from the carbs ½ way through the race, what do they use as an energy source to complete the race?