

- Possibly useful information is on the last pages.
- There are a mix of short answer and longer problems: look over the exam before beginning, to optimize your use of time. Read carefully!!!
- SHOW YOUR WORK in order to receive partial credit.

II. Short answer: answer in the space provided.

11. (3 pts each; total 21 pts) Match each of the terms on the left below with a phrase on the right (put the appropriate letter in the blank).

glycogenin _____

uncoupler _____

glucagon _____

glycogen _____

gluconeogenesis _____

debranching enzyme _____

ubiquinone _____

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|---|
| <p>a. low [glucose] signal</p> <p>b. primer for polymer synthesis</p> <p>c. high [glucose] signal</p> <p>d. lipid-soluble weak acid</p> <p>e. synthesis of glucose</p> <p>f. cleaves glycosidic linkages</p> <p>g. cleaves peptide bonds</p> <p>h. oxidative phosphorylation</p> <p>i. chymotrypsin</p> <p>j. polymer of glucose</p> <p>k. breakdown of glucose</p> <p>l. forms glycosidic linkages</p> <p>m. diffusible electron carrier</p> |
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12. (20 points) Consider a liver cell carrying out the oxidation of glucose under aerobic conditions. Suppose that we added a very potent and specific inhibitor of the mitochondrial ATP synthase, completely inhibiting this enzyme. Indicate whether each of the following statements about the effect of this inhibitor is true or false, and briefly explain your answers.

____ (a) ATP production in the cell will quickly drop to zero.

____ (b) The rate of glucose consumption by this cell will decrease sharply.

____ (c) The rate of oxygen consumption will increase.

____ (d) The citric acid cycle will speed up to compensate.

14. (18 points) Suppose you have isolated a new bacterium with unique components in its electron transfer chain, Q* (a modified quinone) and X.

Oxidant	Reductant	Electrons transferred	E° (V)
O ₂			+0.82
NAD ⁺	NADH	2	-0.32
Q*	QH ₂	2	+0.10
X			+0.50

Normally Complex I catalyzes transfer of 2 electrons from NADH to Q coupled to the transport of 4 protons across the mitochondrial membrane. Deduce whether Q* could play a similar role using the following reasoning.

(a) (6 points) Calculate the ΔG° for electron transfer from NADH to Q*.

(b) (6 points) Calculate the number of protons that could be transported when this electron transfer is coupled to proton transport. Assume you are working against a membrane potential of 0.17 V and $\Delta\text{pH} = 0.5$ (both terms should be unfavorable). $T = 25^\circ\text{C}$.

(c) (2 points) Based on this calculation, can Q* be playing a role similar to Q in a Complex I: can it be the electron acceptor coupled to transfer of 4 protons?

(d) (4 points) Based on its reduction potential, what is the likely location of X (relative to the components listed above) in this new electron chain? Briefly explain.