

Chem. 454-Sp. 1998

Write concise, but clear answers
80 PTS.

EXAM 1

NAME _____.

They wept like anything to see
Such quantities of sand
"If this were only cleared away," they said
"It would be grand
If seven maids with seven mops swept for half a year
Do you suppose, " the Walrus said, "that *they* could get it clear?
I doubt it," said the Carpenter, and shed a bitter tear. ----Lewis Carroll

1. Consider the "grapefruit diet." Proponents of this diet claim that significant intake of citric acid from 6 grapefruits/day will cause you to lose weight regardless of other dietary intake. Convince me to run out and buy some grapefruits by explaining why the diet works and then disappoint me by giving specific reasons why it might not. Please note which enzymes might be effected directly or indirectly by citric acid or related cofactors and metabolites and name those cofactors or metabolites (*e.g.* NAD⁺, ADP, NADH etc.). (25)

2. Animals do not intentionally produce superoxide anions, yet they (and we) have evolved an elaborate enzyme system (superoxide dismutase, catalase, glutathione, etc.) to deal with them. (15)

a. Where can superoxide come from and what tissues may be most affected by its presence?

b. Name one nutrient thought to act as an antioxidant or scavenger of these active oxygen species (fad vitamin or otherwise).

c. What important reaction does glucose-6-phosphate dehydrogenase catalyze? Give two important needs that this enzyme and its subsequent pathways (pentose phosphate) fulfill. When is it good to have a glucose-6-phosphate dehydrogenase deficiency? Explain. When is it bad to have a glucose-6-phosphate dehydrogenase deficiency

3. Cytochrome a and a_3 are both part of cytochrome c oxidase. The a -type hemes have different standard reduction potentials because of the different protein environments around them. SHOW ALL CALCULATIONS!!!! (15)-see attached table for redox potential values

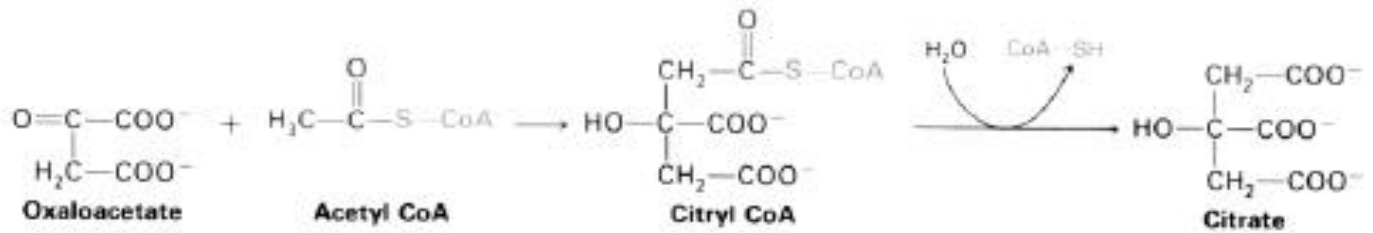
a. Could the transfer of two electrons between these two cytochromes (a and a_3) have sufficient energy (ΔG°) to lead to ATP synthesis from ADP and P_i under standard conditions? Show why or why not.

b. Would transfer of two electrons from $FADH_2$ to CoQ be sufficient for ATP synthesis (theoretically)? Show why or why not.

c. Experimentally, the protonmotive force generated by the 2 electron transfer process of $FADH_2$ to CoQ in mitochondria is 0.160 V. If the transmembrane voltage is 0.090 V (inside negative), what pH would be necessary to achieve this pmf? Would the pH be acidic or basic inside the matrix of the mitochondria? (show work)

4. Starting from acetyl CoA , outline the pathway which plants use to make sugars from fats (fats are broken down to acetyl CoA) and explain why we cannot do this to any significant extent. (give names of intermediates and/or cycles, but not vitamin cofactors, enzymes, etc.). (15)

5. Citrate synthase can be considered to have a two-step reaction; condensation followed by hydrolysis. Using arrow type symbols (“electron pushing”) for organic reactions show how each these steps might occur. (10)



a. Describe briefly in words what you have drawn.

b. Specifically, what features of the enzyme active site could encourage (*i.e.* catalyze) the condensation step and how?

c. What is the purpose of the CoA here, *i.e.* , could the last step occur if the CoA was an -OH group instead ?