BCH 4054 **HOUR TEST 1** **NAME**_____
February 2, 2001

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(6) 1. The free energy change of a chemical reaction varies with the concentration of reactants and products. The relationship is given by the **reaction isotherm:**

$$\Delta G = \Delta G^{o'} + RT\ln Q'$$

(a) What is the significance of the **prime** (') in $\Delta G^{o'}$ and Q'?

(b) What is the relationship between Q' and K'_{eq} for a spontaneous reaction?

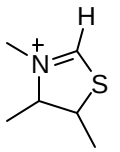
(10) 2. Reactions near equilibrium have ΔG values low, near zero, while reactions that are irreversible or far from equilibrium have large negative ΔG values. In the list of enzymes of glycolysis and the TCA cycle listed below, but a **check** by the enzymes that operate **near equilibrium**.

_____	hexose phosphate isomerase	_____	citrate synthase
_____	triose phosphate dehydrogenase	_____	isocitrate dehydrogenase
_____	succinate dehydrogenase	_____	malate dehydrogenase
_____	phosphoglycero mutase	_____	alpha keto glutarate dehydrogenase
_____	3-phosphoglycerate kinase	_____	phosphofructokinase

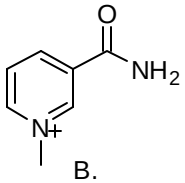
(8) 3. Starting with [1-^{14}C]-glucose, predict which carbon(s) would be labeled in the following intermediates after glycolysis and during **the first turn** of the TCA cycle. (Draw the structure of the intermediate and circle the labeled carbon atom).

(a) pyruvate (b) isocitrate (c) alpha-ketoglutarate (c) malate

(14) 4. Below are the **partial** structures of seven coenzymes you have studied. Below each structure give the **name** of the coenzyme and draw an alternative form of the coenzyme to which it is converted during the course of a reaction.



A.



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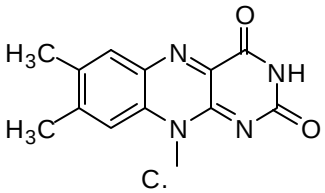

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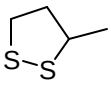

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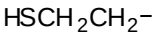

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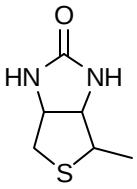

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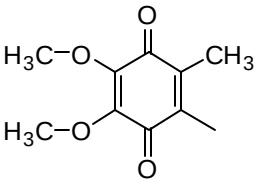

G.

(5) 5. Your textbook gives the reaction catalyzed by succinate dehydrogenase as:

succinate + FAD ® fumarate + $FADH_2$

Your instructor prefers to write the reaction as:

succinate + CoQ ® fumarate + $CoQH_2$

Explain why.

6. In the presence of cyanide and excess cytochrome c, mitochondria can carry out the following reaction (where the NADH is generated from oxidation of substrates via the TCA cycle):

$$NADH + 2\ cyt\ c(ox) \rightarrow NAD + 2\ cyt\ c(red)$$

(6) (a) Calculate $\Delta G^{o'}$ for this reaction.
(E'_o for NAD/NADH is –0.32 volts and for cyt c(ox)/cyt c(red) is +0.25 volts; $\mathbf{F} = 96.5\ kJ\ mol^{-1}\ volt^{-1}$)

(6) (b) Identify all the intermediate electron carriers involved in this reaction, indicating which are organized in multiprotein complexes.

(4) (c) If these mitochondria are tightly coupled to ATP synthesis, what molar ratio of ATP made to NADH oxidized would you expect? Explain your answer

(2) (d) Why is it necessary to add cyanide to observe this reaction?

(6) 7. **Oligomycin** would block the reduction of cytochrome c described in question 2 if the mitochondria are tightly coupled to ATP synthesis, but **dinitrophenol** would relieve this inhibition allowing cytochrome c reduction to resume. Explain how these two inhibitors would be interacting with the system to show these effects.

(18) 8. Following is an alphabetical list of the intermediate electron carriers found in the mitochondrial electron transport chain. Identify the carriers that fit each description on the right by placing the letter of the carrier(s) in the blank next to the description. **A carrier may be used more than once.**

Electron Carrier

(a) Coenzyme Q
(b) Cu_A
(c) Cu_B
(d) cytochrome a
(e) cytochrome a_3
(f) cytochrome b_H
(g) cytochrome b_L
(h) cytochrome c
(i) cytochrome c_1
(j) FAD
(k) Fe/S center
(l) FMN

Description

A component of Complex I _____

A component of Complex II _____

A component of Complex III _____

A component of Complex IV _____

Carries electrons from Complex II to Complex III _____

Carries electrons from Complex III to Complex IV _____

Forms a binuclear center for oxygen reduction _____

Accepts electrons directly from succinate _____

Accepts electrons directly from NADH _____

(15) 9. A number of components are involved in the light reaction of plant photosynthesis. Match a component in the list at the right with each statement below by placing the appropriate letter in the blank. **Only one component may be used per blank**. (P700 is **photosystem I**, P680 is **photosystem II**).

_____ reduced directly by $P680^*$
____ reduced directly by $P700^*$
____ oxidized directly by $P680^+$
____ oxidized directly by $P700^+$
____ an accessory pigment
____ chlorophyll a without Mg^{2+}
____ reduced by cytochrome b/f complex
____ removes electrons from the Mn cluster
____ a Cu containing protein
____ an Fe/S protein

a. Z, a tyrosine residue
b. phycocyanin
c. plastocyanin
d. Ao, a chlorophyll molecule
e. pheophytin
f. cytochrome a_3
g. ferredoxin