BIOSCI 1820
Quiz #3
FEB 2001

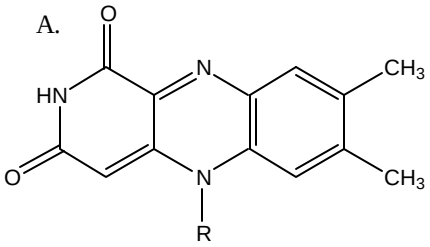
I. Some bacteria deliver the electrons generated from carbohydrate metabolism to elemental sulfur (S) to create hydrogen sulfide (H_2S). Assuming that the action of the inhibitors, electron donors, and electron-extracting compounds function as efficiently in these bacteria as in mammals, what would be the P/S ratio if the following could be added to bacteria containing sufficient ADP and P, and an active ATP synthase?

A. succinate and antimycin A

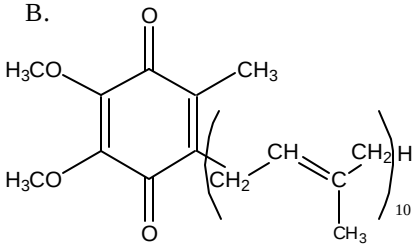
B. β-hydroxybutyrate and exogenous cytochrome C

II. Give the name of the following co-factors:

A.



B.



III. Use the Table to answer the following questions (and please show your work):

Oxidant	Reductant	n	E_0', V
Acetate + CO_2 + $2H^+$	Pyruvate + H_2O	2	−0.70
Succinate + CO_2 + $2H^+$	α-Ketoglutarate + H_2O	2	−0.67
Acetate + $3H^+$	Acetaldehyde + H_2O	2	−0.60
O_2	O_2^-	1	−0.45
Ferredoxin (oxidized)	Ferredoxin (reduced)	1	−0.43
$2H^+$	H_2	2	−0.42
Acetoacetate + $2H^+$	β-Hydroxybutyrate	2	−0.35
Pyruvate + CO_2 + H^+	Malate	2	−0.33
NAD^+ + H^+	NADH	2	−0.32
$NADP^+$ + H^+	NADPH	2	−0.32
FMN (enzyme-bound) + $2H^+$	$FMNH_2$ (enzyme-bound)	2	−0.30
Lipoate (oxidized) + $2H^+$	Lipoate (reduced)	2	−0.29
1,3-Bisphosphoglycerate + $2H^+$	Glyceraldehyde-3-phosphate + P_i	2	−0.29
Glutathione (oxidized) + $2H^+$	2 Glutathione (reduced)	2	−0.23
FAD + $2H^+$	$FADH_2$	2	−0.22
Acetaldehyde + $2H^+$	Ethanol	2	−0.20
Pyruvate + $2H^+$	Lactate	2	−0.19
Oxaloacetate + $2H^+$	Malate	2	−0.17
α-Ketoglutarate + NH_4^+ + $2H^+$	Glutamate + H_2O	2	−0.14
Methylene blue (oxidized) + $2H^+$	Methylene blue (reduced)	2	0.01
Fumarate + $2H^+$	Succinate	2	0.03
CoQ + $2H^+$	$CoQH_2$	2	0.04
Cytochrome b (+3)	Cytochrome b (+2)	1	0.07
Dehydroascorbate + $2H^+$	Ascorbate	2	0.08
Cytochrome c_1 (+3)	Cytochrome c_1 (+2)	1	0.23
Cytochrome c (+3)	Cytochrome c (+2)	1	0.25
Cytochrome a (+3)	Cytochrome a (+2)	1	0.29
$½O_2$ + H_2O	H_2O_2	2	0.30
Ferricyanide	Ferrocyanide	2	0.36
Nitrate + $2H^+$	Nitrite + H_2O	1	0.42
Cytochrome a_3 (+3)	Cytochrome a_3 (+2)	1	0.55
Fe (+3)	Fe (+2)	1	0.77
$½O_2$ + $2H^+$	H_2O	2	0.82

Note: E_0' is the standard reduction potential at pH 7 and 25°C, n is the number of electrons transferred, and each potential is for the partial reaction written as follows: Oxidant + ne^- ⟶ reductant.

A. What is the electromotive force (in E'^{o}, in Volts) for the delivery of the two electrons from NADH completely through complex I?

B. What is the electromotive force for the delivery of the two electrons from cytochrome c completely through cytochrome oxidase?

IV. Multiple Choice: Select the best answer:

A. Which of the following statements about the ATP synthase is false?
i) The proton gradient drives the release of ATP from the enzyme
ii) The F1 portion projects into the intermembrane space of the mitochondria
iii) There are 3 independent sites in the enzyme that represent stages in the enzyme cycle
iv) The α and β subunits are components of the F1 portion of the enzyme

B. Which of the following statements about cytochromes is false?
i) They are approximately 130,000 Daltons in molecular mass
ii) They are highly conserved across all species
iii) Iron is bound in the proteins via a heme-group
iv) Cytochrome C is protein-linked via a cysteine residue

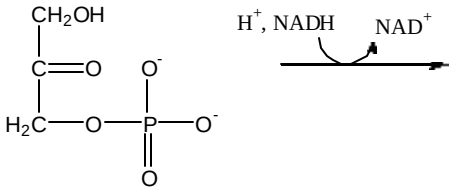
V. Short answer:

A. Which metal is present only in cytochrome oxidase?

B. Name an inhibitor of the Adenine nucleotide translocase (ATP/ADP transporter):

VI. Draw the structures of the products of the following reactions:

A. $2\ H_2O_2 \xrightarrow{\text{Catalase}}$

B. 

VII. Deciphering the pathway:

A. Under conditions in which mitochondria are respiring and ATP synthesis proceeds, what inhibitor will lead to the strongest oxidation of methylene blue?

B. What complex (give the proper name) of the electron transport chain is inhibited by carbon monoxide?

VIII. Choose one uncoupling mechanism or uncoupler and explain how it works: