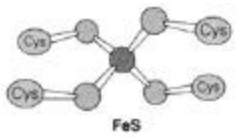
Quiz #3
FEB 2002

KEY

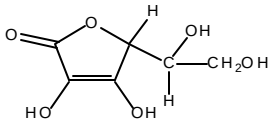
1. Give the names of the following cofactors/vitamins:

A.



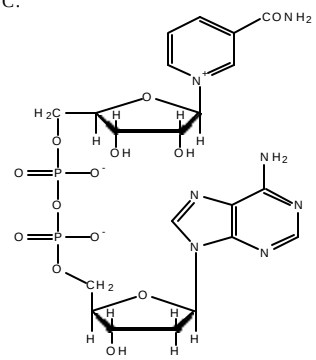
Iron-Sulfur Cluster

B.



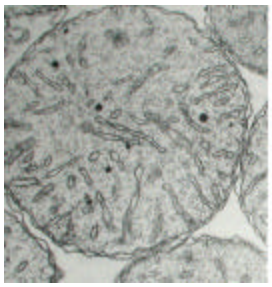
Vitamin C (Ascorbic Acid)

C.



NAD

2. Which picture (A or B) do you think represents the more actively respiring mitochondria? Why?...



(A) (B)

Greater proliferation / invagination of inner membrane.

3. Use the the table to answer the following 2 questions:

Oxidant	Reductant	n	E'_o, 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'_o 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 E_o' in Volts for the reaction catalyzed by succinate dehydrogenase (" succinate-ubiquinone oxidoreductase")? [Assume that the terminal acceptor of electrons is FAD.]

Succinate ----> Fumarate + $2H^+$ + $2e^-$ (-0.03)

FAD + $2H^+$ ----> $FADH_2$ - 0.22

-(0.03) + (-0.22) = -0.25

B. Is the reaction favorable? If not, will it be favorable if Coenzyme Q is instead the electron acceptor? [show your work]

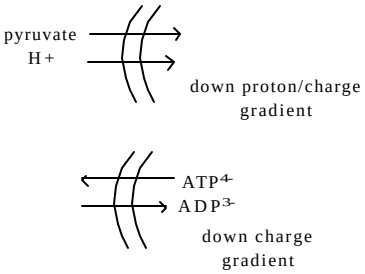
NO.

(-0.03) + (0.04) = +0.01 => FAVORABLE (Just Barely!)

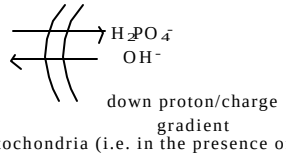
CoQ + $2H^+$ ----> $CoQH_2$

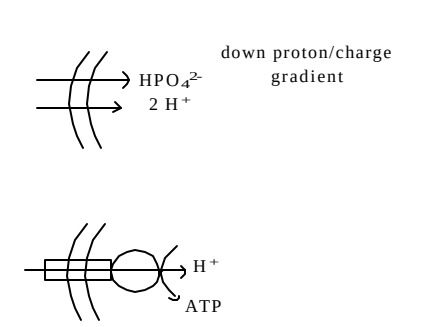
4. We have discussed 5 transport systems by which substrates/metabolites are moved across the mitochondrial inner membrane. Choose 2 examples, state which molecules are being moved and in which direction , and indicate why the process is energetically favorable.

A.



B.





5. In respiring mitochondria (i.e. in the presence of oxygen and FADH and NADH), will cytochrome c ("cyt c") be (A) OXIDIZED or (B) REDUCED under the following conditions?

__A__ Antimycin A is added

Antimycin A inhibits e- transfer TO cyt c. Azide inhibits transfer FROM cyt c

__B__ Azide is added

6. All of the following are uncouplers except:

A. Nigericin
B. Dinitrophenol
C. Oligomycin
D. Valinomycin
E. All of the above are uncouplers

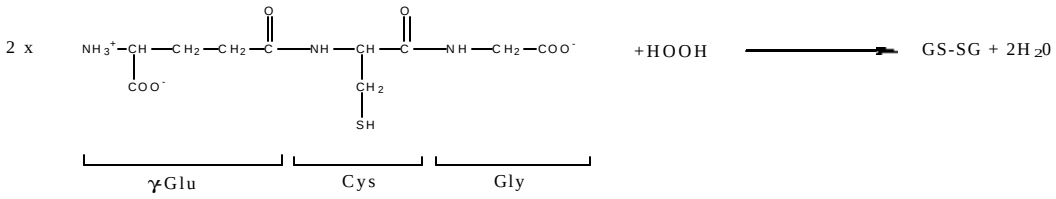
7. Which statement about the ATP Synthase is FALSE?

A. Oligomycin binds to the F1 subunit and inhibits the enzyme
B. The binding sites in the enzyme undergo a conformational change to switch between 3 states
C. The F_O portion of the enzyme projects into the mitochondrial matrix
D. The γsubunit has been shown to actually rotate

8. What is the P/O ratio if respiring mitochondria were fed b-hydorxybutyrate and antimycin?

A. 0
B. 1
C. 2
D. 3

9. Draw the products of the following reaction:



Glutathione

10. Given that $\Delta p = \Delta\Psi - Z\Delta pH$, and that the pH gradient is 0.5 units across the mitochondrial inner membrane and the membrane potential is -0.17V, does the electrical or chemical component of the gradient contribute more to the proton movive force? [show your work; Z=0.059 V]

$\Delta p = \Delta\Psi - Z*\Delta pH$

$\Delta p = -0.17V - (0.059)(0.5)$

$= -0.17V - (0.0295)$

Contributes more ($\Delta\Psi$ = Electrical!)