Chem 352, Fall 2018 - Quiz 4

Use constants: Ideal gas law constant, R = 0.08206 (l•atm)/(mol•K) = 8.314 (J/(mol•K); Faraday's constant, $\mathcal{F}$ = 9.659 x 10^4 J/(V•mol); Planck's constant, h = 6.626 x 10^{-34} J•s.

1. The citric acid cycle, along with the pyruvate dehydrogenase reaction, play a major role in the complete oxidation of the glucose to CO_2 and H_2O ($C_6H_{12}O_6 + 6\ O_2 \rightarrow 6CO_2 + 6\ H_2O$). In this net reaction the carbon atoms from the glucose are oxidized to CO_2 while the hydrogen atoms are used to reduce NAD^+ and ubiquinone (Q) to NADH + H^+ and ubiquinol (QH_2).

   a. Pick one of the three reactions among the pyruvate dehydrogenation reaction and the reactions in the citric acid cycle in which both CO_2 is produced, and *using structural formulas* for the intermediates, write a balanced chemical reaction equation for the reaction you have chosen. Also, label the intermediates (reactants and products) and name of the enzyme involved.
   Enzyme Name _____
   Reaction Equation:

   b. In addition to the acetyl group, which enters the citric acid cycle as acetyl-CoA and contains 2 carbon atoms, 2 oxygen atoms, and 3 hydrogen atoms, there are additional hydrogen and oxygen atoms that enter the citric acid cycle as water. Pick one of the three reactions where this occurs, and *using structural formulas* for the intermediates, write a balanced chemical reaction equation for the reaction you have chosen. Also, label the intermediates (reactants and products) and give the name of the enzyme involved.
   Enzyme Name _____
   Reaction Equation:

2. The electron transport chain (ETC) comprises a series of redox reagents that are linked together.
   a. Identify the redox reagent found in the ETC that fits each of the following descriptions:

Description	Redox agent
The initial donor of electrons to Complex II	
The acceptor of electrons at the end of the ETC	
The mobile 1-electron carrier connecting Complex III to Complex IV	
The mobile 2-electron carrier connecting Complex II to Complex III	
The complex that is site of the Q-cycle	
The initial donor of electrons to Complex I	

   a. Starting at the initial donor to Complex II and ending with the acceptor from Complex III, write the *net balanced reaction equation* for the flow of 2 electrons from this donor to this acceptor.

   b. Using the appropriate reduction potentials provided in the table below, calculate the standard free energy change per mole of this reaction. (Show your calculations.)

$\Delta G°' =$_____

TABLE 10.4 Standard reduction potentials of some important biological half-reactions

Reduction half-reaction	$E°'$ (V)
Cytochrome b_5 (microsomal), $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.02
Fumarate + $2\,H^+ + 2e^- \rightarrow$ Succinate	0.03
Ubiquinone (Q) + $2\,H^+ + 2e^- \rightarrow QH_2$	0.04
Cytochrome *b* (mitochondrial), $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.08
Cytochrome c_1, $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.22
Cytochrome *c*, $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.23
Cytochrome *a*, $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.29
Cytochrome *f*, $Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.36
Plastocyanin, $Cu^{2+} + e^- \rightarrow Cu^+$	0.37
$NO_3^- + 2\,H^+ + 2e^- \rightarrow NO_2^- + H_2O$	0.42
Photosystem I (P700)	0.43
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.77
$\frac{1}{2}O_2 + 2\,H^+ + 2e^- \rightarrow H_2O$	0.82
Photosystem II (P680)	1.1