

Key for Chem 431b Test #2: ave±sd = 75±22 (60%±18%)  
( approximate letter grades based on all Quizzes, HW and Tests:  
85% and above ≈ A; 70% and above ≈ B, 51% and above ≈ C

Part I True or False:

- 1 T (eg Succinate DH uses FAD)
- 2 F (eg Isocitrate DH doesn't use TPP)
- 3 T (with or without atractyloside, oligomycin blocks oxidative phosphorylation at the ATPase)
- 4 F (antimycin blocks at site II. That's before cytochrome C. so Cyt C will be more oxidized than reduced and the ratio of  $\text{CytC}_{\text{ox}}/\text{CytC}_{\text{red}}$  will increase not decrease).
- 5 T (if there is both  $\text{O}_2$  and substrate, but no ADP, then we have state 4.
- 6 F (the 2 C's removed in the first round are those which were originally from OAA)
- 7 T (the  $\text{K}^+$  uniport would decrease the potential gradient but not the chemical gradient. That would cause an effect on any electrogenic transport like that of ADP/ATP transport,
- 8 T
- 9 F (it is only necessary to utilize the nonoxidative phase of the PPP)
- 10 F (ubiquinone, or CoQ is a lipidlike molecule not a protein.)

Part II Fill in the blanks:

- 1)  $\text{NAD}^+$  to NADH
- 2) Dihydrolipoyl Transsuccinylase (this is in the  $\alpha$ -ketoglutarate complex, analogous to DLT, or dihydrolipoyl transacetylase in PDH complex)
- 3) cis-aconitate
- 4) 6 (3 from the NADH generated in  $\alpha\text{KG} \rightarrow \text{succinylCoA}$  , 1 GTP generated from succinyl CoA  $\rightarrow$  succinate. Malonate then inhibits the step from succinate DH step.
- 5) 2
- 6) electrical potential gradient ( $\text{ATP}^{4-}/\text{ADP}^{3-}$  transport involves a net transfer of  $-1$  charge to the outside, which is the  $+$  side of the inner membrane)
- 7) uncoupler. (bongkreik acid blocks oxidative phosphorylation at the adenine nucleotide translocase antiport; but if we uncouple it from the electron transport chain, respiration will still occur without phosphorylation).
- 8) pyruvate carboxylase, phosphoenol pyruvate carboxykinase (PEPCK), Fructose bisphosphatase, glucose-6-phosphatase (any 2 of these 4 enzymes will do).
- 9) glyoxylate, isocitrate lyase. (in the glyoxylate cycle, plants can split isocitrate (a  $\text{C}_6$  molecule) into succinate (a  $\text{C}_4$ ) and glyoxylate ( $\text{C}_2$ ) by the step utilizing isocitrate lyase.
- 10) transaldolase and transketolase.

Part III Multiple Choice

- 1) e
- 2) a

3) d ( can't accumulate any of intermediates of the TCA cycle by adding acetyl CoA)

4) c

5) b

6) e

7) a

8) c

part IV

a) first get the  $\Delta G$  for the transfer of 1 mole of  $H^+$ : Here, we use a simplified formula and constants:

$$\Delta G = RT\Delta pH + zF\Delta\Psi = (10)(300)(1.0) + (1)(100,000)(0.1) = 3000 + 10,000 = 13 \text{ kJ/mol } H^+$$

since we have to have 3  $H^+$ :  $3(13) = 39 \text{ kJ}$  total energy available

The energy actually used is:  $30 \text{ kJ / ATP}$ , so % eff =  $100\% \times (30/39) = 77\%$

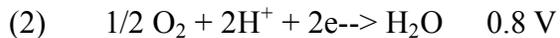
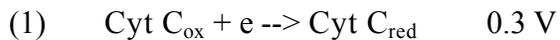
(you can estimate it as:  $100 \times 30/40$  or  $\approx 75\%$ )

b) Here, we do a similar calculation but this time there is a net transfer of 1 electron charge and there is only the electrical component:

$$\Delta G = zF\Delta\Psi = (-1)(100,000)(0.1) = -10 \text{ kJ/mole ATP}$$

c) %eff =  $(\Delta G \text{ stored as 1 ATP} / \Delta G \text{ released by the oxidation of Cyt C}) \times 100\%$

to get the  $\Delta G$  from oxidation of cytochrome C:



so for the net equation:  $(2) - 2 \times (1)$ :



and  $\Delta G = -nF\Delta E = -(2)(100,000)(.5) = 100,000 \text{ J} = 100 \text{ kJ}$

so the % eff =  $30 \text{ kJ}/100\text{kJ} \times 100\% = 30\%$

Part V:

1) For the diagram showing the inner membrane and the components and the flow of  $H^+$ , consult your notebook. (we wrote it on the board several times)

2) states: a) 4, b) 3, c) 2, d) 3, e) 5.