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 $CytC_{ox}/CytC_{red}$ will increase not decrease).
5 T (if there is both 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 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) NAD^+ to NADH
2) Dihydrolipoyl Transsuccinylase (this is in the a-ketoglutarate complex, analogous to DLT, or dihydrolipoyl transacetylase in PDH complex)
3) cis-aconitate
4) 6 (3 from the NADH generated in aKG-> succinylCoA , 1 GTP generated from succinyl CoA -> succinate. Malonate then inhibits the step from succinate DH step.
5) 2
6) electrical potential gradient (ATP^{4-}/ADP^{3-} transport involves a net transfer of –1 charge to the outside, which is the + side of the inner membrane)
7) uncoupler. (bongkrekic 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 C_6 molecule) into succinate (a C_4) and glyoxylate (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 ΔG 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 kJ/mol H^+

since we have to have 3 H^+: 3(13) = 39 kJ total energy available

The energy actually used is: 30 kJ / ATP, so % eff = 100% x (30/39) = 77%
(you can estimate it as: 100 x 30/40 0r ≈ 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 kJ/mole ATP

c) %eff = (ΔG stored as 1 ATP / ΔG released by the oxidation of Cyt C)x100%

to get the ΔG from oxidation of cytochrome C:

(1) Cyt C_{ox} + e --> Cyt C_{red} 0.3 V
(2) 1/2 $O_2 + 2H^+ + 2e \rightarrow H_2O$ 0.8 V

so for the net equation: (2) - 2x(1):

2 Cyt C_{red} + 1/2 $O_2 + 2H^+$ --> 2 Cyt C_{ox} + H_2O ΔE = .8-(.3) = + .5V

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

so the % eff = 30 kJ/100kJ x 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.