Chemistry and Biochemistry 153A, Winter 2011

Final Exam Answers – Sheet 1

1. a. (1) False – *Yeast cells can perform alcoholic fermentation; Human cells can perform homolactic fermentation*
   b. (1) False – *Fermentation yields less energy than oxidation*
   c. (1) True
   d. (1) False – *The reduced form is NADH*
   e. (1) False – *Coenzyme Q is an electron carrier; Coenzyme A is an acyl carrier*
   f. (1) True
   g. (1) True
   h. (1) True
   i. (1) False – *Coenzyme Q is found in membranes*
   j. (1) False – *$FADH_2$ is not diffusible, it is part of Complex II*
2. (3) b
3. a. (2) 2, 5
   b. (2) C
   c. (2) D, E, or F
   d. (2) A or B
   e. (4) Concentrations of pathway intermediates are measured and used to calculate ΔG for each reaction. Steps with large, negative ΔG are likely regulated.
4. (5) Any 5 words or phrases related to ATP synthase
5. a. (3) True
   b. (3) False
   c. (3) True
6. (3) Adjacent functional groups in the enzyme (e.g. heme R-groups, aa R-groups) influence the electron affinity
7. (4) a, b, d
8. a. (2) reductant; oxidized
   b. (3) $\Delta E'^\circ = E'^\circ_{acceptor} - E'^\circ_{donor}$
   $= E'^\circ_{NAD+} - E'^\circ_{ethanol} = -0.315\text{ V} - (-0.197\text{ V})$
   $= -0.118\text{ V}$
   c. (2) False – *ΔE'° is negative, so the reaction is favored in the reverse direction*
   d. (3) $\Delta G'^\circ = -nF\Delta E'^\circ$
   $= -2(96.5\text{ kJ/Vmol})(-0.118\text{V}) = 22.8\text{ kJ/mol}$
   e. (5) At equilibrium, $\Delta G = \Delta G'^\circ + RT\ln Q = 0$
   So $Q = e^{-\Delta G'^\circ/RT}$
   Also, $Q = [\text{acet.}][\text{NADH}]/[\text{EtOH}][\text{NAD}^+]$
   Setting the two equal and rearranging, ratio [EtOH]/[acetaldehyde]
   $= \{[\text{NADH}]/[\text{NAD}^+]\}\cdot e^{\Delta G'^\circ/RT}$
   $= (1/700)\cdot e^{(22.8\text{kJ/mol})/(0.00831\text{kJ/molK})(310\text{K})}$
   = 10, at equilibrium
   To favor forward reaction, there must be more reactant than at equilibrium, so [EtOH]/[acetaldehyde] > 10
   f. (2) C
   g. (3) ΔG° is measured at higher $[H^+]$ than ΔG'° (1M versus 10^{-7} M). Since a proton is produced in the rxn, higher $[H^+]$ favors the reverse direction.
9. a. (4) nuc: -OH, hydride;
   elec: acetaldehyde, NAD^+
   b. (2) isozymes
   c. (2) enz: GAPDH
   (2) sim: both oxidize an aldehyde and reduce NAD^+
   (2) diff: GAPDH couples oxidation with phosphorylation
10. a. (2) ligase, synthetase
    b. (2) succinyl-CoA synthetase
    c. (6) 1. Phosphoryl transfer (to acetate from ATP), nuc: acetate; elec: ATP
    2. Thioester formation, nuc: CoA, elec: acetylphosphate
11. a. (3) Although carbons of ethanol enter TCA cycle, they don't contribute to net synthesis of intermediates (not anaplerotic rxns)
    b. (5) Carbons enter TCA cycle, stay and label oxaloacetate. Oxaloacetate can be converted to glucose via gluconeogenesis.
    c. (4) carbons 3 & 4 (lower left & far left)

Chemistry and Biochemistry 153A, Winter 2011

Final Exam Answers – Sheet 2

12. a. (4) ADH rxn: 1NADH
    ALDH rxn: 1NADH
    Acetate → AcCoA: -1ATP
    TCA cycle: 3NADH, $1FADH_2$, 1GTP
    Net: 5NADH, $1FADH_2$, 1GTP, -1ATP
  b. (3) 1 NADH → 2.5 ATP, so 5NADH → 12.5 ATP; $1FADH_2$ → 1.5 ATP, 1GTP=1ATP
    Sum: 12.5 + 1.5 + 1 – 1 = **14 ATP**
  c. (3) glc oxidation yields 32 ATP, so 34/180 = 0.18 mol ATP/gram glc
  d. (3) ethanol is more reduced
  e. (2) True
13. a. (1) Lineweaver-Burk or double-reciprocal
  b. (4) A defined [S] is allowed to react with enzyme, and [P] vs time is measured. The initial slope of this curve, V_o, is then calculated.
  c. (2) competitive
  d. (2) non-competitive
  e. (3) A, C
  f. (3) In the NAD^+ binding site, where the nicotinamide binds
  g. (2) A
  h. A. (3) 6, B. (2) 3
14. a. (2) A
  b. (3) To create smaller fragments for accurate sequencing and to allow reassembly of sequence fragments (via overlapping peptides)
  c. (2) Lys is longer but not branched, ionizable, and has a positive charge (versus neutral Gln). Also, Lys is usually not an H-bond acceptor.
  d. (2) 5
  e. (4) $pI = (pKa_1+pKa_2)/2 = (4+4)/2 = 8/2 = 4$
    Ionizable groups (from lowest pKa to highest): C-term COOH (~3), Glu-R COOH (~4), Glu-R COOH (~4), N-term NH_3^+ (~8), Lys-R NH_3^+ (~10.5). Below pH 4, the predominant charge states of the groups sum to a net positive charge. Above pH 4, the predominant charge states of the groups sum to a net negative charge.
  f. (2) B
  g. (2) No
15. a. (5) x-axis: pO_2; y-axis: θ (from 0 to 1.0)
    Mb: left-most curve, hyperbolic, approaching θ=1
    Mb + NO: right-shifted from Mb curve, hyperbolic, approaching θ<1
    Hb: sigmoidal curve, approaching θ=1
    Hb + NO: left-shifted from Hb curve, less sigmoidal than Hb, approaching θ<1
  b. (1) False – *Hb is not an enzyme*
16. a. (2) B
  b. (2) membrane lipid or membrane structure
17. a. (3) B
  b. (5) (a) amylose
    (b) α-D-glucopyruanose
    (c) α(1→4) O-glycosidic
    (d) amylopectin
    (e) α(1→6) O-glycosidic
  c. (2) hydrolase, glycosidase
  d. (3) C, G, (F)
  e. (2) a
  f. A. (2) Schiff base or imine
    B. (2) amino acid (or peptide)
    C. (2) Aldolase
    D. (3) By acting as an electron sink, stabilizing the carbanion that results from cleavage
  g. A. (3) The heat induces movements that break the weak interactions that stabilize tertiary structure
    B. (2) Exposed hydrophobic patches cause protein aggregation into large, insoluble clusters
  h. (3) O_2 is available, allowing aerobic breakdown of glucose; this is more efficient than fermentation and promotes yeast growth
  i. (2) Because CO_2 is produced during fermentation
  j. (2) d