1. No. (All are formed within each subunit.)
2. 22 (10 in α subunit, 12 in β)
3. d (Asn is necessary since there is an N-linked glycosylation)
4. b
5. a. Heating would separate and denature the subunits because it breaks the weak interactions that stabilize 2°, 3°, and 4° structure.
   b. D
6. a. C
   b. B
7. a. B
   b. The protein hormone, in its normal conformation, with its carbohydrates attached
8. a
9. The lack of sequence similarity suggests convergent evolution (in which 2 sequences start out different). However, the structures are so similar that it’s possible the subunits started as the same sequence and diverged to the point where they no longer show any sequence similarity.
10. d
11. True
12. a
13. hydrophobic (van der Waals)
14. a. glucose + ATP → glucose-6-phosphate + ADP + H⁺
   b. PIPES. The reaction produces H⁺, so a buffer that has more molecules in the deprotonated state (pK_a < pH) will be better able to resist the change in pH.
   c. pH = pK_a + log ([A’]/[HA])
      [A’]/[HA] = 10^pH-pK_a = 10^{7.2-6.8} = 10^{0.4} = 2.51
      [A’]+[HA] = 100 mM; [HA]= 100 mM - [A’]
      [A’]/[HA] = [A’]/(100mM – [A’]) = 2.51
      [A’] = 251mM – 2.51[A’]
      3.51[A’] = 251mM
      [A’] = 71.5 mM
      [HA] = 100 mM – 71.5 mM = 28.5 mM
   d. Mg^{2+}
   e. A, D, G, H
f. ΔG’° = -RTlnK’_eq = -RTln([ADP][G6P]/[ATP][Glc][ATP])
   [ADP][G6P] and [ATP]=[Glc], so K’_eq = ([ADP][ATP])^2 = e^{-ΔG°/RT} = e^{16.7/(0.00831)(298)} = 848.7
   [ADP]/[ATP] = (848.7)^{0.5} = 29.1
   g. [ADP]+[ATP] = 10 mM, so [ATP] = 10mM – [ADP]
   [ADP][ATP]=[ADP]/(10mM–[ADP]) = 29.1
   [ADP] = 291mM – 29.1[ADP]
   30.1[ADP] = 291mM; [ADP] = 9.67 mM
h. [ADP] = [H’] produced = 9.67 mM
   so, 9.67 mM deprot. buffer → prot.
   pH = pK_a + log([A’]/[HA])
   = 6.8 + log(71.5–9.67)/(28.5+9.67)
   = 6.8 + 0.2 = 7.0
15. a. Production of glycogen in sheep relies on the activity of (non-glucokinase) hexokinase.
   b. double-reciprocal or Lineweaver-Burk
   c. Sheep hexokinase has a lower K_m than rat hexokinase.
   d. Yes. Since the [glucose] in sheep is lower, you would expect the K_m of sheep hexokinase to be lower. (Sheep hexokinase has higher binding affinity for glucose.)
   e. The higher purity sample has less of a non-competitive inhibitor.
   f. The authors cannot be sure that all inhibitors have been removed.
   g. True
16. a. transferase, kinase
   
   b. 
   
   c. 
   
   d. A
   e. isomerase, mutase
   f. Phosphoglycerate mutase (PGM)
   g. Enzyme 1. This step couples ATP hydrolysis to galactose phosphorylation, so it’s likely to be highly spontaneous (like the hexokinase reaction).
   h. ATP, NADH
   i. galactose, ADP, AMP, P_i, NAD^+
   j. D
17. a. Triacylglycerols or triglycerides
   b. 1-myristoyl-2-myristoyl-3-palmitoyl-glycerol
   c. Reactant: ATP, products: ADP + H⁺; enzyme 1 is a transferase (class) and kinase (subclass)
   d. Either glyceraldehyde-3-phosphate or dihydroxyacetonephosphate is produced by enzyme 2. Enzyme 2 is an oxidoreductase (class) and dehydrogenase (subclass)
   e. enz 1: -1 ATP
      enz 2: +1 NADH
      GAPDH: +1 NADH
      PGK: +1 ATP
      PK: +1 ATP
      PDH complex: +1 NADH
      isocitrate DH: +1 NADH
      α-KGDH complex: +1 NADH
      succCoA synthetase: +1 GTP
      succinate DH: +1 FADH₂
      malate DH: +1 NADH
      Total: ATP+GTP: 2; NADH: 6; FADH₂: 1
   f. 3: oxidoreductase, dehydrogenase; 4: lyase, (hydratase); 5: oxidoreductase, dehydrogenase; 6 transferase, acyltransferase
   g. Because the β-carbon of the fatty acid is oxidized.
   h. 2x myristic acid (14 carbons) → 2 × 7 acetyl-CoA
      1x palmitic acid (16 carbons) → 8 acetyl-CoA
      14 + 8 = 22 acetyl-CoA
   i. transport across mb: -3 ATP
      β-oxidation: produces 1 FADH₂ and 1 NADH per round
      6 rounds for myristic acid; 7 for palmitic
      2 × 6 + 7 = 19 rounds, so 19 FADH₂ & 19 NADH
      TCA: 3 NADH, 1 FADH₂ & 1 GTP per round
      for 22 acetyl-CoA: 66 NADH, 22 FADH₂, 22 GTP
      Total: ATP+GTP: 19; NADH: 85; FADH₂: 41
   j. 2+19 directly from ATP+GTP = 21
      (6+85 NADH)×2.5 ATP/NADH = 227.5
      (1+41 FADH₂) ×1.5 ATP/FADH₂ = 63
      total ATP equivalents = 311.5
   k. 1 glucose yields 32 ATP
      \[
      \frac{311.5 \text{ ATP/lipid}}{750 \text{ Da}} \div \frac{32 \text{ ATP/glucose}}{180 \text{ Da}} = 2.3x
      \]