1. In allosteric interactions...

A. proteins that consist of a single polypeptide chain form aggregates.
B. disulfide bonds are broken.
C. changes that take place in one site of a protein cause drastic changes at a distant site.
D. metal ions always bind to the protein.
E. allosteric activators bind to the active site.

2. When an enzyme is purified from a complex mixture of proteins what usually happens to the total amount of protein and the specific activity during the purification process?

A. The total amount of protein and the specific activity both increase.
B. The total amount of protein and the specific activity both decrease.
C. The total amount of protein increases and the specific activity decreases.
D. The total amount protein decreases and the specific activity increases.
E. No change.

3. If a chemical reaction starts with 1.0 M concentrations each of reactants A and B and products C and D, under what conditions of $K_{eq}$ and $\Delta G^{\circ}$ will the reaction proceed in the forward direction, $A + B \rightarrow C + D$?

A. If $K'_{eq}$ is greater than 1 and $\Delta G^{\circ}$ is negative.
B. If $K'_{eq}$ is 0 and $\Delta G^{\circ}$ is negative.
C. If $K'_{eq}$ is negative and $\Delta G^{\circ}$ is negative.
D. If $K'_{eq}$ is less than 1 and $\Delta G^{\circ}$ is positive.
E. If $K'_{eq}$ is less than 1 and $\Delta G^{\circ}$ is negative.

4. When the linear form of glucose cyclizes, the product is a(n):

A. anhydride.
B. glycoside.
C. hemiacetal.
D. lactone.
E. oligosaccharide.
5. The aqueous solution with the lowest pH is:

A. 0.1 M HCl
B. 0.1 M acetic acid (pKₐ = 4.86)
C. 0.1 M formic acid (pKₐ = 3.75)
D. 0.1 M ascorbic acid (pKₐ₁ = 4.17 and pKₐ₂ = 11.6)
E. 1.0 x 10⁻¹³ M NaOH

6. A solution buffered at pH 6.5 containing 0.5 mM histidine, 1.0 mM arginine, 0.1 mM lysine, and 0.7 mM tyrosine was loaded onto a cation-exchange column and completely washed with pH 6.5 buffer. Which amino acid came off the column first?

A. Arg
B. His
C. Lys
D. Tyr
E. None, all would be retained on the column at pH 6.5

7. Which of the following lipids is used for energy storage?

A. glycolipids
B. glycerophospholipids
C. sphingolipids
D. triacylglycerols
E. spingophospholipids

8. Which of the following is true?

A. Enzymes force reactions to proceed in only one direction
B. Enzymes alter the equilibrium of the reaction.
C. Enzymes alter the standard free energy of the reaction.
D. All of the above.
E. None of the above.
9. What is the [sodium acetate]/[acetic acid] ratio when the in a solution with a pH = 3.76? The pKₐ of acetic acid is 4.76.

A. 1 : 1  
B. 1 : 10  
C. 10 : 1  
D. 2 : 1  
E. 0.5 : 1

10. The binding of one O₂ molecule to one hemoglobin molecule results in:

A. the release of any other O₂ that may have bound earlier.  
B. a decrease in the ability of hemoglobin to bind a second O₂ molecule.  
C. an increase in the ability of hemoglobin to bind a second O₂ molecule.  
D. the dissociation of the hemoglobin subunits.  
E. the association of the hemoglobin subunits.

11. Which of the following has a thioester bond?

A. PEP (phosphoenolpyruvate)  
B. ATP  
C. Phosphocreatine  
D. Acetyl-CoA  
E. ADP

12. Cytochalasin is a competitive inhibitor for facilitated glucose transport. Which of the following will characterize the kinetics of glucose transport in the presence of cytochalasin?

Note: The Kᵢ is the concentration of [glucose]₀ that yields ½Vₘₐₓ for transport.

A. The apparent Vₘₐₓ for glucose transport increases.  
B. The apparent Vₘₐₓ for glucose transport decreases.  
C. The apparent Kᵢ decreases.  
D. The apparent ratio, Kᵢ/Vₘₐₓ, is unchanged.  
E. The apparent Kᵢ increases.
13. Which of the following is true about the denaturation of double-stranded DNA?

A. Denaturation increases with decreasing temperature.
B. **Denaturation is accompanied by an increase in the absorption of UV light by DNA.**
C. G-C rich DNA melts at lower temperature than A-T rich DNA.
D. Once denatured, DNA strands cannot anneal.
E. Denaturation always leads to the strand breakage of DNA.

14. The glycolytic enzyme which catalyzes an oxidation reduction reaction is:

A. Phosphohexose isomerase
B. Phosphoglycerate mutase
C. Enolase
D. Fructose-1,6-bisphosphate aldolase
E. None of these

15. The pentose phosphate pathway is important for:

A. the generation of ADP.
B. to generate intermediates for glycolysis and gluconeogenesis.
C. the degradation of lactate during anaerobic metabolism in mammals.
D. the degradation of ethanol during anaerobic metabolism in yeast.
E. **to generate NADPH and ribose for nucleic acid biosynthesis.**

16. Glycogen is degraded in a:

A. phosphorylation reaction.
B. hydrolysis reaction.
C. dephosphorylation reaction.
D. **phosphorolysis reaction.**
E. oxidation reaction.
17. Which of the following is true about the fermentation of glucose?
   A. It always generate lactate.
   B. The hydrogen to carbon ratio (H:C) of the reactants and products remains the same.
   C. There is no net generation of ATP.
   D. It always generates CO₂.
   E. It produces O₂.

18. Activation of a G protein-coupled receptor causes stimulatory G protein (Gₛ) to
   A. replace its bound GDP with GTP.
   B. dissociate from adenylyl cyclase.
   C. hydrolyze GTP into GDP and Pi.
   D. generate cGMP.
   E. bind to γ and β subunits.

19. It is known that hexapeptides can serve as PKA substrates, at least in the test tube. You are working with purified PKA, which of following hexapeptides might be a substrate for PKA?
   A. RFCHHL
   B. QFRRKRF
   C. RASCTF
   D. LHHCE
   E. RAMCYF

20. All enzyme-linked membrane receptors:
   A. act by phosphorylating substrates.
   B. have their active sites on the cytosolic side of the plasma membrane.
   C. alter gene expression.
   D. consist of more than one subunit.
   E. are peripheral membrane proteins.
21. Which of the following compounds cannot serve as the starting material for the synthesis of glucose via gluconeogenesis?

A. acetate  
B. glycerol  
C. lactate  
D. oxaloacetate  
E. α-ketoglutarate

22. The direct/immediate effect of cAMP in the protein kinase A pathway is to:

A. activate adenylate cyclase  
B. dissociate the regulator subunits from the catalytic subunits  
C. phosphorylate specific cellular proteins  
D. phosphorylate PKA  
E. release hormones from target tissues

23. The following DNA fragment was sequence by the Sanger method. The asterisk indicates a fluorescent label

\[
\begin{align*}
\ast & 5' \cdots 3'-OH \\
3' & ATTACGCAAGGACATTAGAC \cdots 5'
\end{align*}
\]

A sample of the DNA was reacted with DNA polymerase and the following mixture of nucleotides (in an appropriate buffer): dATP, dTTP, dCTP, dGTP, and ddTTP; and the ddTTP was included in relatively small amounts.

The resulting DNA was separated by electrophoresis on an agarose gel and the band pattern shown in the box below. What is the sequence of the DNA in the band indicated by the arrow?

A.  *5'-Primer-TAATGCGddT  
B.  *5'-Primer-ddT  
C.  *5'-Primer-TAAddT  
D.  *5'-Primer-TATGCTddT  
E.  *5'-Primer-TATGCTTCCddT
24. In an anaerobic muscle preparation, lactate formed from glucose $^{14}$C-labeled at C-1 would be labeled in the:

A. C-1 of lactate.
B. C-2 of lactate.
**C. C-3 of lactate.**
D. C-1 and C-2 of lactate.
E. C-2 and C-3 of lactate.

25. Galactosemia, a disease characterized by high blood [galactose], is a genetic error of metabolism associated with:

A. the excessive ingestion of galactose.
B. deficiency in lactokinase.
C. deficiency in hexokinase IV.
**D. deficiency in UD-glucose: galactose-1-phosphate uridylytransferase.**
E. CDP-galactose kinase.

26. Which of the following is true about motion of membrane lipids?

A. They can move most rapidly when in the gel phase.
B. Lateral diffusion is catalyzed by flippase proteins.
**C. Transbilayer diffusion involves the transfer of lipids from one face of the bilayer to another.**
D. To increase the fluidity of membranes at low temperatures, cells synthesize more saturated fatty acids and fewer unsaturated fatty acids.
E. Transbilayer diffusion never needs energy input.

27. Sphingosine is not a component of:

A. **cardiolipin.**
B. ceramide.
C. cerebrosides.
D. gangliosides.
E. sphingomyelin.
28. What is the net charge of phosphatidylserine at pH = 6.0?

A. -2  
B. -1  
C. 0  
D. +1  
E. +2

29. All of the bypass reactions used in gluconeogenesis

A. require high-energy equivalents.  
B. involve the removal of phosphate groups.  
C. are irreversible.  
D. requires mitochondrial enzymes.  
E. produce ATP.

30. Below are the standard reduction potentials (\(E^\circ\)) for two conjugate redox pair:

- Pyruvate-/lactate- \(E^\circ = -0.185\)
- NAD+/NADH \(E^\circ = -0.320\)

Which of the following is true?

A. The pyruvate/lactate conjugate redox pair has a greater tendency to lose electrons than the NAD+/NADH redox pair.
B. **Pyruvate has a greater affinity for electrons than NAD+.**  
C. NAD+ is a reducing agent.  
D. Under standard conditions, NAD+ is more likely to be converted to NADH, than pyruvate is to converted to lactate.  
E. Lactate is a reducing agent.
Using the data given below for the bind of a ligand, L, to its receptor, R, answer questions 31 and 32.

\[ \text{R} \cdot \text{L} \implies \text{R} + \text{L} \]

<table>
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<th>[L]_{total} (\mu\text{M})</th>
<th>[R]_{free} (\mu\text{M})</th>
<th>[\text{R} \cdot \text{L}] (\mu\text{M})</th>
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</table>

Using the data given below for the binding of a ligand, L, to its receptor, R, answer questions 31 and 32.

\[ \text{R} \cdot \text{L} \implies \text{R} + \text{L} \]

31. What is the value for B_{max}?
   a) 1 \mu\text{M}  
   b) 4 \mu\text{M}  
   c) 8 \mu\text{M}  
   d) 20 \mu\text{M}  
   e) 100 \mu\text{M}  

32. What is the value for the K_{d}?
   a) 1 \mu\text{M}  
   b) 4 \mu\text{M}  
   c) 8 \mu\text{M}  
   d) 20 \mu\text{M}  
   e) 100 \mu\text{M}  

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