1. Hemoglobin undergoes conformational change when it:
   a. binds the first oxygen.   b. binds carbon dioxide.   c. experiences a pH shift.
   d. binds 2,3-bisphosphoglycerate.   e. all of the above.

2. Amylose contains:
   a. α-1,4 bonds.   b. α-1,4 and α-1,6 bonds.   c. β-1,4 bonds.   d. β-1,4 and β-1,6 bonds.

3. Sugars dissolve exceedingly well in water because of their:
   a. salt linkages.   b. ionizable groups.   c. -OH's.   d. sulfite groups.   e. ring structure.

4. The D or L conformation of a 6 carbon pyranose is determined by carbon number:
   a. 1.   b. 2.   c. 3.   d. 4.   e. 5.

5. The position anomeric carbon of fructose is carbon number:
   a. 1.   b. 2.   c. 3.   d. 4.   e. 5.

6. D-mannose is an epimer of D-glucose at carbon number:
   a. 1.   b. 2.   c. 3.   d. 4.   e. 5.

7. The sugar below can not form a pyran or furan ring:

8. Sucrose is:
   a. non-reducing.   b. glucose-(α-1,2)-fructose.   c. pyran and furan.   d. all of the above.
   e. none of the above.

9. When CO₂ binds to hemoglobin, it reacts directly with:

10. The Bohr effect of oxygen binding to hemoglobin A is explained by pH drop of 0.2 results in:
    a. lower affinity for O₂.   b. higher affinity for O₂.   c. release of CO₂.   d. binding CO₂.

11. The type of bi-substrate enzyme reaction mechanism that involves a chemically modified enzyme is:
    a. ordered single displacement.   b. random single displacement.   c. ping-pong.
    d. tennis.   e. basketball.

12. Enzyme(s) regulated by covalent modification involving hydrolysis of a peptide bond is(are):
    a. protein kinase.   b. phosphatase.   c. phosphorylase kinase.   d. zymogens.
    e. adenylylclase.

13. Glucuronic acid has:
    a. carbonyl and keto groups.   b. carboxyl and methyl groups.   c. carboxyl and alcohol groups.
    d. only alcohol groups.   e. none of the above.

14. Glycogen is branched (α 1,6) so that it has many:
    a. reducing ends.   b. non-reducing ends.   c. glucose at N-terminal.   d. β 1,4 bonds.

15. Bacterial cell wall peptidoglycan contains:
16. Each D-glucose unit in cellulose is 0.45 nm long. Consider bamboo which can grow at a rate of 1.25 cm/hour under optimal conditions. In order for this to occur, how many glucose units per second are added to a growing chain of cellulose oriented in the direction of growth.
   a. $2.78 \times 10^8$
   b. $2.78 \times 10^4$
   c. $4.63 \times 10^5$
   d. $7.71 \times 10^4$
   e. $7.71 \times 10^3$

17. In a protein's alpha helix, amino acid 7 (from the N-terminal end of the helix) is H-bonded to amino acid(s):
   a. 3 and 11
   b. 4 and 12
   c. 5 and 9
   d. cis-Proline
   e. 8

18. Hairdressing salons are examples of practical biochemistry because they can:
   a. hydrolyze proteins
   b. reduce and oxidize disulfides
   c. label N-terminal amino acids
   d. phosphorylate serines and threonines
   e. all of the above

19. Random coil is a protein structure that is:
   a. always changing in a protein
   b. a solid structure in a particular protein
   c. part of the protein in motion
   d. tightly coiled
   e. all of the above

20. The newly discovered sulfliimine bond in collagen-IV is a bond between methonine and hydroxylysince. It is:
   a. a single bond
   b. a double bond
   c. a triple bond
   d. a peptide bond
   e. a glycosidic bond

21. In protein structure, motifs are:
   a. in domains
   b. made up of domains
   c. motile portions of proteins
   d. composed of three amino acids

22. Alpha/Beta protein families are:
   a. made of about equal amounts of alpha and beta
   b. have alpha separated from beta
   c. using alpha to connect to parallel beta structure
   d. using alpha to connect to non-parallel beta structure
   e. using beta to connect to parallel alpha structure

23. In an equilibrium dialysis experiment the concentration of free ligand on both sides of the dialysis apparatus is:
   a. larger on the protein side
   b. smaller on the protein side
   c. the same on both sides

24. The effect of 2,3-bisphosphoglycerate is to make hemoglobin-A take more of the:
   a. R state
   b. disordered state
   c. cream puff state
   d. T state
   e. Florida State

25. Several antibodies (immunoglobins) bind their antigens (ligands) with different $K_d$; the one with the highest affinity is the one whose $K_d$ is:
   a. $3 x 10^{-2}$
   b. $4 x 10^{-5}$
   c. $5 x 10^{-9}$
   d. $3 x 10^5$
   e. $5 x 10^9$

26. The $k_{cat}/K_M$ values of all enzymes indicate that enzymes work as fast as:
   a. a jet fighter plane
   b. a passenger plane
   c. molecular diffusion
   d. product can be removed

27. The EC number for bacterial luciferase is 1.14.14.3. These numbers refer to:
   a. type of chemistry
   b. rates of reaction
   c. heat stability of the protein
   d. degree of random coil
   e. all of the above

28. The chymotrypsin reaction demonstrated that as catalysts enzymes:
   a. have a yield of 1
   b. are chemically modified in the reaction
   c. have more than one active site
   d. can catalyze without being modified in the reaction
   e. have higher binding affinities than antibodies

29. Allostertic effectors are small molecules that:
   a. reversibly bind to the active site
   b. covalently modify enzymes
   c. do not bind the active site
   d. look like product to inhibit the reaction
   e. none of the above

30. Zymogen regulation of enzyme activity is dependent upon:
   a. allosteric effectors
   b. breaking peptide bond(s)
   c. enzymes going backwards
   d. modifying the enzyme’s N-terminal amino acid
   e. lowering the pH of assay
1. Using the Hayworth projections, diagram showing all atoms a repeating dimer of cellulose. (6 points)

2. Below is a table showing an experiment with two enzymes: FLUase and Heatase. Both enzymes are able to convert the substrate, basketballin, into the product, pointsfore (B => P). Plot the data on the attached graph paper. Please try to be neat. **This table is printed on the graph paper.**

<table>
<thead>
<tr>
<th>Basketlin, mM</th>
<th>FLUase rate µM/min</th>
<th>Heatase rate µM/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0625</td>
<td>0.039</td>
<td>0.0227</td>
</tr>
<tr>
<td>0.0909</td>
<td>0.047</td>
<td>0.0292</td>
</tr>
<tr>
<td>0.143</td>
<td>0.0555</td>
<td>0.0380</td>
</tr>
<tr>
<td>0.50</td>
<td>0.0740</td>
<td>0.0620</td>
</tr>
</tbody>
</table>

a. Graph the data as a Lineweaver Burke plot. (6 points)
b. Calculate the $K_M$ for each enzyme on the Graph paper. (4 points)
c. The concentration of each enzyme was the same (8.7 nM), calculate the $k_{cat}$ for these enzymes on the graph paper. (2 points)
d. Which enzyme is the most efficient? (2 points) Answer on the graph paper.