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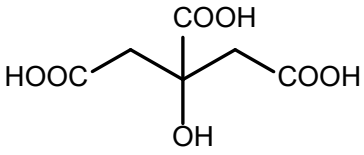
Worksheet #30: Biochemistry Review

1. You are preparing 75.00 mL of a 0.125 M citrate buffer at pH 4.95. Solutions of citric acid ($C_6H_8O_7$, $1.25\ \mathrm{M}$), sodium citrate ($NaC_6H_7O_7$, $1.50\ \mathrm{M}$), disodium citrate ($Na_2C_6H_6O_7$, $0.75\ \mathrm{M}$), and trisodium citrate ($Na_3C_6H_5O_7$, $0.50\ \mathrm{M}$) are available. Citric acid is a polyprotic acid with multiple pK_a values, shown below. Select the appropriate pK_a and the dominant acid/conjugate base pair for preparing a buffer at pH 4.95. Then calculate the volumes of the acid and conjugate base solutions needed to prepare 75.00 mL of the buffer. Show all calculations in the space provided below.



Citric Acid - $C_6H_8O_7$

$pKa_1 = 3.13$

$pKa_2 = 4.76$

$pKa_3 = 6.39$

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2. Draw the structure of the peptide GLHQR at pH 1.00. Draw the peptide with the correct stereochemistry, protonation states, and charges. Clearly indicate and label the following: N-terminus, C-terminus, all α-carbons, all side chains (R groups), all peptide bonds.

3. Calculate the pI point of the peptide EYH. Below are the pKa values for each amino acid in the peptide.

Amino Acid	**pKa_1**	**pKa_2**	**pKa_R**
E	2.19	9.67	4.25
H	1.82	9.17	6.00
Y	2.20	9.11	10.07

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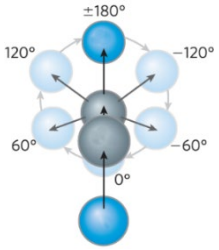
4. Draw the Newman projection that corresponds to the dihedral angles below:



Ψ = +60 ° Φ = -120 ° ω = 180 °

5. Define each level of protein structure:
   1° structure:

   2° structure:

   3° structure:

   4° structure:

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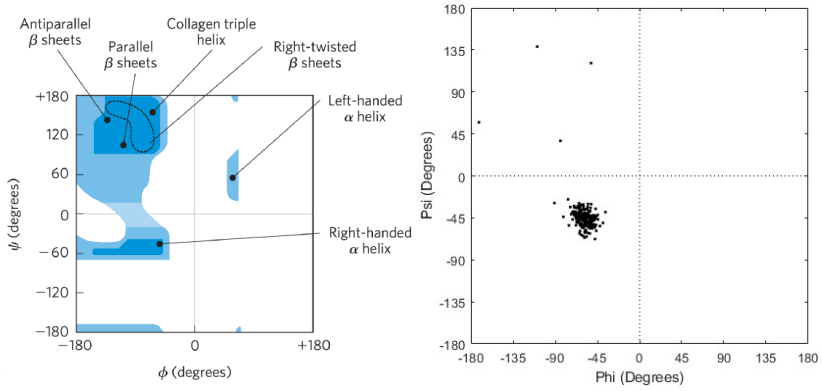
6. What secondary structure(s) does the protein corresponding to the Ramachandran plot below contain?



7. Calculate the initial velocity of an enzyme catalyzed reaction when the substrate concentration is equal to four times the K_m.

8. Summarize the changes to K_m and V_{max} for each type of reversible inhibition.

9. List the three factors that reduce the affinity of heme for carbon monoxide (CO) in myoglobin compared with free heme and briefly explain how each factor decreases CO binding or increases O_2 binding.

10. Define the Bohr effect and explain it's affect on the affinity of hemoglobin for O_2.

11. How do enzymes help lower the activation energy of a reaction?

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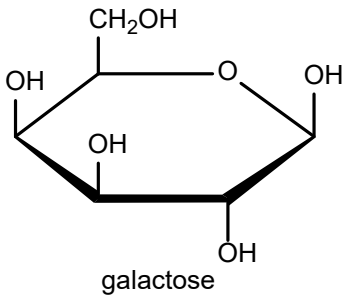
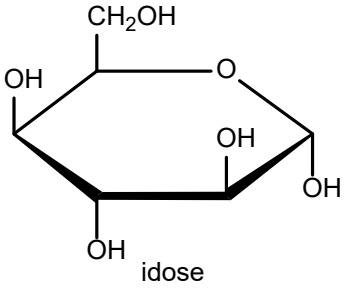
12. Draw and name the disaccharide formed when galactose and idose are linked by a glycosidic bond between C1 of galactose and C4 of idose.



galactose



idose

13. List the three main stages of cellular respiration and briefly describe the primary goal of each stage.

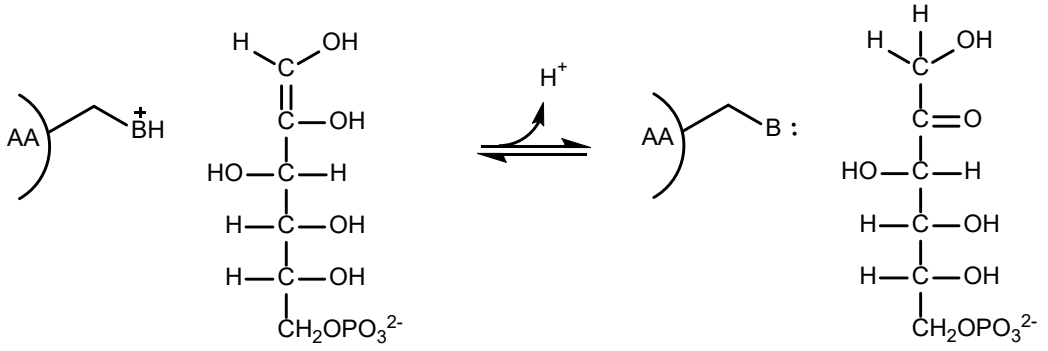
Stage 1:

Stage 2:

Stage 3:

14. For each reaction shown below use arrows to show the movement of electrons that lead to the formation of the product. List the type of catalytic strategy displayed (acid/base, metal ion, or covalent).

a.



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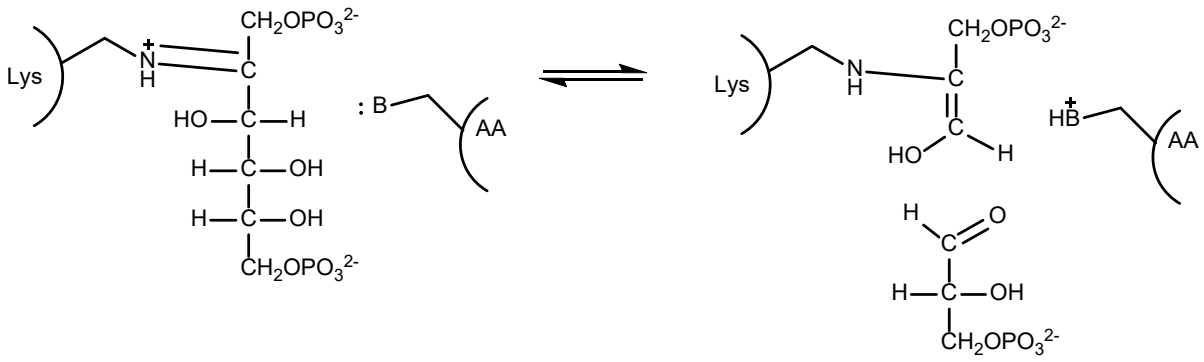
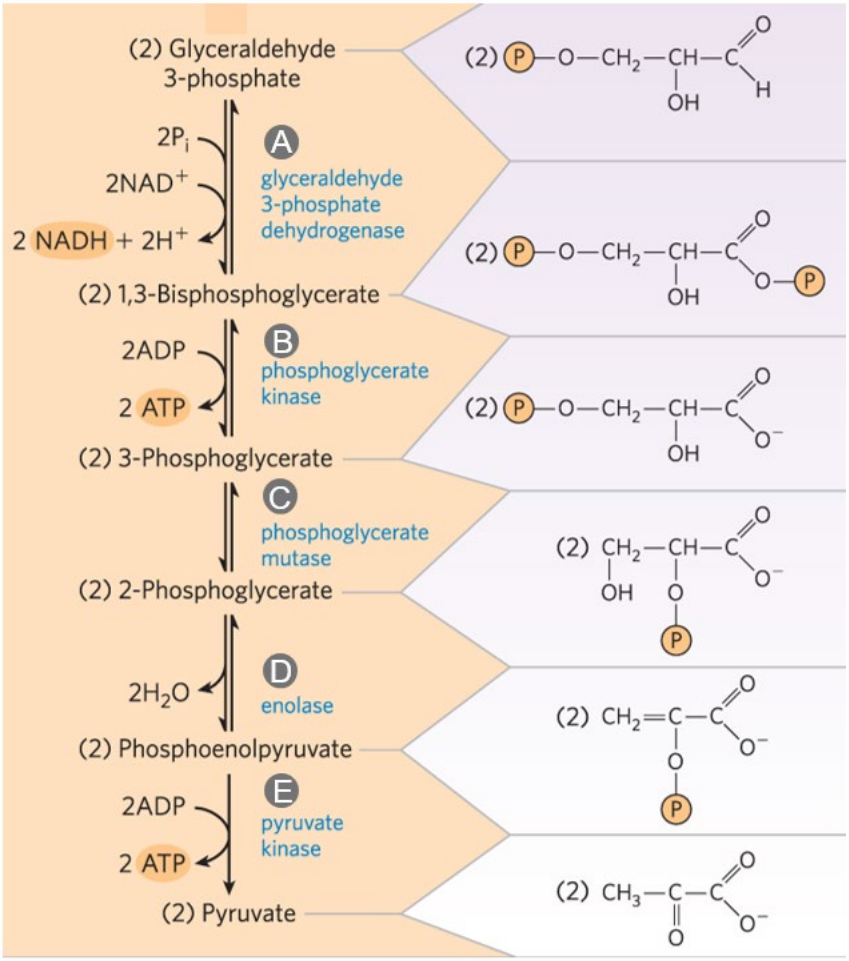
b.



15. The figure below shows a portion of the glycolysis pathway. Using the figure answer the questions below.



a. Which reaction(s) in the pathway represents an energy conserving reaction? Explain your answer.

b. Which reaction(s) in the pathway are examples of substrate level phosphorylation? Explain your answer.

c. Which phase of glycolysis does the figure above show? Explain your answer.

d. Which enzymes are transferase? Explain your answer.

e. Which enzymes are isomerases? Explain your answer.

f. Which enzymes are oxidoreductases? Explain your answer.

16. What is the source of electrochemical energy in ATP synthesis? Explain your answer.

17. Draw a z-scheme showing the movement of electrons through the light reactions of photosynthesis.