Biochemistry I Fall 2017 Practice for Exam2 Dr. Stone Name_____

No answers will be provided.

Here are some constants and equations that may be useful:

$K_a = [H+][A-]/[HA]$
$pH = pKa + \log [A-]/[HA]$
K_a for $H_3PO_4 = 7.5 \times 10^{-3}$
K_a for $H_2PO_4^- = 1.38 \times 10^{-7}$
$K_w = [H+][OH-] = 1 \times 10^{-14}$

$K_{eq} = [products]/[reactants]$
$\Delta G = \Delta H - T\Delta S$
$\Delta G = \Delta G^{\circ\prime} + RT \ln Q$
$Q = [products]/[reactants]$
$\Delta G^{\circ\prime} = -RT \ln K_{eq}$

K_a for $H_2CO_3 = 2.7 \times 10^{-4}$

K_a for $HPO4^{-2} = 3.98 \times 10^{-13}$
K_a for acetic acid $= 1.74 \times 10^{-5}$
K_a for formic acid, $CH_2O_2 = 1.78 \times 10^{-4}$
K_a for lactic acid, $C_3H_6O_3 = 1.41 \times 10^{-4}$

K_{eq} for the formation of carbonic acid from carbon dioxide and water= 0.003 (K_h) at 37°C

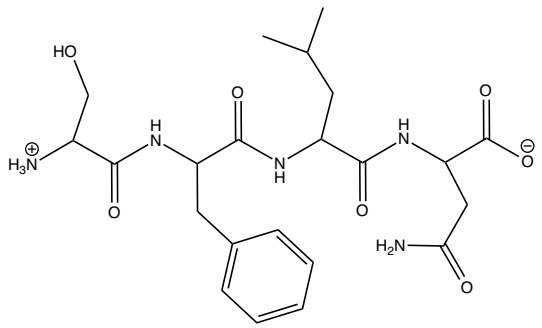
Multiple choice: Circle all of the correct answers. Some questions many have more than one correct answer.

1. Buffers

I. neutralize solutions
II. contain a weak acid and a base
III. maintain the pH close to neutrality
IV. maintain the pH of the solution close to the -log of the K_a of the weak acid.

A) I, II and III B) I and III C) II and IV D) IV only E) none of these

2. For this peptide, what is the correct name?



A. T F I N
B. S Y L Q
C. C F I N
D. C F L Q
E. S F L N
F. none of these the correct name is_____

4. What is the secondary structure of Keratin?

A. ß sheets
B. ß turns and ß sheets
C. α helices
D. α chains
E. none of these

5. Collagen is the most abundant protein in the human body.

I. Collagen has a left handed helix with 3 amino acids per turn
II. Collagen has a right handed helix with 3.4 amino acids per turn
III. Every third amino acid in collagen is a glycine
IV. Cysteines in collagen form linkages that hold the collagen fibrils together

A. I and III B. II and IV C. I, II and III D. IV only E. none of these

6. The quaternary structure of keratin is

A. A left handed coiled coil
B. A right handed coiled coil
C. A right handed α helix
D. A left handed α chain.
E. None of these

7. The function of keratin and collagen are:

A. Keratin provides structural support and collagen provides protection
B. Keratin provides protection and collagen provides structural support
C. Keratin and collagen provide protection and structural support
D. Keratin and collagen provide structural support, only keratin provides protection
E. None of these

8. Scurvy

I. is due to a lack of Vitamin C that is needed to make 4-hydroxy proline
II. can be avoided if Hot Cheetos are consumed.
III. is due to a lack of 4-hydroxy proline; this makes collagen weak and results in bruising and bleeding
IV. is due to a Vitamin D deficiency; this makes collage weak and results in bruising and bleeding

A. I and III B. II and IV C. I, II and III D. IV only E. none of these

9. What makes the keratin in horns harder than the keratin in skin?

A. There is more lysine in the keratin of horns.
B. There is more cysteine in the keratin of skin.
C. There is less cysteine in the keratin of skin.
D. There is more glutamate and lysine in the keratin of horns.
E. None of these

10. Why is SDS (sodium dodecyl sulfate) added to the acrylamide gel for the electrophoresis of proteins?

A. To provide ampholytes to enhance the separation of charged proteins
B. To denature the proteins
C. To add a uniform amount of negative charges
D. To add a uniform amount of positive charges
E. To denature the polyacrylamide
F. None of these
G. More than one of these, circle all correct answers

11. Chaperonins _____

A. help shape proteins by catalyzing the isomerization of proline
B. protect proteins from denaturing under high temperature conditions
C. help shape proteins by shuffling disulfide linkages
D. are elaborate protein complexes that hydrolyze ATP in the process of folding proteins
E. ensure that bad genes are not replicated accidentally, thereby ruining the future of the organism.
F. none of the above
G. More than one of the above, circle all of the correct answers.

12. Which of the following is true about the Edman degradation system of sequencing polypeptides?
I) The Edman degradation system is carried out on a machine called an Edmanator.
II) The Edman degradation system will work on any size polypeptide.
III) In the Edman degradation system the amino-terminal residue is labeled with 1-fluro,2,4- dinitrobenzene and the polypeptide is hydrolyzed with 6M HCl to its constituent amino acids.
IV) In the Edman degradation system the amino-terminal residue is labeled with phenylisothiocyanate, cleaved with trifluroacetic acid, purified and identified in each successive cycle.

A. I and II B. II and IV C. I, II and III D. IV only E. none of these

13. Why is a peptide treated with dithiothreitol and iodoacetate prior to SDS PAGE?
A. This breaks the crosslinks in collagen
B. This oxidizes the disulfide bonds to form iodosulfoxides
C. This oxidizes tryptophan so it can be measured by UV absorbance
D. This reduces disulfide bonds and acetylates the resultant thiol groups
E. None of these

14. What is isoelectric focusing used for?
A. Determine the pI of a protein
B. Determine the pKa of a protein
C. Separate proteins based on their molar mass
D. Separate proteins based on their hydrophobicity
E. None of these
F. More than one of these, circle all correct answers

15. What effect does carbonic anhydrase have on the equilibrium concentrations of carbon dioxide, water and carbonic acid?
I. Carbon dioxide increases
II. Carbon dioxide decreases
III. Carbonic acid increases
IV. Carbon dioxide does not change

A. I and III B. II and IV C. I, II and III D. IV only E. None of these

16. What chemicals are used to only determine the N-terminus amino acid of a peptide?
A. 1-fluro-2,4-dinitrobenzene, 1.0M HCl
B. phenyl isothiocyanate, 1 M trifluoracetic acid
C. dithiothreitol, iodoacetate
D. performic acid
E. None of these

17. Match the following techniques with how they are used to study proteins. Write the number on the blank line. A. SDS PAGE_____
B. mass spectroscopy_____
C. Edmund degradation_____
D. X-ray crystallography_____
E. nuclear magnetic resonance ____
F. circular dichroism spectroscopy _____

1. measure amounts of protein secondary structures
2. determine protein structure using diffraction patterns and a computer program
3. determine exact mass of proteins and the sequence of peptides
4. determine structure of a protein in solution
5 determine molar mass of denatured proteins by comparing to standards with know molar masses
6. determine the sequence of peptides

Short answer section:

18. Explain why plasmids that are used for cloning have antibiotic resistance genes.

19. Will the peptide VEGY absorb UV light? Explain your answer.

20. Where are the amino acid R groups for a peptide that is an α helix?

21. Draw the structure of the following peptide: WICK

22. Put the full name (correct spelling) of one amino acid in each blank:

Which two amino acids are found in ß turns? _____and _____

Which amino acid forms a covalent bond that is not a peptide bond?_____

Which amino acids are not found in keratin_____and _____

Give an example of two amino acids that could form an ionic bond between each other:

_____ and _____

What amino acid has a pKa of 6? _____

23. In order to determine if a mutation has occurred, DNA is sequenced using the Sanger (dideoxy) method, use the data from the PAGE gel below to give the sequence of DNA. Be sure to label the 5' and 3' ends of the DNA.

Lanes: 1. 2. 3. 4.

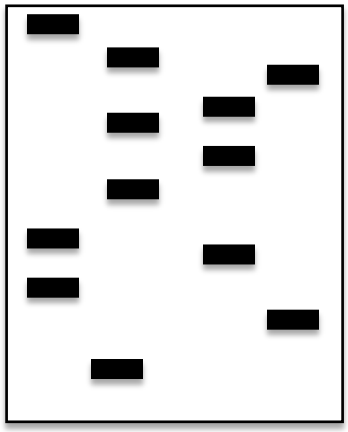


Figure1, DNA sequencing gel for a dodecamer (12 bases) of DNA.

Lane 1: dATP, dGTP, dCTP, dTTP, ddATP

Lane 2: dATP, dGTP, dCTP, dTTP, ddTTP

Lane 3.: dATP, dGTP, dCTP, dTTP, ddGTP

Lane 4: dATP, dGTP, dCTP, dTTP, ddCTP

24. How does dideoxy sequencing work? Briefly explain the chemistry involved.

Problem section. Show all of your work. No work = no points.

25. What is the pI for the peptide, TRNH. Show your work.

26. Draw the titration curve for the titration of 20 mL of a 0.12 M solution of glutamate (carboxylic acid pKa = 2.19, amino pKa = 9.67, you need to know the pKa for the R group) with 0.10 M sodium hydroxide. Clearly label the axes of your graph (pH vs mL of NaOH added.) Be sure to include pH values and volumes for the following: Start of the titration (no sodium hydroxide added), the pH at the volume that is half of the volume of each endpoint, pH and volume at the end points of the titration. Show all of your calculations.
27. Draw the correct structure for the tetrapeptide, WYPA, that predominates at pH=7.

28. What is the pI for the tetrapeptide, REDSQC? The pKa for the carboxy terminus is 3.2, the pKa for the amino terminus is 8.3.

29. A protein was digested with an enzyme and the following four peptides were purified by anion exchange chromatography at pH 6. All amino teminus pKa values are 8.2, all carboxy terminal pKa values are 3.1:

KANW ELDCARD SF ENW

a. Which peptide eluted first?

b. Second?

c. Third?

d. Fourth?

e. What enzyme was used to cut the peptide?

30. The three dimensional structure of a biochemical macromolecule is formed and maintained by noncovalent interactions. What are three types of intermolecular forces? For each type of IMF, give an example of a pair of amino acids that could have that IMF between their R groups.