

SC/BIOL 2020.04

Term test #1

October 7, 2008

This test is multiple choice. There are 30 questions.
There are a total of 9 pages of this exam.

You are allowed to use a non-programmable
calculator.

Choose the BEST answer and indicate your choice on
the scantron. Please use a pencil.

Each question is worth 1 mark.

YOU ***MUST*** HAND IN THE SCANTRON CARD TO
HAVE YOUR TEST MARKED!!!

Good Luck!

1. In myoglobin, which residue binds to the iron atom?

- a) Histidine
- b) Lysine
- c) Alanine
- d) Phenylalanine
- e) Arginine

2. Sickle cell disease most likely results from an increase in the

- a) ionic interactions between the hemoglobin molecules
- b) hydrophobic interactions between the hemoglobin molecules
- c) oxygen affinity of the hemoglobin molecule
- d) molecular weight of the hemoglobin molecule
- e) synthesis and exclusive use of β -subunits of hemoglobin

3. Most vitamins

- a) are precursors to coenzymes
- b) are synthesized by humans
- c) consist of amino acids, fatty acids or sugars
- d) are covalently linked to proteins without modification
- e) none of the above

4. Which of the following amino acid residues in a protein is a potential site for phosphorylation?

- a) Cysteine
- b) Arginine
- c) Methionine
- d) Tyrosine
- e) Asparagine

5. What significant roles does water play in biochemistry?

- a) Water is a participant in many reactions, all biomolecules are soluble in water, and water helps regulate pH and temperature.
- b) Water is a participant in many reactions, water is an important solvent, and water helps regulate pH and temperature.
- c) Water is a participant in many reactions, water is an important solvent, and water helps regulate pressure and temperature.
- d) Water is a participant in all reactions, all biomolecules are soluble in water, and water helps regulate pressure and temperature.
- e) None of the above are true

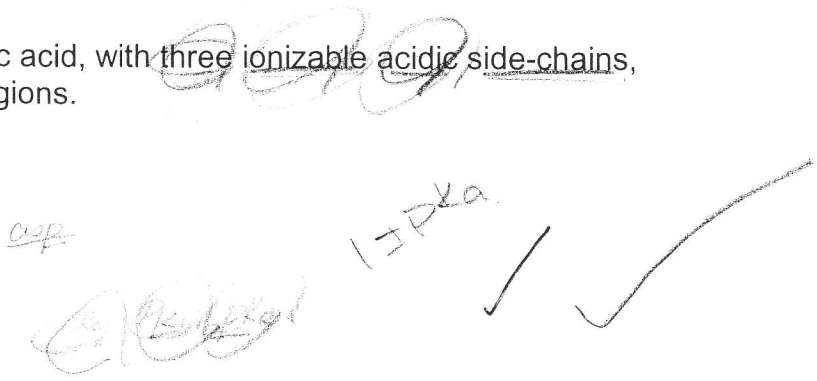
6. Which of the following pairs of K_a and pK_a values is incorrect?

- a) 1.78×10^{-4} , 3.75
- b) 3.16×10^{-3} , 2.50
- c) 5.62×10^{-10} , 9.25
- d) 6.31×10^{-8} , 7.20
- e) 1.38×10^{-4} , 5.86



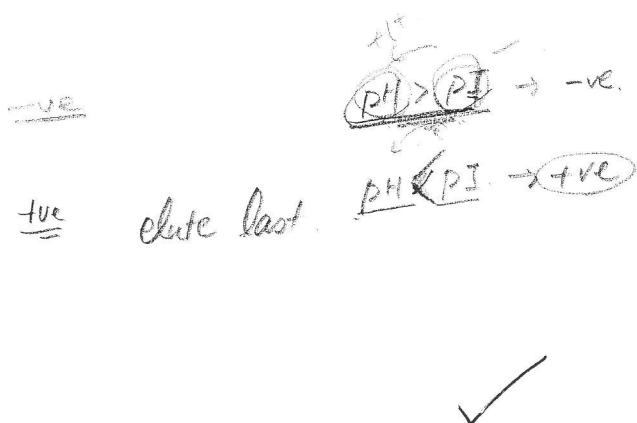
7. The polyprotic molecule aspartic acid, with three ionizable acidic side-chains, has _____ potential buffering regions.

- a) zero
- b) one
- c) two
- d) three
- e) four



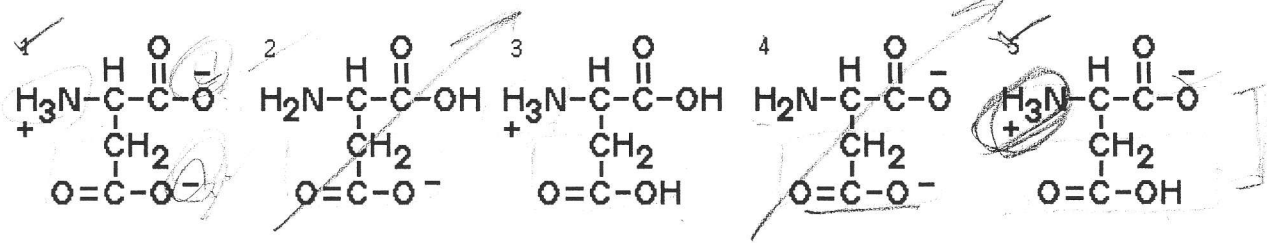
8. A mixture of five proteins whose properties are listed below is loaded on a negatively charged ionic exchange column at pH 7. The column is eluted by increasing the salt concentration. What is the likely order of elution of the proteins from the column?

Protein	MW	pI
I.	10,000	12.4
II.	21,000	8.4
III.	45,000	9.5
IV.	98,000	10.6
V.	115,000	7.9



- a) I, II, III, IV, V
- b) V, IV, III, II, I
- c) V, II, III, IV, I
- d) III, II, IV, I, V
- e) I, IV, III, II, V

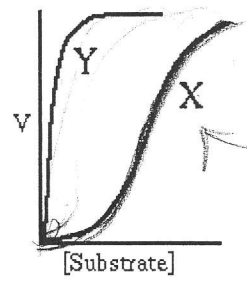
9. Which pair of the following forms of aspartic acid would predominate in a buffered solution at pH=4?



- a) 1 and 2
- b) 2 and 4
- c) 1 and 5
- d) 3 and 5
- e) 3 and 4

$pK_a = 2.3$
 $pH < pK_a$
 ✓

10. Refer to the graph when answering. "X" represents the native enzyme and "Y" the enzyme plus a fixed concentration of a modifier. The modifier

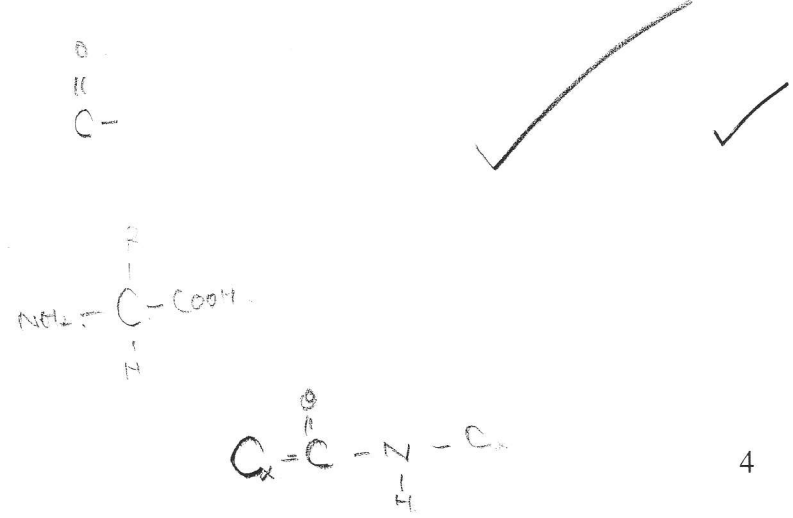


- a) increases the V_{max} of the enzyme
- b) increases the K_M
- c) is a non-competitive inhibitor
- d) is a competitive inhibitor
- e) is an allosteric activator

$V_0 = \frac{V_{max} [S]}{K_M + [S]}$
 $K_M + K_S$
 $-K_M$
 ✓

11. Which sequence of atoms can be found in the backbone (i.e. peptide chain) of polypeptides?

- a) C-N-N-C
- b) C-C-C-N
- c) C-C-N-C
- d) N-C-C-C
- e) C-O-C-N



12. Which amino acid substitution most likely causes a change in a protein's tertiary structure?

- a) Threonine to serine
- b) Arginine to lysine
- c) Valine to leucine
- d) Isoleucine to arginine ✓
- e) Asparagine to glutamine

13. The concentration of 2,3-bisphosphoglycerate (BPG) in human erythrocytes increases by 50 percent within 2 days upon reaching an altitude of 4000m. How is hemoglobin (Hb) affected by this increase in BPG?

- a) Oxygen binding increases due to heterotropic allosteric interactions ✗
- b) Oxygen binding increases due to homotropic allosteric interactions ✗
- c) Hb has a greater tendency to polymerize
- d) Less carbon dioxide is bound to the alpha chain amino groups of Hb
- e) The relative amount of deoxy Hb increases ✓

14. What is the ratio of [S] to K_m when the velocity of an enzyme-catalyzed reaction is 80% of V_{max} ?

- a) 0.25
- b) 0.5
- c) 2
- d) 4 ✓
- e) 8

$$\frac{[S]}{K_m}$$

$$V_0 = 0.8 V_{max}$$

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

$$\frac{V_0}{V_{max}} = \frac{[S]}{K_m + [S]}$$

15. The active site residue on chymotrypsin that attacks the carbonyl oxygen of the peptide bond of the substrate arises from which amino acid side chain?

- a) aspartate
- b) histidine ✓
- c) serine
- d) cysteine
- e) lysine



$$8K_m + 8[S] = 10[S]$$

$$8K_m = 2[S]$$

$$4K_m = [S]$$

16. You have a mixture of two peptides, Arg-Lys and His-His. Which column and pH is the best combination for separating them?

- a) negatively charged column, pH 2
- b) positively charged column, pH 2
- c) negatively charged column, pH 8
- d) positively charged column, pH 8 ✓
- e) negatively charged column, pH 14

Arg-Lys

His-His

Alp.

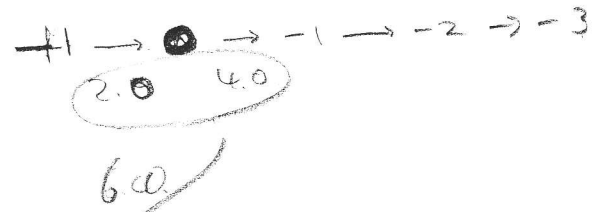
6. RPH

ASP

SH

17. A tetrapeptide was made that consisted of the following amino acids: ~~Leu-cys-val-asp~~. The pKa's for the amino acids (in their free form) are listed below. Use these values to determine the pI for this tetrapeptide. Assume these free amino acid values are applicable to the tetrapeptide.

Amino Acid	Terminal Amine	Terminal Carboxy	R-group
Leucine	9.6	2.4	
Cysteine	10.8	1.8	8.4
Valine	9.6	2.3	
Aspartate	10.0	2.0	4.0

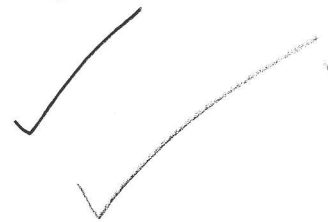


- a) 8.4
- b) 6.1
- c) 6.8
- d) 3.0
- e) 9.0



18. Which of the following is most important in the formation of an α -helix from a polypeptide chain?

- a) Hydrogen bonds
- b) Salt bridges
- c) Disulfide bridges
- d) Hydrophobic interactions
- e) Van der Waals interactions



19. The amino acid His has an R-group with a pKa of 6.0. What percentage (%) of the total His R-groups will carry a zero charge at pH 5.2?

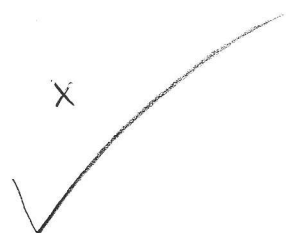
- a) 14%
- b) 16%
- c) 0.16%
- d) 84%
- e) the question cannot be answered from the information provided

$pH = pKa + \log \left[\frac{A^-}{HA} \right]$

Handwritten notes: "6.0", "5.2", "Lower", "X"

$pKa = pH$

Handwritten notes: "5.2", "H"



20. Cyanogen bromide cleaves the peptide bond at

- a) the carboxyl side of Arg and Lys residues
- b) the carboxyl side of Cys residues ✓
- c) the carboxyl side of Met residues ✓
- d) the carboxyl side of Cys and Met residues
- e) none of the above

21. Given are five K_M values for the binding of five substrates to a particular enzyme. Which substrate from the information below has the strongest affinity for the enzyme?

- a) 150 mM ✓
- b) 0.15 mM ✓
- c) 15 μ M ✓
- d) 1.5 nM ✓
- e) 15 000 μ M
mM

K_M

$$K_M = \frac{k_2 + k_3}{k_1}$$

22. All of the following statements about an α -helix in general are true EXCEPT:

- a) A Proline can disrupt an α -helix in proteins ✓
- b) The side chains of the amino acid residues are extended outward in a helical array ✓
- c) There are 3.6 amino acid residues per helical turn ✓
- d) The main chain atoms of the polypeptide form the helical backbone ✓
- e) α -helices are left-handed ✓

23. The adjacent β -strands of an antiparallel β -sheet are held together primarily by

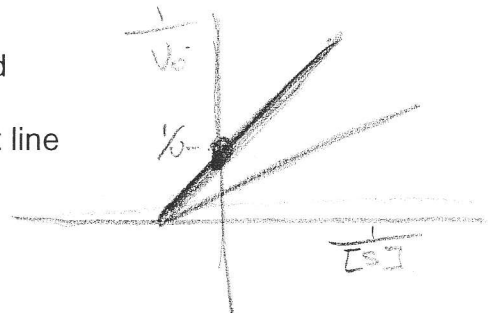
- a) peptide bonds ✓
- b) hydrogen bonds ✓
- c) van der Waals forces
- d) ionic interactions
- e) hydrophobic interactions

24. The enzyme gyrase is a tetramer composed of two subunits of molecular weight 110,000 and two subunits of molecular weight 90,000. A sample of the pure gyrase is run on a gel filtration column under physiological conditions (i.e., neutral pH, normal saline). A separate sample of gyrase is electrophoresed on a polyacrylamide gel containing SDS and β -mercaptoethanol. The following table shows 5 possible outcomes of the gel filtration column and the SDS-PAGE gel. Which is the expected outcome?

Gel filtration	SDS gel
a) One peak at 200,000 and...	One band at 200,000.
b) One peak at 400,000 and...	One band at 400,000.
c) One peak at 400,000 and...	Two bands, one at 90,000, one at 110,000.
d) Two peaks, one at 90,000, one at 110,000 and...	One band at 400,000.
e) Two peaks, one at 90,000, one at 110,000 and...	Two bands, one at 90,000, one at 110,000.

25. What is the major advantage of using Lineweaver-Burk plots rather than the Michaelis-Menten rectangular hyperbolic plots to analyze kinetic data?

- a) Lower enzyme concentrations are required
- b) Lower substrate concentrations are required
- c) Fewer data points are required
- d) V_{max} is obtained by extrapolating a straight line
- e) None of the above



26. In noncompetitive inhibition,

- a) the V_{max} of the enzyme is reduced
- b) the V_{max} is increased
- c) the both the K_M and the V_{max} is affected
- d) the K_M is increased
- e) the K_M is decreased

$$v_0 = \frac{V_{max} \cdot [S]}{K_M + [S]}$$

$$\frac{1}{v_0} = \frac{K_M + [S]}{V_{max} \cdot [S]}$$

$$= \frac{K_M}{V_{max}} \cdot \frac{1}{[S]} + \frac{1}{V_{max}}$$

27. An amino acid which has a net negative charge at pH 6 is:

- a) tyr
- b) gln
- c) arg ✓
- d) asp ✓
- e) gly ×

COOH
pH



28. Which of the following lacks a chiral center

- a) gly ✓
- b) his
- c) tyr
- d) phe
- e) glu

Arg
Asp



29. Which amino acid residue is most likely to be found at the interior of a protein:

- a) gly ×
- b) leu ✓
- c) ser ×
- d) gln ×
- e) trp ×



30. Riboflavin is a water-soluble organic substance that is not synthesized by humans. Metabolically, it is chemically converted into a substance called flavin adenine dinucleotide, which is required by succinate dehydrogenase. Which of the following statements is most correct?

- a) Riboflavin is a coenzyme ✓
- b) Flavin adenine dinucleotide is a vitamin ×
- c) Succinate dehydrogenase is a coenzyme ×
- d) Flavin adenine dinucleotide is a coenzyme ✓
- e) none of the above

