BIOL/CHEM 3361 Name_____
Spring 2011

EXAM I
FORM A

Place your name at the top of this page of the exam. On the F-1712 Scantron form, use a no. 2 pencil to enter your test form designation, i.e., A or B. Also print and encode your name and your UTD ID (starting in the first column on the left and leaving the last spaces blank). Leave phone number, code and subject score sections blank.
Select the best answer for the following multiple-choice questions and enter the corresponding letter on the Scantron sheet. You may use these test pages to make notes and work problems.
You may use a non-graphing calculator or a graphing calculator you have cleared of all stored data.
When finished, turn in this exam along with your Scantron sheet.

1. Which of the following amino acids would be the most conservative replacement for a phe residue in a protein, and thus least likely to change the protein's structure and activity?
   a. glu
   b. his
   c. arg
   d. gly
   e. tyr

2. Which of the following serves as the blood and interstitial fluid buffer?
   a. ATP-phosphate system
   b. sulfate
   c. CO_2-bicarbonate system
   d.histidine
   e. thiol

3. The energy of an Individual H-bond is about
   a. 0.2 kJ/mol
   b. 5 kJ/mol
   c. 400 kJ/mol
   d. -25 kJ/mol
   e. -50 kJ/mol

4. Which of the following amino acid side chains is not amphipathic (aka amphiphilic)
   a. serine
   b. aspartic acid
   c. valine
   d. glutamine
   e. lysine

5. Which of the following amino acids has a side chain that can form hydrogen bonds?
   a. serine
   b. glycine
   c. isoleucine
   d. valine
   e. alanine

6. Which of the following amino acids has a side chain that can participate in charge-charge interactions?
   a. S
   b. N
   c. I
   d. H
   e. A

7. When non-polar molecules are dissolved in water, which of the following is true?
   a. The normal clathrate structure of water is broken up
   b. Charge-dipole interactions hold the molecules in solution
   c. The entropy of the system increases
   d. H-bonds form between the non-polar molecules and water
   e. H_2O forms a clathrate-like structure around the non-polar molecules

8. Which of the following properties characterize glycine ?
   a. has no D and L stereoisomers.
   b. is the smallest amino acid.
   c. forms H-bonds with its side chain
   d. a & b
   e. all of the above

9. The amino acid sequence of an individual polypeptide is its
   a. primary structure
   b. secondary structure
   c. tertiary structure
   d. quaternary structure
   e. pentanary structure

10. Defining r as the distance of separation of centers of charge, the energy of dipole-dipole interactions is a function of
   a. r^{-1}
   b. r^{-2}
   c. r^{-3}
   d. r
   e. r^{2}

11 Which of the following domains of life are comprised of organisms that share a common biochemistry?
   a. eukarya
   b. archaea
   c. bacteria
   d. a. & c.
   e. all of the above

12. Selenium is found in what can be called the 21st standard amino acid. This amino acid is
   a. selenomethionine
   b. selenoserine
   c. selenothreonine
   d. selenocysteine
   e. none of the above

13. Calculate the final pH of a solution made by the addition of 10 ml of 0.50 M NaOH to 10 ml of a 0.55 M solution of a weak acid with a pKa of 5.1.
    a. 5.90
    b. 6.10
    c. 6.65
    d. 7.10
    e. 9.10

14. Which of the following will contribute to a reaction going in the forward direction?
    a. ΔG is positive
    b. ΔS is negative
    c. $T\Delta S$ is 0
    d. $-T\Delta S$ is positive
    e. ΔH is negative

15. Disulfide bridges in proteins
    a. are principally found in extracellular proteins
    b. can covalently link polypeptide chains in multimeric proteins
    c. can be easily broken by reduction with mercaptoethanol
    d. a and b
    e. all of the above

16. Which of the following chemical groups is not added to proteins during post-translational modification of amino acid residues?
    a. hydroxyl
    b. imidazole
    c. carboxyl
    d. phosphate
    e. methyl

17. The most abundant cation inside cells is
    a. Na^+
    b. Ca^{2+}
    c. K^+
    d. Mg^{2+}
    e. Li^+

18. Which form of chromatography uses a decreasing salt gradient to elute proteins?
    a. affinity chromatography
    b. anion exchange chromatography
    c. cation exchange chromatography
    d. hydrophobic chromatography
    e. gel filtration

19. The H^+ concentration in a pH 5.6 solution is
    a. 1.0×10^{-4} M
    b. 4.0×10^{-6} M (either b or c counted correct)
    c. 1.0×10^{-6} M
    d. 6.0×10^{-4} M
    e. 1.0×10^{-7} M

20. Which of the following amino acids has a side chain that absorbs light in the 260-280 nm range?
    a. Phe
    b. Tyr
    c. Trp
    d. a & b
    e. all of the above

21. An amino acid with N in its side chain is
    a. Arg
    b. Trp
    c. Asp
    d. a & b
    e. all of the above

22. In mass spectrometry proteins are separated in the basis of their
    a. size
    b. charge at pH 2
    c. m/z ratio
    d. pI
    e. polarity

23. The $\Delta G^{o\prime}$ for the reaction below is -24 kJ/mol at 25º C. What is the Gibbs free energy change for the reaction if all species are 0.01 M in concentration? R is 8.31 J/ºK·mol

$$A \leftrightarrow B + C$$

    a. -20 kJ/mol
    b. -23 kJ/mol
    c. -30 kJ/mol
    d. -35 kJ/mol
    e. -40 kJ/mol

24. The $\Delta G^{o\prime}$ for binding a substrate to an enzyme is -22.8 kJ/mol at 25º C. What is the Keq for the reaction? R is 8.31 J/ºK·mol
    a. 10^{4}
    b. 10^{-4}
    c. $10^{5.5}$
    d. $10^{-5.5}$
    e. 10^{6}

25. The buffer range for a weak acid is
    a. pI ± 1
    b. pKa ± 1
    c. pOH ± 1
    d. pI ± 2
    e. pKa ± 2

26. The number of amino acid residues in a protein with molecular weight of 90,000 is about
    a. 250
    b. 500
    c. 750
    d. 1000
    e. none of the above

27. Which of the following would serve as the best buffer for a reaction at pH = 5.5?

	Ka
a. acetic acid	1.74×10^{-5}
b. pyridine	5.90×10^{-6}
c. $H_2PO_4^-$	1.38×10^{-7}
d. tris-hydroxymethylaminomethane (TRIS)	8.32×10^{-9}
e. ethylamine	1.78×10^{-11}

28. Hydrophobic interactions are
    a. entropy driven
    b. electrostatic in nature
    c. due to van der Waals attractive forces
    d. the strongest of weak interactions
    e. enthalpy driven

29. At physiological pH the positively charged amino acid residues comprise approximately what percent of all residues in a protein?
    a. 5 %
    b. 12%
    c. 25%
    d. 45%
    e. 55%

30. Which amino acid can form disulfide bridges in a mildly oxidizing environment?
    a. Y
    b. S
    c. I
    d. C
    e. M

31. Which amino acid can be phosphorylated post-translationally?
    a. Y
    b. S
    c. I
    d. a & b
    e. all of the above

32. Which amino acid has the side chain $-(CH_2)_3-$ that ends in a link to the α-N ?
    a. proline
    b. isoleucine
    c. leucine
    d. valine
    e. alanine

33. Iodoacetic acid and iodoacetamide react specifically with which amino acid?
a. C
b. D
c. N
d. W
e. T

34. What is the pI value for aspartic acid, which has pKa values of 2.1, 3.9, and 9.8?
a. 2.1
b. 3.0
c. 6.85
d. 5.27
e. none of the above

35. What is the ratio of the concentration of a weak acid to its conjugate base when the pH of a solution is equal to the pKa of the weak acid?
a. 1:2
b. 1:10
c. 10:1
d. 2:1
e. 1:1

36. Which elements comprise the predominant divalent cations in organisms
a. Ca^{2+} and Mg^{2+}
b. Mg^{2+} and Mn^{2+}
c. Zn^{2+} and Cu^{2+}
d. Zn^{2+} and Mo^{2+}
e. Ca^{2+} and Zn^{2+}

37. What is the enthalpy change for a solution when a salt such as LiCl is dissolved in water? Remember, the solvation of ammonium sulfate was exothermic.
a. no significant change, i.e. about 0 in value
b. decrease, i.e., negative in value
c. increase, i.e., positive in value
d. cannot predict

38. What is the ratio of the concentration of a weak acid to its conjugate base when the pH of a solution is 1 unit below the pKa of the weak acid?
a. 1:2
b. 1:10
c. 10:1
d. 2:1
e. 1:1

39. Which peptidase or chemical could you use to cleave the oligopeptide: RCMARSH?
a. trypsin
b. V8 protease
c. cyanogen bromide
d. a & b
e. a & c

40. At pH 7 what charge is carried by the peptide: RCMARSH?
    a. +3
    b. +2
    c. +1
    d. 0
    e. -1

41. CM-cellulose is used for
    a. anion exchange chromatography
    b. cation exchange chromatography
    c. gel filtration
    d. affinity chromatography
    e. hydrophobic chromatography

42. What amino acid has the one letter symbol F?
    a. glutamic acid
    b. lysine
    c. phenylalanine
    d. histidine
    e. aspartic acid

43. $\Delta G^{\circ\prime}$ represents
    a. the Gibbs free energy for a reaction
    b. the Gibbs free energy difference where all reactants and products are 1M or 1 atmosphere
    c. the Gibbs free energy difference at equilibrium
    d. the standard state Gibbs free energy change with pH set at 1.0
    e. the standard state Gibbs free energy change with pH set at 7.0

44. The pKa value for an acidic group can sometimes depend on the solution conditions or the immediate environment of the group. If glutamic acid is dissolved in a dioxane/water mixture rather than water, how will the pKa value of its side chain be affected? Hint: dioxane has a lower dielectric constant than water.
    a. it will increase
    b. it will decrease
    c. it will be essentially unchanged
    d. cannot predict

45. The two principal secondary structures of proteins are?
    a. alpha helix & beta strand
    b. beta strand & gamma helix
    c. alpha & 3_{10} helices
    d.collagen helix & beta bends
    e. gamma & 3_{10} helices

Bonus question

46. After cleavage of the hexapeptide Asp-Tyr-Met-His-Cys-Arg-Phe-Glu-Glu with chymotrypsin, the products will be
    a. two peptides that can be separated by DEAE anion exchange chromatography pH 6
    b. two peptides that cannot be separated by DEAE anion exchange chromatography pH 6
    c. three peptides that can be separated by DEAE anion exchange chromatography pH 6
    d. three peptides that cannot be separated by DEAE anion exchange chromatography pH 6

cont. on next page

Answer the following question on the back of your Scantron sheet.

47. Give the single letter abbreviations for the following amino acids and draw their complete chemical structures at pH 7, showing all charges present on the majority of the molecules at this pH:
    a. tyrosine
    b. histidine
    c. serine