A. Multiple choice question (50%, 2% each; one correct answer only)

1. The chirality of an amino acid results from the fact that its α carbon:

A) has no net charge.

B) is a carboxylic acid.

C) is bonded to four different chemical groups.

D) is in the L absolute configuration in naturally occurring proteins.

E) is symmetric.

2. The formation of a peptide bond between two amino acids is an example of a(n) _____ reaction.

A) cleavage

B) condensation

C) group transfer

D) isomerization

E) oxidation reduction

3. The average molecular weight of the 20 standard amino acids is 138, but biochemists use 110 when estimating the number of amino acids in a protein of known molecular weight. Why?

A) The number 110 is based on the fact that the average molecular weight of a protein is 110,000, with an average of 1,000 amino acids.

B) The number 110 reflects the higher proportion of small amino acids in proteins, as well as the loss of water when the peptide bond forms.

C) The number 110 reflects the number of amino acids found in the typical small protein; only small proteins have their molecular weight estimated this way.

D) The number 110 considers a relatively small number of nonstandard amino acids.

E) The number 138 represents the molecular weight of conjugated amino acids.

4. All of the following are considered "weak" interactions in proteins, ***except:***

A) hydrogen bonds.

B) hydrophobic interactions.

C) ionic bonds.

D) peptide bonds.

E) van der Waals forces.

5. An α helix would be destabilized most by:

A) an electric dipole spanning several peptide bonds throughout the α helix.

B) interactions between neighboring Asp and Arg residues.

C) interactions between two adjacent hydrophobic Val residues.

D) the presence of an Arg residue near the carboxyl terminus of the α helix.

E) the presence of two Lys residues near the amino terminus of the α helix.

6. Amino acid residues commonly found in the middle of β turn are:

A) Ala and Gly.

B) hydrophobic.

C) Pro and Gly.

D) those with ionized R-groups.

E) two Cys.

7. An average protein will not be denatured by:

A) a detergent such as sodium dodecyl sulfate.

B) heating to 90°C.

C) iodoacetic acid.

D) pH 10.

E) urea.

8. Which of the following is not known to be involved in the process of assisted folding of proteins?

A) Chaperonins

B) Disulfide interchange

C) Heat shock proteins

D) Peptide bond hydrolysis

E) Peptide bond isomerization

9. In hemoglobin, the transition from T state to R state (low to high affinity) is triggered by:

A) Fe^{2+} binding.

B) heme binding.

C) oxygen binding.

D) subunit association.

E) subunit dissociation.

10. The predominant structural feature in myosin molecules is:

A) α β structure.

B) an α helix.

C) the Fab domain.

D) the light chain.

E) the meromyosin domain.

11. Which of the following statements is *false*?

A) Collagen is a protein in which the polypeptides are mainly in the α-helix conformation.

B) Disulfide linkages are important for keratin structure.

C) Gly residues are particularly abundant in collagen.

D) Silk fibroin is a protein in which the polypeptide is almost entirely in the β conformation.

E) α-keratin is a protein in which the polypeptides are mainly in the α-helix conformation.

12. A sequence of amino acids in a certain protein is found to be -Ser-Gly-Pro-Gly-. The sequence is most probably part of a(n):

A) antiparallel β sheet.

B) parallel β sheet.

C) α helix.

D) α sheet.

E) β turn.

13. A good transition-state analog:

A) binds covalently to the enzyme.

B) binds to the enzyme more tightly than the substrate.

C) binds very weakly to the enzyme.

D) is too unstable to isolate.

E) must be almost identical to the substrate.

14. The reference compound for naming D and L isomers of sugars is:

A) fructose.

B) glucose.

C) glyceraldehyde.

D) ribose.

E) sucrose.

15. Which of the following is not a reducing sugar?

A) Fructose

B) Glucose

C) Glyceraldehyde

D) Ribose

E) Trehalose

16. B-form DNA in vivo is a _____-handed helix, _____ Å in diameter, with a rise of ____ Å per base pair.

A) left; 20; 3.9

B) right; 18; 3.4

C) right; 18; 3.6

D) right; 20; 3.4

E) right; 20; 3.6

17. Chargaff's rules state that in typical DNA:

A) A = G.

B) A = C.

C) A = U.

D) A + T = G + C.

E) A + G = T + C.

18. The nucleic acid bases:

A) absorb ultraviolet light maximally at 280 nm.

B) are all about the same size.

C) are relatively hydrophilic.

D) are roughly planar.

E) can all stably base-pair with one another.

19. An integral membrane protein can be extracted with:

A) a buffer of alkaline or acid pH.

B) a chelating agent that removes divalent cations.

C) a solution containing detergent.

D) a solution of high ionic strength.

E) hot water.

20. The fluidity of the lipid side chains in the interior of a bilayer is generally increased by:

A) a decrease in temperature.

B) an increase in fatty acyl chain length.

C) an increase in the number of double bonds in fatty acids.

D) an increase in the percentage of phosphatidyl ethanolamine

E) the binding of water to the fatty acyl side chains.

21. Which of the following does not involve cyclic AMP?

A) Regulation of glycogen synthesis and breakdown

B) Regulation of glycolysis

C) Signaling by acetylcholine

D) Signaling by epinephrine

E) Signaling by glucagon

22. For the reaction A → B, the K_{eq}' is 10^4. If a reaction mixture originally contains 1 mmol of A and no B, which one of the following must be true?

A) At equilibrium, there will be far more B than A.

B) The rate of the reaction is very slow.

C) The reaction requires coupling to an exergonic reaction in order to proceed.

D) The reaction will proceed toward B at a very high rate.

E) $\Delta G'^{\circ}$ for the reaction will be large and positive.

23. The anaerobic conversion of 1 mol of glucose to 2 mol of lactate by fermentation is accompanied by a net gain of:

A) 1 mol of ATP.

B) 1 mol of NADH.

C) 2 mol of ATP.

D) 2 mol of NADH.

E) none of the above.

24. Which of the following is a cofactor in the reaction catalyzed by glyceraldehyde 3-phosphate dehydrogenase?

A) ATP

B) Cu^{2+}

C) heme

D) NAD^+

E) $NADP^+$

25. The oxidation of 3 mol of glucose by the pentose phosphate pathway may result in the production of:

A) 2 mol of pentose, 4 mol of NADPH, and 8 mol of CO_2.

B) 3 mol of pentose, 4 mol of NADPH, and 3 mol of CO_2.

C) 3 mol of pentose, 6 mol of NADPH, and 3 mol of CO_2.

D) 4 mol of pentose, 3 mol of NADPH, and 3 mol of CO_2.

E) 4 mol of pentose, 6 mol of NADPH, and 6 mol of CO_2.

B.問答題(50%)

1. Either allosteric control of enzyme activity or enzyme induction/repression can be used to regulate the metabolic rates of cells. Which control mechanism should be the most useful to adjust to rapid changes in conditions? Explain your answer. (5%)

2. List three proteins that can be activated and then function as a GTP-GDP exchange factor for activation of G protein or Ras. (6%)

3. Give the steps that produce CO_2 in the citric acid cycle. (4%)

4. The bacterium *E. coli* can grow at 20 °C or at 40 °C. At which growth temperature, you would expect the membrane phospholipids to have a higher ratio of unsaturated to saturated fatty acids. Why? (5%)

5. What is the chemiosmotic model proposed by Peter Michell for ATP synthesis in oxidative phosphorylation? (5%)

6. What compounds would accumulate in an individual with beriberi? (2%) why? (2%)
7. Animals cannot convert fatty acids to glucose. Why? (5%)
8. (a) hypoxanthine-guanine phosphoribosyltransferase (b) adenosine deaminase
   (c) glucuronyl bilirubin transferase (d) tyrosine 3-monooxygenase
   (e) phenylalanine hydroxylase (f) methionine synthase
   (g) cystathionine β-synthase (h) branched-chain α-keto acid dehydrogenase
   Match the following disease caused by the deficiency of above enzyme:
   ___(1)___ maple syrup urine disease (1%)
   ___(2)___ albinism (1%)
   ___(3)___ Lesch-Nyhan syndrome (1%)
   ___(4)___ jaundice (1%)
   ___(5)___ homocystinuria (1%)
   ___(6)___ phenylketonuria (1%)

9. We require fats and proteins in our diets. Why? (6%)

10. Calculate the number of ATP molecules obtained from the anaerobic conversion of the following compounds to lactate in liver:
    (a) glucose (1%) (b) fructose (1%) (c) mannose (1%) (d) galactose (1%)