

A. Each question below contains five suggested answers. Choose the one best response to each question. (2% each)

1. Which of the following aromatic acids has the strongest absorption of UV light at 280 nm when they are present in equimolar concentration?

- A. Tyrosine  
 B. Tryptophane  
 C. Phenylalanine  
 D. Histidine  
 E. Lysine

2. If a mixture of aspartate and glycine at pH 3.0 is poured through a cation-exchange column and eluted with more buffer (at pH 3.0), which of the following will happen?

- A. Aspartate will elute first because it has less net positive charge than glycine at pH 3.0.  
 B. Aspartate will elute second because it has more net positive charge than glycine at pH 3.0.  
 C. Aspartate will elute first because it has more net positive charge than glycine at pH 3.0.  
 D. Aspartate and glycine will elute together because they have identical pK<sub>i</sub>s.  
 E. None of the above.

3. The peptide leucylvalylalanylglutamyllysine has

- A. no free amino group.  
 B. three carboxyl groups.  
 C. five peptide bonds.  
 D. six peptide bonds.  
 E. none of the above.

4. The tripeptide Tyr-Lys-Met is first reacted with 1-fluoro-2,4-dinitrobenzene (FDNB) and then hydrolyzed in acid. The resulting solution will contain :

- A. All three amino acids, each labeled by FDNB.  
 B. All three amino acids, but tyrosine and lysine will be labeled by FDNB.  
 C. All three amino acids, but only tyrosine will be labeled by FDNB.  
 D. One amino acid labeled by FDNB and unlabeled dipeptide.  
 E. None of the above.

5. Which of the following statements about protein structure is **incorrect**?

- A. The primary structure refers to the sequence of amino acids in a protein.  
 B. The  $\alpha$ -helix is one of the secondary structure.  
 C. The tertiary structure is produced by the interaction of side chains of the amino acids and is not dependent upon the sequence of amino acids in the protein.  
 D. The quaternary structure requires the presence of more than one peptide chain.  
 E. None of the above.

6. Three proteins (x, y, z) in a mixture are to be separated and purified. The best methods to fractionate these proteins with retention of their activity would be

| Protein | Molecular weight | Isoelectric point |
|---------|------------------|-------------------|
| X       | 84,000           | 5.0               |
| Y       | 43,000           | 4.9               |
| Z       | 45,000           | 7.5               |

- A. ammonium sulfate precipitation followed by gel filtration.  
 B. gel filtration followed by peptide mapping.  
 C. gel filtration followed by ion-exchange chromatography at pH 6.0.  
 D. gel filtration followed by ion-exchange chromatography at pH 2.0.  
 E. gel filtration by SDS-polyacrylamide gel electrophoresis.

7. The O<sub>2</sub>-saturation curve of hemoglobin
- A. is simple hyperbolic.
  - B. is sigmoid.
  - C. shows negative cooperativity.
  - D. is the same as that of myoglobin.
  - E. none of the above.
8. Which of the following statements about enzyme is incorrect?
- A. Enzyme can increase the equilibrium constant of a reaction, thus favoring product formation.
  - B. Enzymes can lower the activation energy for the conversion of substrate to product.
  - C. Enzymes can increase the rate at which substrate is converted into product.
  - D. Most enzymes are proteins.
  - E. None of the above.
9. Carbonic anhydrase requires Zn<sup>2+</sup> to accomplish its catalytic activity. In the absence of zinc, carbonic anhydrase would be referred to as a(n)
- A. coenzyme.
  - B. cofactor.
  - C. prosthetic group.
  - D. holoenzyme.
  - E. apoenzyme.
10. The Michaelis-Menten constant K<sub>m</sub>
- A. equals the [s] at which V=V<sub>max</sub>.
  - B. equals the [S] at which v=1/2 V<sub>max</sub>.
  - C. equals the 1/2[S] at which V=V<sub>max</sub>.
  - D. equals the 1/2[S] at which v=1/2 V<sub>max</sub>.
  - E. can not be determined from the Linweaver-Burk plot.
11. The K<sub>m</sub> of an enzyme-catalyzed reaction that follows Michaelis-Menten kinetics would be altered by the presence of
- A. a competitive inhibitor.
  - B. a noncompetitive inhibitor.
  - C. both A and B.
  - D. excess substrate.
  - E. none of the above.
12. A glycogen molecule
- A. is composed of β-D-glucose polymer.
  - B. is a heteropolysacchride.
  - C. has only one reducing end.
  - D. has many reducing ends.
  - E. contains a branched amylose unit.
13. The major carrier of chemical energy in all cells is:
- A. adenine.
  - B. adenosine.
  - C. adenosine triphosphate.
  - D. acetyl chloride.
  - E. None of the above.

14. The endoplasmic reticulum (ER) and the Golgi complex are very important in the production and transport of proteins. Which of the following statements about the production and transport of proteins is **incorrect**?
- A. Proteins that are to be transported from a cell or inserted into the plasma membrane are synthesized on ribosomes attached to a portion of the ER known as the rough ER.
  - B. After the proteins are synthesized, they pass through the ER membrane into the ER lumen.
  - C. As the proteins pass through the Golgi complex, they are modified by the addition of sulphate, carbohydrate, or lipids moieties. Some of these modifications serve as signals or "addresser" that determine the final location of these proteins.
  - D. Proteins to be transported from the cell are packaged in a secretory vesicles and exit the cell exocytosis.
  - E. None of the above.
15. Which of the following is a fat-soluble vitamin and derived from cholesterol?
- A. Vitamin A.
  - B. Vitamin C.
  - C. Vitamin D.
  - D. Vitamin E.
  - E. Vitamin K.
16. Which of the following statements about lipid bilayer is a general feature in all biological membranes?
- A. Individual lipid molecules in one face of the bilayer readily diffuse (flip-flop) to the other monolayer.
  - B. Individual lipid molecules are not free to diffuse laterally in the surface of the bilayer.
  - C. Polar, but uncharged, compounds readily diffuse across the bilayer.
  - D. The bilayer is stabilized by covalent bonds between neighbouring phospholipid molecules.
  - E. Lateral diffusion of individual lipid molecules with the plane of each monolayer is a common type of motion.
17. An integral membrane protein will commonly be solubilized by extraction with:
- A. a buffer of alkaline or acid pH.
  - B. a solution containing detergent.
  - C. a solution of high ionic strength.
  - D. a chelating agent that removes divalent cations.
  - E. hot water.
18. Which of the following statements about ionophore is correct?
- A. An ionophore may diffuse back and forth across a membrane.
  - B. An ionophore may form a channel across a membrane through which an ion may diffuse.
  - C. An ionophore may catalyze electrogenic mediated transport of an ion.
  - D. All of the above.
  - E. None of the above.
19. In a double stranded DNA, which of the following is true? [X] indicates the the number of X residues.
- A.  $[A]=[C]$
  - B.  $[G]=[T]$
  - C.  $[A]+[T]=[G]+[C]$
  - D.  $[A]+[C]=[G]+[T]$
  - E. None of the above.

20. Which of the following statements is incorrect?
- A. DNA exists in a nucleoprotein complex called chromatin in eucaryotic cell.
  - B. The proteins of chromatin are composed only of histones.
  - C. Five distinct histones are known: H1, H2A, H2B, H3 and H4.
  - D. The nucleosome is composed of DNA and histones.
  - E. Nuclear matrix, a scaffold of proteins, provide a structural framework within the nucleus.
21. Which of the following DNA sequence is most likely to be recognized by type II restriction enzyme?
- A. 5'-GGCAAATT-3'
  - B. 5'-GGGGTTTT-3'
  - C. 5'-AAAAAAA-3'
  - D. 5'-GGGGCCCC-3'
  - E. 5'-GACTGACT-3'
22. Which of the following is not used in biosynthesis of pyrimidine?
- A. ATP
  - B. Carbamoyl phosphate
  - C. Glutamine
  - D. Aspartate
  - E. None of the above
23. Specific radioactive identification of ribosomal RNA can be achieved by using  $^{14}\text{C}$ -labeled
- A. cytosine.
  - B. guanine.
  - C. uracil.
  - D. deoxyribose.
  - E. thymidine.
24. Which of the following statements correctly describe the synthesis of eukaryotic RNA?
- A. Encoding genes cannot be continuous.
  - B. Identical mRNA molecules may be derived from different copies of a specifically repeated gene.
  - C. Most genes produce primary mRNA that is continuous.
  - D. All genes coding for mRNA are continuous.
  - E. No genes coding for mRNA are discontinuous.
25. DNA ligase is essential for all the following except:
- A. DNA repair.
  - B. formation of phosphodiester bonds between DNA chains of double-helical DNA molecules.
  - C. formation of phosphodiester bonds between DNA chains of single-stranded DNA molecules.
  - D. formation of a phosphodiester bond between the 5'-phosphate group at the end of one DNA chain and the 3'-hydroxy group at the end of the other chain.
  - E. normal DNA synthesis.
26. All of the following statements about glycogen metabolism are true except that:
- A. cyclic-AMP-activated protein kinase stimulates glycogen synthase.
  - B. phosphorylase kinase is activated by phosphorylation.
  - C. phosphorylase b is activated by phosphorylation.
  - D. cyclic AMP levels are raised by epinephrine and glucagon stimulation of adenylate cyclase.
  - E. a futile cycle of glycogenesis and glycogenolysis is prevented by second-messenger regulation.
27. All of the following are common to the synthesis of all steroid hormones except:
- A. cortisol.
  - B. progesterone.
  - C. cholesterol.
  - D. pregnenolone.
  - E. NADPH.

28. All known effects of cyclic AMP in eukaryotic cells result from
- A. activation of the catalytic unit of adenylate cyclase.
  - B. activation of synthetases.
  - C. activation of protein kinase.
  - D. phosphorylation of G protein.
  - E. stimulation of  $Ca^{2+}$  release from endoplasmic reticulum.
29. How many moles of high-energy-phosphate bond equivalents are utilized in the synthesis of 1 mole of triglycerol from free fatty acids and glycerol?
- A. 3
  - B. 4
  - C. 7
  - D. 9
  - E. 12
30. The number of net molecules of ATP yielded in the conversion of one glucosyl residue in glycogen to two molecules of lactate is
- A. one.
  - B. two.
  - C. three.
  - D. four.
  - E. five.
31. During the stages of starvation, blood or tissue levels of all the following would be expected to be elevated except:
- A. glycogen.
  - B. glucagon.
  - C. epinephrine.
  - D. norepinephrine.
  - E. ketone bodies.
32. If the template DNA sequence, conventionally written (ie, 5' to 3'), is ....pApGpCp...., the complementary DNA synthesized by reverse transcriptase (RNA-dependent DNA polymerase), will be
- A. ....pTpCpGp....
  - B. ....pGpCpTp....
  - C. ....pUpCpGp....
  - D. ....pGpCpUp....
  - E. ....pTpGpCp....
33. The biological effects of phorbol esters may be traced to their effect on
- A. adenylate cyclase.
  - B. calmodulin.
  - C. inositol triphosphatase.
  - D. phospholipase C.
  - E. protein kinase C ( $Ca^{2+}$ -dependent).
34. The pentose-phosphate pathway is of great importance in cellular metabolism because it produces
- A. NADH.
  - B. ATP.
  - C. Acetyl-CoA.
  - D. ADP.
  - E. NADPH.
35. The major site of acetoacetate formation from fatty acids is the
- A. liver.
  - B. adipose tissue.
  - C. small intestine.
  - D. kidney.
  - E. muscle.

36. A promotor site on DNA

- A. transcribes repressor.
- C. codes for RNA polymerase.
- E. translate specific proteins.

- B. initiates transcription.
- D. regulates termination.

37. Insulin has many direct effects on various cell types. All of the following cellular activities are increased following exposure to physiological concentrations of insulin **except**:

- A. plasma membrane transfer of glucose.
- C. gluconeogenesis.
- E. formation of ATP, DNA and RNA.

- B. glucose oxidation.
- D. lipogenesis.

38. Oxidative degradation of actyl CoA in the citric acid cycle gives a net yield of the following **except**:

- A. FADH<sub>2</sub>.
- C. 2 ATP.
- E. 2 CO<sub>2</sub>.

- B. 3 NADH.
- D. 1 GTP.

39. Which one of the following hormones is derived most completely from tyrosine?

- A. Glucagon
- C. Insulin
- E. Endorphin

- B. Thyroxine
- D. Prostaglandins

40. The receptor for insulin

- A. has a domain homologous with that for the progesterone receptor
- B. can bind Zn<sup>2+</sup>.
- C. can bind with high affinity to DNA.
- D. has a tyrosine kinase domain.
- E. has an adenylate cyclase domain.

B. Describe the metabolic changes during starvation. (20%)