

一、選擇題 (每題一分, 均為單選, 答錯不倒扣)

- \_\_\_\_\_ 1. Which of the following amino acids is not optically active?
- A. Proline
  - B. Threonine
  - C. Glutamic acid
  - D. Glycine
  - E. Alanine
- \_\_\_\_\_ 2. Compared to a saturated fatty acid of the same chain length, an unsaturated fatty acid
- A. has a higher melting point.
  - B. has a higher density of packing in a monolayer.
  - C. imparts greater fluidity to a membrane.
  - D. has a higher pK.
  - E. has a higher boiling point.
- \_\_\_\_\_ 3. The transformation of glycine to serine which involves the addition of one carbon unit requires the presence of
- A. niacin and B<sub>6</sub>.
  - B. B<sub>12</sub> and B<sub>6</sub>.
  - C. folic acid and B<sub>12</sub>.
  - D. niacin and B<sub>12</sub>.
  - E. thiamine and B<sub>6</sub>.
- \_\_\_\_\_ 4. Glycogen
- A. contains  $\beta$  1,4-glycosidic bonds.
  - B. contains  $\alpha$  1,4-linkages only.
  - C. contains  $\alpha$  1,6-linkages only.
  - D. is composed entirely of glucose residues.
  - E. none of the above
- \_\_\_\_\_ 5. The nitrogen atom at position 3 of pyrimidine nucleotides is derived is denovo synthesis from
- A. glutamine.
  - B. aspartic acid.
  - C. glycine.
  - D. tryptophan.
  - E. arginine.
- \_\_\_\_\_ 6. Phospholipids are important cell membrane constituents because they
- A. are the only amphoteric molecules in cells.
  - B. contain both polar and nonpolar portions.
  - C. can form liposomes with water.
  - D. contain glycerol.
  - E. combine covalently with proteins.
- \_\_\_\_\_ 7. In electrophoresis, if pH is higher than the pI (isoelectric point), the protein will
- A. move toward cathode.
  - B. move toward anode.
  - C. not move.
  - D. form zwitterion.
  - E. precipitate.

8. How many moles of ATP are formed when 1 mole of glucose as glycogen is oxidized to lactate?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 6

9. Xanthine is

- A. a final product of purine degradation.
- B. an intermediate in the formation of urate from guanine.
- C. deficient in the condition known as gout.
- D. a competitive inhibitor of hypoxanthine oxidase.
- E. a competitive inhibitor of IMP dehydrogenase.

10. Formation of  $\alpha$ -helix in proteins is due mainly to the presence of

- A. hydrogen bond.
- B. disulfide bond.
- C. hydrophobic interaction.
- D. salt bridge.
- E. DNA.

11. Which of the following reactions is rate limiting step of cholesterol biosynthesis?

- A. Lanosterol  $\longrightarrow$  Cholesterol.
- B. HMGCoA  $\longrightarrow$  Mevalonic acid + CoASH.
- C. Acetoacetyl CoA + Acetyl CoA  $\longrightarrow$  HMGCoA.
- D. Squalene  $\longrightarrow$  Lanosterol
- E. Mevalonic acid  $\longrightarrow$  Squalene

12. Which of the following statements regarding methionine is INCORRECT?

- A. S-adenosylmethionine contains a positively charged sulfur (sulfonium) that facilitates the transfer of substituents to suitable acceptors.
- B. S-adenosylmethionine participates in the formation of spermine.
- C. In activation of methionine to S-adenosylmethionine, two phosphate groups of ATP are released.
- D. Methionine can be generated by transferring the methyl group from 5-methyltetrahydrofolate to homocysteine.
- E. S-adenosylhomocysteine is formed from S-adenosylmethionine after the methyl group is transferred to its acceptor.

13. Which of the following statements about tRNA is INCORRECT?

- A. The tRNA usually contains about 65-100 nucleotides.
- B. The modified bases are important in the three-dimensional structure of tRNA.
- C. The tRNA comprises about 15% of the total cellular RNA.
- D. The CCA-OH is present at the 3' terminus of all completed tRNA molecules.
- E. The tRNA binds amino acids without the participation of any enzyme.

14. Which of the following factors affect(s) the solubility of proteins?

- A. salt concentration
- B. pH of the solution
- C. organic solvents
- D. all of the above
- E. none of the above

15. HDL can remove cholesterol from peripheral tissues because it has high LCAT activity and high content of

- A. triglycerides.
- B. phospholipids.
- C. proteins.
- D. cholesterol.
- E. none of the above

- \_\_\_\_\_ 16. The symptoms of scurvy are due primarily to
- A. a failure to remove the NH<sub>2</sub>-terminal fragments from procollagen molecules.
  - B. a failure to incorporate ascorbic acid into procollagen molecules.
  - C. the inadequate formation of hydroxyproline and hydroxylysine.
  - D. the inadequate formation of disulfide bonds between procollagen molecules.
  - E. a failure to protect the procollagen molecules from oxidation by peroxides.
- \_\_\_\_\_ 17. Which subunit of procaryotic RNA polymerase is responsible for promoter recognition?
- A. sigma ( $\sigma$ )
  - B. rho ( $\rho$ )
  - C.  $\alpha$
  - D.  $\beta'$
  - E.  $\beta$
- \_\_\_\_\_ 18. Peptide bond is one type of
- A. hydrogen bond.
  - B. ionic bond.
  - C. covalent bond.
  - D. hydrophobic bond.
  - E. disulfide bond.
- \_\_\_\_\_ 19. Ketosis is ascribed to
- A. a slowdown in fat metabolism.
  - B. an overproduction of acetyl CoA.
  - C. an underproduction of glucose.
  - D. an overutilization of glucose.
  - E. the ketogenicity of pyruvate in the liver.
- \_\_\_\_\_ 20. If  $\frac{1}{2}$  mole of fructose-1,6-diphosphate were oxidized to one mole of lactate by the glycolytic pathway, the net yield of ATP would be
- A. 0.
  - B. 1.
  - C. 2.
  - D. 3.
  - E. 4.
- \_\_\_\_\_ 21. In eukaryote, which of the following polymerase is required for the synthesis of rRNA?
- A. RNA polymerase I
  - B. RNA polymerase II
  - C. RNA polymerase III
  - D. none of the above
  - E. all of the above
- \_\_\_\_\_ 22. Based on chemical structure, insulin is
- A. carbohydrate.
  - B. glycoprotein.
  - C. protein.
  - D. lipoprotein.
  - E. nucleic acid.
- \_\_\_\_\_ 23. Thiamine is a cofactor for
- A. the fixation of carbon dioxide.
  - B. amino transferases.
  - C. the metabolism of acyl groups.
  - D. the transfer of one-carbon unit.
  - E. decarboxylation reactions.

24. Cholesterol uptake is mediated by
- LDL receptor.
  - nonspecific protein.
  - sterol carrier protein.
  - HDL.
  - IDL.
25. If you assume that the  $E'_0$  for fumarate +  $2H^+$  +  $2e^- \longrightarrow$  succinate is 0.03 volts, the  $E'_0$  for  $\frac{1}{2}O_2$  +  $2H^+$  +  $2e^- \longrightarrow$   $H_2O$  is 0.82 volts, and the formation of ATP from ADP and Pi under the conditions in question requires a free energy change of 7.3 Kcal/mol; the percentage efficiency of energy conservation in ATP as succinate is oxidized to fumarate by intact mitochondria is approximately ( $F=23.062$  kcal/V.mol)
- 20%.
  - 30%.
  - 40%.
  - 50%.
  - 60%.
26. Which of the following enzymes can join a 5'-monophosphate group to a 3'-OH group?
- DNA polymerase I
  - DNA polymerase II
  - DNA polymerase III
  - DNA ligase
  - DNA primase
27. The terms "primary", "secondary" and "tertiary" in protein chemistry refer, respectively, to
- $\alpha$ -helix,  $\beta$ -helix and  $\gamma$ -helix.
  - peptide bonds, disulfide bonds and van der Waals forces.
  - peptide bonds, hydrogen bonds and  $\alpha$ -helix.
  - electrostatic interaction, van der Waals forces and disulfide bonds.
  - amino acid sequence,  $\alpha$ -helix and hydrophobic interactions.
28. The main steroid produced in the ovary is
- estradiol.
  - corticosterone.
  - aldosterone.
  - testosterone.
  - cortisol.
29. Which of the following statements about Vitamin D is INCORRECT?
- It is converted into a hormone.
  - After UV irradiation, ergosterol is a good source of Vitamin D.
  - Children in the tropic area require dietary Vitamin D.
  - 7-Dehydrocholesterol in human skin is converted to Vitamin D<sub>3</sub> by ultraviolet irradiation.
  - Chronic renal and hepatic failure may result in abnormality of Vitamin D metabolism.
30. In regard to the cytochromes:
- Cytochrome aa<sub>3</sub> has a more positive oxidation-reduction potential than oxygen.
  - Only cytochrome a contains a heme prosthetic group.
  - Cytochrome c is a peripheral membrane protein.
  - Cytochrome b contains copper which is reduced and oxidized during electron transport.
  - none of the above

31. Which of the following factors is NOT required for protein synthesis?

- A. mRNA
- B. Ribosomes
- C. GTP
- D. Aminoacyl-tRNAs
- E. Aminoglycosides

32. Cycloheximide is an inhibitor of

- A. DNA synthesis in procaryotes.
- B. DNA synthesis in eucaryotes.
- C. protein synthesis in procaryotes.
- D. protein synthesis in eucaryotes.
- E. all of the above

33. An important structural feature of antibodies (immunoglobulins) is that

- A. they are composed of two peptide chains.
- B. they are composed of a single peptide chain.
- C. they are composed of two heavy and two light chains.
- D. they contain no sulfur amino acids.
- E. they dissociate in concentrated urea solution.

34. The catalytic unit of adenylate cyclase is activated by the G-protein in the presence of

- A. CTP.
- B. ATP.
- C. cAMP.
- D. GTP.
- E. GDP.

35. The pyruvate dehydrogenase complex

- A. catalyzes a reaction with the net production of acetyl CoA and  $FADH_2$ .
- B. contains thiamine pyrophosphate as a cofactor.
- C. contains biotin as a cofactor.
- D. catalyzes the reduction of FAD by NADH.
- E. none of the above

36. Which of the following vitamins is INCORRECTLY matched with its chemical name?

- A. Vitamin E ( $\alpha$ -tocopherol)
- B. Vitamin  $B_1$  (Niacin)
- C. Vitamin  $B_6$  (pyridoxal)
- D. Vitamin  $B_2$  (flavin)
- E. Vitamin  $B_{12}$  (cyanocobalamine)

37. Which of the following enzymes is NOT required for repair of thymine dimers?

- A. UV-specific endonuclease
- B. DNA polymerase I
- C. thymidine kinase
- D. DAN ligase
- E. photolyase (photoreactivity enzyme)

38. Blood plasma differs from blood serum in content of

- A. lipids.
- B. erythrocytes.
- C. carbohydrates.
- D. fibrinogen and blood coagulating factors.
- E. sodium ions.

39. Which of the following enzymes participates in fatty acid oxidation?

- A. Carnitine acyltransferase
- B. Malic enzyme
- C. Acetyl CoA carboxylase
- D. Glucose-6-phosphate dehydrogenase
- E. Pyruvate carboxylase

40. If one mole of acetyl CoA is oxidized to succinate via the Krebs cycle in conjunction with the electron transport system,

- A. 10 moles of high energy phosphate bonds are formed.
- B. 2 moles of  $\text{CO}_2$  are formed.
- C. 2 moles of molecular  $\text{O}_2$  are consumed.
- D. oxaloacetate is not involved in this sequence.
- E. none of the above

41. In the derivation of the Michaelis-Menten equation it is assumed that

- A. the concentration of the enzyme-substrate complex declines continually as the reaction proceeds.
- B. the product can be converted back to the substrate in the initial state of enzyme reaction.
- C. the velocity of the reaction is linearly proportional to the concentration of the enzyme-substrate complex.
- D. the concentration of the enzyme-substrate complex is always approximately equal to the concentration of the total enzyme.
- E. The binding of the enzyme to substrate is irreversible.

42. The most common and important experimental technique for transferring a plasmid from one bacterium strain to another is

- A.  $\text{CaCl}_2$  transformation.
- B.  $\text{AlCl}_3$  transformation.
- C.  $\text{LiCl}$  transformation.
- D. spheroplast transformation.
- E. nick translation.

43. When hemoglobin combines with  $\text{O}_2$

- A. the  $\text{Fe}^{+2}$  of hemoglobin is oxidized to  $\text{Fe}^{+3}$ .
- B. the subunits dissociate into monomers.
- C. only one  $\text{O}_2$  can be bound for each molecule of hemoglobin.
- D. the dissociation of  $\text{O}_2$  and hemoglobin follows a sigmoid curve.
- E. none of the above

44. Which of the following enzymes catalyzes the rate limiting step in fatty acid synthesis?

- A. Glucose-6-phosphate dehydrogenase.
- B. Citrate cleavage enzyme.
- C. Malic enzyme.
- D. Fatty acid synthase.
- E. Acetyl CoA carboxylase.

45. Which of the following statements regarding branched-chain amino acids is INCORRECT?

- A. All branched chain amino acids are essential in human beings.
- B. The catabolism products of leucine are glucogenic.
- C. All branched-chain amino acids are oxidized to branched-chain acyl CoAs one carbon shorter than their parent compounds.
- D. All branched-chain amino acids are catabolized in a similar process as  $\beta$ -oxidation of fatty acids.
- E. The first step in degradation of branched-chain amino acids is the transamination of the  $\alpha$ -amino groups to  $\alpha$ -ketoglutarate.

46. In the Krebs cycle, the hydrolysis of succinyl CoA results in
- A. the release of  $O_2$  .
  - B. the release of  $CO_2$  .
  - C. a substrate level phosphorylation.
  - D. the reduction of  $NAD^+$ .
  - E. none of the above
47. The primary transcript in encaryotes
- A. is usually shorter than the functional RNA.
  - B. may contain modified bases.
  - C. will not contain modified bases but may contain modified sugar.
  - D. could contain information for more than one RNA molecule.
  - E. is most efficient if the transcript contains high G-C content.
48. In a severe deficiency of Vitamin K
- A.  $\gamma$ -carboxylation of the appropriate glutamic acid residues of prothrombin is inhibited.
  - B. the formation of fibrin is increased.
  - C. the binding of  $Ca^{+2}$  to prothrombin is enhanced.
  - D. an abnormal fibrinogen is synthesized.
  - E. none of the above
49. Pyruvate and alanine are components of a shuttle that involves
- A. transport of muscle nitrogen to liver gluconeogenesis.
  - B. transport of alanine and pyruvate between cytosol and mitochondria in liver.
  - C. transport of alanine for protein synthesis in muscle.
  - D. transport of alanine to muscle.
  - E. muscular gluconeogenesis.
50. Pyruvate carboxylase
- A. catalyzes the conversion of phosphoenol pyruvate to oxaloacetate.
  - B. contains no prosthetic group.
  - C. is an allosteric enzyme with an absolute requirement for acetyl CoA.
  - D. requires GTP as a substrate.
  - E. none of the above
51. Which of the following bases is never found in the first (5') position of an anticodon
- A. A
  - B. U
  - C. C
  - D. G
  - E. none of the above
52. The most likely method for precipitating active proteins from a tissue extract is by the addition of
- A. 1N HCl.
  - B. 1N NaOH.
  - C. trichloroacetic acid.
  - D. ammonium sulfate.
  - E. none of the above
53. Which of the following conditions would increase the rate of the Krebs cycle?
- A. high  $NADH + H^+$
  - B. low ADP
  - C. high ATP
  - D. high  $NAD^+$
  - E. none of the above

54. Which of the following enzymes can repair damaged RNA?

- A. RNA polymerase I
- B. RNA polymerase II
- C. RNA polymerase III
- D. all of the above
- E. none of the above

55. Heme, the prosthetic group of hemoglobin, is formed by the incorporation of  $Fe^{+2}$  into

- A. uroporphyrin I.
- B. protoporphyrin III.
- C. coproporphyrin III.
- D. bilirubin.
- E. porphyrin.

56. Glycogen phosphorylase

- A. is called phosphorylase b when it is in active form.
- B. acts on glycogen to produce glucose-6-phosphate directly.
- C. is activated by phosphorylase phosphatase.
- D. is inactivated by phosphorylase kinase.
- E. none of the above

57. Order the DNA molecules shown below from lowest to highest melting temperature. In each case only one of the complementary strand is given.  
(1) AAAGTTTAATTC (2) AGTATCAATGCTT (3) GGACCCTGCCAG  
Answer

- A. 1,2,3
- B. 1,3,2
- C. 2,1,3
- D. 2,3,1
- E. 3,1,2

58. Glycogen synthetase

- A. exists in inactive form when it is phosphorylated.
- B. can make  $\alpha(1 \rightarrow 6)$  glycosidic bonds.
- C. is inactivated by phosphoprotein phosphatase.
- D. is activated by cyclic AMP-dependent protein kinase.
- E. none of the above

59. DNA polymerization occurs at

- A. 5' end of the primer.
- B. 3' end of the primer.
- C. 3' end of the template.
- D. 5' end of the template.
- E. none of the above

60. The chemiosmotic coupling hypothesis

- A. states that an electrochemical gradient of protons across the mitochondrial inner membrane serves as the means of coupling the energy flow of electron transport to the formation of ATP.
- B. does not involve the ATP synthetase enzyme.
- C. does not require an organized membrane.
- D. requires the generation of a high-energy compound.
- E. none of the above

61. When DNA is denatured by heating

- A. the absorbance at 260 nm goes down.
- B. the strands are hydrolyzed to oligonucleotides.
- C. the base pairs become linked by covalent bonds.
- D. the viscosity of the solutions is increased.
- E. the strands will hybridize with complementary DNA or RNA when the solution is cooled.



62. Which of the following statements is INCORRECT?

- A. The principal components of membrane are phospholipids and proteins.
- B. In the human red cell it has been shown that phosphatidylcholines predominate on the inner leaflet of the bilayer and phosphatidylethanolamines on the outer leaflet.
- C. Membrane peripheral proteins are generally less hydrophobic than integral proteins.
- D. The fluid-mosaic model of membrane structures states that most proteins and lipids have free rapid lateral diffusion.
- E. none of the above

63. Which of the following bases is(are) purine ?

- A. adenine
- B. uracil
- C. thymine
- D. none of the above
- E. all of the above

64. In the purification of enzymes from tissue extracts, it is generally most desirable to obtain the

- A. lowest  $K_m$ .
- B. highest yield of protein.
- C. greatest number of enzyme units.
- D. highest specific activity.
- E. smallest requirement for added cofactors.

二選擇題(每題二分, 均為單選)

65. Which of the following statements regarding asparagine is CORRECT?

- A. Asparagine is formed from aspartic acid during post-translational modification of proteins.
- B. Asparagine is an essential amino acid in human.
- C. Asparagine is an intermediate in the urea cycle.
- D. The synthesis of asparagine requires glutamine and ATP.
- E. The amide nitrogen of asparagine represents the major form of nontoxic transport of ammonia in human.

66. Which of the following statements regarding the urea cycle is INCORRECT?

- A. The synthesis of carbamoyl phosphate is regulated by N-acetylglutamate.
- B. Carbamoyl phosphate synthetase (use ammonia as substrate) and ornithine transcarbamoylase are located in mitochondrial matrix.
- C. Argininosuccinate lyase catalyzes the formation of argininosuccinate.
- D. Four high-energy phosphate bonds are cleaved to make one molecule of urea.
- E. The immediate precursor of urea in urea cycle is arginine.

67. The following experiments are carried out using a pure preparation of the enzyme that catalyzes stearate synthesis from acetyl CoA and malonyl CoA in the presence of all the cofactors required for reaction.

67a. If acetyl CoA is supplied in the form of  $C^3H_3COSCoA$ , and malonyl CoA (2%) is unlabeled, how many tritium atoms will be incorporated into each molecule of stearate formed?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

67b. If malonyl CoA is supplied in the form of  $^{-}OOC^3H_2COSCoA$ , and acetyl CoA (2%) is unlabeled, how many tritium atoms will be incorporated into each molecule of stearate formed?

- A. 2
- B. 4
- C. 8
- D. 12
- E. 16

三、簡答題

68. Proteins are long polymers of amino acids joined by peptide bonds. In aqueous solution at pH=7, most proteins are folded so that the nonpolar amino acid side chains are inside in a nonpolar environment, whereas most of the polar side chains are outside, in contact with water. By inspection of their structures, answer the following briefly:

68a. Decide whether the following amino acids are likely to have their side chains on the outside or the inside of a globular protein in solution: (2%) aspartic acid, phenylalanine, lysine, valine.

68b. Why might glycine be found either inside or outside? (1%)

68c. How might serine, threonine, asparagine and glutamine be accommodated (1%) inside, even though they are polar?

69. A DNA template strand contains the sequence 5'-ATCGTACCGTTGCCTAAC-3'

69a. What is the sequence of mRNA that can be (1%) transcribed from this strand.

69b. What amino acid sequence could be coded by (2%) this sequence? Starting from the 5' end. (Use the genetic code)

Table 4-1 The genetic code\*

First position (5' end)	Second position				Third position (3' end)
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop (och)	Stop	A
	Leu	Ser	Stop (amb)	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val (Met)	Ala	Glu	Gly	G

四、問答題

70. How are the three irreversible reactions of glycolysis bypassed (3%) in glyconeogenesis?

71. The  $\epsilon$ -amino group of lysine has a pKa of 10.5 and the  $\alpha$ -amino group has a pKa of 9.0. (3%)

71a. Draw the structure of lysine and indicate the  $\epsilon$ -amino group on the structure

71b. What fraction of  $\epsilon$ -amino groups will be protonated (in the form of  $-\text{NH}_3^+$ ) at pH=9.5?

71c. Explain why the pKa of the  $\epsilon$ -amino group is higher than that of the  $\alpha$ -amino group?

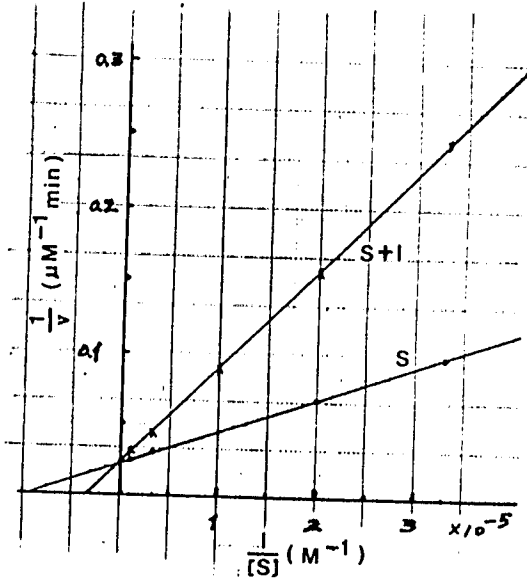
72. If palmitate is the only energy source, explain the efficiency of energy (6%) production for a diabetic patient compared to a normal person?

73. Outline a method for determining the relative amounts of glucose oxidized (3%) in a specific tissue by the phosphogluconate pathway vs. glycolysis and the tricarboxylic acid pathways.

74. The kinetics of an enzyme are measured as a function of substrate concentration(S) in the presence and absence of  $2 \times 10^{-3} \text{M}$  inhibitor(I).

[S]	Velocity ( $\mu\text{mole}/\text{min}$ )	
	without inhibitor	with inhibitor
$0.3 \times 10^{-5} \text{M}$	10.4	4.1
$0.5 \times 10^{-5} \text{M}$	14.5	6.4
$1.0 \times 10^{-5} \text{M}$	22.5	11.3
$3.0 \times 10^{-5} \text{M}$	33.8	22.6
$9.0 \times 10^{-5} \text{M}$	40.5	33.8

74a. Calculate  $V_{max}$  and  $K_m$ :  
 (2%) (1) in the absence of inhibitor  
 (2) in the presence of inhibitor



74b. What type of inhibition is this?  
 (2%)

74c. What is the dissociation constant of this inhibitor?  
 (2%)