

一. 選擇題 (1-30 題, 每題一分, 答錯倒扣 0.25 分, 均為單選)

I. Choose the best one answers. (1% each, 1-30)

1. Bile salts are important in the digestion and absorption of triacylglycerol because they:
  - A. convert the inactive lipases to the active form.
  - B. emulsify the triacylglycerol globules to produce a greater surface area that will increase the activity of the lipases.
  - C. activate the cleavage of triacylglycerol at the C-2 position.
  - D. permit greater permeability of the triacylglycerol through the intestinal wall.
  - E. none of the above.
2. The function of carnitine acyltransferase II is to:
  - A. provide an inner membrane channel for the transport of o-acylcarnitine.
  - B. catalyze the formation of o-acylcarnitine.
  - C. catalyze the conversion of o-acylcarnitine to acyl-CoA and carnitine.
  - D. transfer carnitine to acyl-CoA.
  - E. all of the above.
3. The first three reactions in the  $\beta$ -oxidation of saturated fatty acid produce
  - A. 2 moles of NADH.
  - B. 2 moles of  $FADH_2$ .
  - C. 2 moles of ATP.
  - D. 3 moles of ATP.
  - E. 1 mole each of NADH and  $FADH_2$ .
4. The degradation of palmitoyl-CoA requires seven cycles of  $\beta$ -oxidation. How many ATPs are generated from just this  $\beta$ -oxidation?
  - A. 28.
  - B. 30.
  - C. 35.
  - D. 40.
  - E. 42.

(背面仍有題目, 請繼續作答)

5. Type II diabetes is associated with
- A. oversecretion of insulin.
  - B. inadequate secretions of insulin.
  - C. shortage of insulin receptors.
  - D. low blood glucose levels.
  - E. none of the above.
6. The principal electron carrier utilized in fatty acid biosynthesis is
- A. NADH.
  - B.  $\text{NAD}^+$ .
  - C. NADPH.
  - D.  $\text{NADP}^+$ .
  - E.  $\text{FADH}_2$ .
7. The addition of two carbon units to the growing fatty acid chain is driven by
- A. hydrolysis of ATP.
  - B. oxidation of NADPH.
  - C. reduction of  $\text{NADP}^+$ .
  - D. decarboxylation of malonyl-CoA.
  - E. all of the above.
8. For mitochondrial acetyl-CoA to be available in the cytoplasm for use in fatty acid biosynthesis, it must be transported from the mitochondria. What compounds are involved in the shuttle system for this transport?
- A. Citrate-malate-oxaloacetate.
  - B. Oxaloacetate-pyruvate.
  - C. Citrate-malate-pyruvate.
  - D. Carnitine acyltransferase I.
  - E. Carnitine acyltransferase II.
9. In the acetyl-CoA carboxylase catalyzed reaction, palmitoyl-CoA acts as a (n)
- A. competitive inhibitor.
  - B. effector of the energy charge.
  - C. allosteric activator.
  - D. feed-back inhibitor.
  - E. non-specific inhibitor.

10. If the carbon in the bicarbonate used in malonyl-CoA synthesis were labeled with  $C^{14}$  in the synthesis of palmitate, where would the label be found in the reaction products?
- A.  $CO_2$ .
  - B. C-16 of palmitate.
  - C. C-1 of palmitate.
  - D. Evenly distributed in palmitate.
  - E. None of the above.
11. The committed step in cholesterol biosynthesis is catalyzed by
- A. HMG-CoA synthase.
  - B. HMG-CoA reductase.
  - C. mevalonate kinase.
  - D. squalene monooxygenase.
  - E. none of the above.
12. The role of hormone-sensitive lipase is to
- A. hydrolyze lipids stored in the liver.
  - B. hydrolyze triacylglycerol stored in adipose tissue.
  - C. hydrolyze membrane phospholipids in hormone-producing cells.
  - D. synthesize triacylglycerol in the liver.
  - E. synthesize lipids in adipose tissue.
13. A fatty acid with an odd number of carbons will enter the citric acid cycle as acetyl-CoA and
- A.  $\alpha$ -ketoglutarate.
  - B. malate.
  - C. succinyl-CoA.
  - D. citrate.
  - E. butyrate.
14. The major site of formation of acetoacetate from fatty acids is the
- A. intestinal mucosa.
  - B. adipose tissue.
  - C. liver.
  - D. muscle.
  - E. kidney.

(背面仍有題目,請繼續作答)

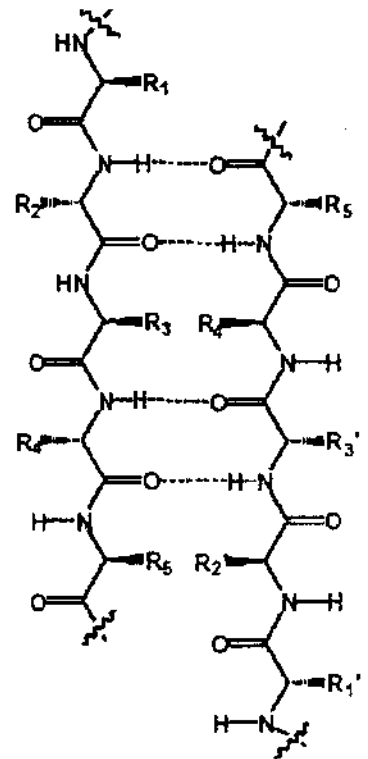
15. The rate-limiting step in fatty acid synthesis is
- formation of acetyl-CoA from acetate.
  - the reaction catalyzed by acetyl-CoA carboxylase.
  - condensation of acetyl-CoA and malonyl-CoA.
  - the reduction of the acetoacetyl group to a  $\alpha$ -hydroxybutyryl group.
  - formation of malonyl-CoA from malonate and coenzyme A.
16. By which of the following compounds the cholesterol is synthesized from
- acetyl-CoA.
  - malate.
  - oxalate.
  - lipoic acid.
  - choline.
17. The titration curve of alanine shows the ionization of two functional groups with pKa1 and pKa2 values of 2.34 and 9.69, respectively. The titration of di-, tri-, and larger oligopeptide of alanine also shows the ionization of two functional groups. The value of pKa1 will \_\_\_\_\_ with each addition of an Ala residue to the Ala oligopeptide. The value of pKa2 will \_\_\_\_\_ with each addition of an Ala residue to the Ala oligopeptide.
- increase; increase
  - decrease; decrease
  - increase; decrease
  - decrease; increase
  - none of them
18. Which the following techniques cannot be used to determine the 3D dimensional structures of proteins?
- X-ray diffraction
  - Cryoelectron microscopy
  - Circular dichroism spectroscopy
  - Nuclear magnetic resonance spectroscopy
  - None of them

19. Polylysine, a polypeptide made up of only L-Lys residues, has the random coil conformation at neutral pH. However, when pH is raised to 10, the conformation of polylysine became  $\alpha$ -helical. Which of the following interaction caused this conformational change?
- Hydrogen bond
  - Electrostatic interaction
  - Van der Waals interaction
  - Covalent bond
  - Hydrophobic interaction
20. Which of the following generalizations concerning motor proteins is correct?
- They convert potential energy into chemical energy.
  - They convert chemical energy into potential energy.
  - They convert kinetic energy into chemical energy.
  - They convert chemical energy into kinetic energy.
  - They convert chemical into chemical energy.
21. The increase of  $\text{CO}_2$  in blood stream will result in the \_\_\_\_\_ of pH of blood stream and the \_\_\_\_\_ of the hemoglobin's binding to oxygen.
- increase; increase
  - decrease; decrease
  - increase; decrease
  - decrease; increase
  - none of them
22. The binding of oxygen to hemoglobin has a \_\_\_\_\_ curve?
- linear
  - hyperbolic
  - sigmoid
  - polynomial
  - none of them

23. An antibody binds to an antigen with a  $K_d$  of 0.6 nM. When concentration of antigen is 0.2 nM, the  $\theta$  will be? ( $\theta$ : the fraction of ligand-binding sites on the protein that are occupied by ligand)
- A. 1/10  
 B. 1/4  
 C. 1/3  
 D. 1/2  
 E. 1
24. What is the net charge of peptide A (Arg-Glu-Pro-Asp-Gly-Tyr) at pH 7.0?
- A. 2  
 B. 1  
 C. 0  
 D. -1  
 E. -2
25. In a mixture of the five proteins listed below, which should run first in the gel filtration chromatography?
- A. cytochrome c,  $M_r = 13,000$   
 B. ribonuclease A,  $M_r = 13,700$   
 C. serum albumin,  $M_r = 68,500$   
 D. immunoglobulin G,  $M_r = 145,000$   
 E. RNA polymerase,  $M_r = 450,000$

26. What is the secondary structure of the following structure?

- A.  $\alpha$ -helix  
 B. anti-parallel  $\beta$ -sheet  
 C. parallel  $\beta$ -sheet  
 D. turn  
 E. coil



27. What is the tertiary structure of the following structure?



- A. all  $\alpha$ -
- B. all  $\beta$
- C.  $\beta$ - $\beta$ - $\alpha$  motif
- D.  $\alpha$ - $\beta$ - $\beta$  motif
- E. small and irregular motif

28. Which of the following structure can be used to stabilize the phosphate group?

- A.  $\alpha$ -helix
- B. anti-parallel  $\beta$ -sheet
- C. parallel  $\beta$ -sheet
- D. turn
- E. coil

29. Three residues  $\gamma$ -turn has CO(i) to NH(i + ?) hydrogen bond pattern?

- A. 2
- B. 3
- C. 4
- D. 5
- E. 6

30. Which of the following website or algorithm can be used to align protein sequences?

- A. blast
- B. pdb databank
- C. scop
- D. cath
- E. swiss protein database

## II. 選擇題 (31-48 題, 每題二分, 答錯倒扣 0.5 分, 均為單選)

Questions 31-40. Answer the following questions using the key outlined below:

- (A) if 1, 2, and 3 are correct
- (B) if 1 and 3 are correct
- (C) if 2 and 4 are correct
- (D) if only 4 is correct
- (E) if all four are correct

## 31. Glycosaminoglycans

- 1. are structurally homopolysaccharides.
- 2. are high molecular weight polyanions.
- 3. contain only D-form monosaccharide residues.
- 4. contain a family of linear polymers composed of repeating disaccharide units.

## 32. Phosphofructokinase-1

- 1. catalyzes a rate-limiting step in glycolysis.
- 2. is inhibited by citrate.
- 3. is activated by fructose-2,6-bisphosphate.
- 4. is activated by ATP.

## 33. Which of the following statements is correct of the conversion of glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate?

- 1. It generates a high-energy compound.
- 2. It is an oxidation process.
- 3. The reaction mechanism involves the formation of a thiohemiacetal intermediate.
- 4. The reaction mechanism does not involve a phosphorolytic cleavage reaction.

## 34. The reaction that involves a substrate-level phosphorylation in TCA cycle is

- 1. succinate  $\longrightarrow$  fumarate.
- 2. isocitrate  $\longrightarrow$   $\alpha$ -ketoglutarate.
- 3.  $\alpha$ -ketoglutarate  $\longrightarrow$  succinyl-CoA.
- 4. succinyl-CoA  $\longrightarrow$  succinate.



35. Pyruvate carboxylase
1. requires pyridoxal phosphate as a cofactor.
  2. is an anaplerotic reaction for TCA cycle
  3. is activated by  $\text{NAD}^+$ .
  4. requires ATP.
36. The primary function of the pentose phosphate pathway is to
1. synthesize pentose phosphates.
  2. convert pentose phosphates to metabolic intermediates for providing energy.
  3. synthesize NADPH.
  4. synthesize  $\text{CO}_2$ .
37. The major enzymes or proteins functioning as electron-transfer components in the mitochondrial electron-transfer systems are
1. iron-sulfur proteins.
  2. flavin-linked dehydrogenases.
  3.  $\text{NAD}^+$ -linked dehydrogenases.
  4. cytochrome P450.
38. Which of the following statements is correct?
1. When  $K'_{eq} < 1$ ,  $\Delta G^\circ$  is positive.
  2.  $\Delta G^\circ$  and  $\Delta G$  mean the same thing.
  3.  $\Delta G^\circ$  of a given reaction is a constant.
  4. When  $\Delta G^\circ = 1$ , the reaction is at equilibrium.
39. Which of the following enzymes is involved in gluconeogenesis but not in glycolysis?
1. Glucose-6-phosphate dehydrogenase
  2. Fructose 1,6-bisphosphatase
  3. Phosphoglycerate kinase
  4. Phosphoenolpyruvate carboxykinase
40. Glycogen synthase is covalently activated by
1. adenylate cyclase
  2. synthase phosphorylase kinase.
  3. active protein kinase.
  4. phosphoprotein phosphatase.

(背面仍有題目,請繼續作答)

41. The coenzyme that participates in the carboxylation reactions is
- A. biotin.
  - B. vitamin D.
  - C. nicotinamide dinucleotide.
  - D. flavin coenzyme.
  - E. coenzyme A.
42. An effective electron sink used to stabilize negative charge is found in which of the following coenzymes?
- A. Riboflavin
  - B. Vitamin A
  - C. Coenzyme A
  - D. Thiamine pyrophosphate
  - E. Vitamin C
43. Covalent catalysis is carried out by enzymes using a
- A. sequential bisubstrate mechanism.
  - B. random bisubstrate mechanism.
  - C. simple unimolecular mechanism.
  - D. ping-pong mechanism.
  - E. Theorell-Chance reaction mechanism.
44. Many metabolic pathways involve multistep reactions consider the following pathway:
- E1      E2      E3      E4
- A-----> B-----> C-----> D-----> F (final product)
- Feed back inhibition is usually associated with
- A. binding of product F to the active site of E1.
  - B. F interacting with an allosteric site in E1.
  - C. B interaction with an allosteric site in E2.
  - D. all the intermediates and products in the reaction compete inhibition with the active site in E1.
  - E. F interacting with the allosteric site in E4.

45. The primary control of blood clotting is
- A. induction of protein synthesis.
  - B. post-translational modification.
  - C. proteolytic cleavage of proenzymes.
  - D. association to form different isozymes.
  - E. conformational changes in the subunits in an allosteric interaction.
46. Which of the following is **NOT** expected to be a characteristic of a homotetrameric allosteric enzyme?
- A. It is a multiple subunit enzyme.
  - B. It has more than one active site per enzyme.
  - C. Its effector sites are overlapping with the active sites.
  - D. It exhibits hyperbolic kinetic profiles.
  - E. It may have two different conformations R form and T form.
47. Which of the designations listed below does not correspond to major classes of enzymes as outlined by the International Union of Biochemistry?
- A. Ligases
  - B. Phosphatases
  - C. Hydrolases
  - D. Isomerases
  - E. Transferases
48. A particular aminotransferase requires pyridoxal phosphate as an essential component for its activity. The biological active enzyme unit is called
- A. holoenzyme.
  - B. apoenzyme.
  - C. cofactor.
  - D. coenzyme.
  - E. prosthetic group.

### III. 問答題

49. The chemical structures among the bases of nucleic acids are very similar. However, the architecture topology of a DNA sequence has been suggested to be highly correlated to its biological function. Please identify as many sequence-dependent structural variations as you can and describe their biological functions in terms of their applications in molecular biology. (10%)
50. 5-fluorocytosine has been used as a therapeutic agent to treat fungal infection. Recently, it has been applied as a prodrug for suicide gene therapy in combination with a gene encoding an enzyme of nucleotide metabolism. Please demonstrate the mechanism of this prodrug strategy and compare its advantage over the use of ganciclovir combined with herpes simplex virus thymidine kinase as the alternative prodrug strategy. (14%)
51. Please describe the correlations among glycolysis, citric acid cycle, pentose phosphate pathway, and the biosynthesis of non-essential amino acids. (10%)