

考生注意事項：所有考題務必在答案卷上依序作答，在問題卷上作答者不計分。

I. 選擇題 (1-30 題，每題一分，答錯倒扣 0.25 分，均為單選)

1. Which of the following biological molecules represents the most reduced form of carbon?
 - A. Carbohydrates.
 - B. Lipids.
 - C. Proteins.
 - D. DNA.
 - E. RNA.

2. Which of the following is the main force to hold the membrane lipids in a lipid bilayer?
 - A. Hydrophobic force.
 - B. Hydrogen bonds.
 - C. Electrostatic forces.
 - D. Covalent bonds.
 - E. None of the above.

3. Which of the following is the main characteristic of the essential fatty acids?
 - A. They must be synthesized in mammals.
 - B. They serve as precursors for prostaglandins.
 - C. They must be obtained in the diet.
 - D. They contain 16 carbons.
 - E. None of the above.

(背面仍有題目,請繼續作答)

4. Which of the following energy sources produces the greatest energy in metabolic reactions in the cell?
- A. Nucleic Acids.
 - B. Proteins.
 - C. Lipids.
 - D. Carbohydrates.
 - E. None of the above.
5. General linkages found in the lipid-anchored membrane proteins are:
- A. Thioester linkage.
 - B. Thioether linkage.
 - C. Amide linkage.
 - D. All of the above.
 - E. None of the above.
6. Carnitine acyltransferase I is located in the mitochondrion within the
- A. intermembrane space.
 - B. outer membrane.
 - C. inner membrane.
 - D. matrix.
 - E. none of the above.
7. The first reactions in the β -oxidation of saturated fatty acids produce:
- A. 2 moles of NADH.
 - B. 2 moles of FADH.
 - C. 3 moles of ATP.
 - D. 1 mole of NADH and 1 mole of FADH.
 - E. 2 mole of NADH and 2 mole of FADH.

8. If the palmitoyl-CoA is degraded in β -oxidation for only three cycles, how many ATPS are generated?
- A. 20.
 - B. 15.
 - C. 10.
 - D. 5.
 - E. 1.
9. Primary ketone bodies generated in the oxidation of fatty acids are
- A. acetone, butyric acid and acetyl-CoA.
 - B. acetoacetate, hydroxyacetone phosphate, and butyric acid.
 - C. acetone, β -hydroxybutyric acid, and acetoacetate.
 - D. acetoacetate, acetyl-CoA, and acetate.
 - E. none of the above.
10. 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.
11. Which of the following is not a principal source of acetyl-CoA?
- A. Amino acid degradation.
 - B. Pentose phosphate pathway.
 - C. Glycolysis.
 - D. Fatty acid oxidation.
 - E. None of the above.

12. One of the main sources of NADPH for fatty acid biosynthesis is
- A. the TCA cycle.
 - B. oxidative phosphorylation.
 - C. conversion of malate to pyruvate, catalyzed by malic enzyme.
 - D. the conversion of malate to oxaloacetate, catalyzed by malate dehydrogenase.
 - E. none of the above.
13. Starting with acetyl-CoA, how many molecules of ATP are hydrolyzed to form myristoyl-CoA?
- A. 5.
 - B. 6.
 - C. 7.
 - D. 8.
 - E. 9.
14. Cholesterol is a precursor for the following molecules except:
- A. lanosterol.
 - B. estradiol.
 - C. cholate.
 - D. progesterone.
 - E. androgen.
15. The rate limiting 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.

16. The cholesterol released from LDL pathway and accumulated in the cells will:
- A. increase the ACAT activity.
 - B. Inhibit the HMG-CoA reductase.
 - C. Induce the production of LDL receptors.
 - D. do all three things mentioned above.
 - E. do nothing.

Questions 17-23.

- A. Arg-Lys-Met-Ala
- B. Cys-Pro-Arg-Ala
- C. Asp-Trp-Tyr-Ala
- D. Asp-His-Glu-Ala
- E. Leu-Val-Phe-Ala

Which one of the above tetrapeptides:

- 17. is most negatively charged at pH 7.0?
- 18. is most positively charged at pH 7.0?
- 19. has pI around 7?
- 20. contains the large number of nonpolar side chains?
- 21. contains amino acid with $\text{CH}_2\text{CH}_2\text{SCH}_3$ side chain?
- 22. will have the greatest light absorbance at 280 nm?
- 23. will form disulfide bond?

(背面仍有題目,請繼續作答)

24. Which amino acid residue has a lone electron pair at one of its ring nitrogens which makes it important for binding zinc atoms in insulin and iron atoms in haemoglobin (hemoglobin)?
- A. Glu
 - B. Tyr
 - C. Trp
 - D. His
 - E. Cys
25. Five interaction forces can contribute the protein stability. Which interaction force is an entropy-driven process?
- A. covalent bond
 - B. hydrogen bond
 - C. van der Waals interaction
 - D. electrostatic interaction
 - E. hydrophobic interaction
26. Which of the following contributes the major stabilization energy in the secondary structures of proteins?
- A. Hydrogen bond.
 - B. Salt bridge.
 - C. Van der waals interaction.
 - D. Covalent bond.
 - E. Hydrophobic interaction.

27. Sterically allowed values of phi and psi for an amino acid can be presented as a Ramachandran plot. Which one of the following statements is false?
- A. Allowed phi and psi angles can be calculated or determined experimentally for tri-peptides of the amino acid
 - B. Ramachandran plots are symmetrical along the phi equals psi diagonal
 - C. In the absence of Gly, only 3 small regions of the Ramachandran plot are physically accessible to a polypeptide chain
 - D. The allowed areas on a Ramachandran plot can be significantly enlarged by allowing for small deviations from peptide bond planarity
28. What is the major secondary structure of DNA-binding protein involving DNA binding?
- A. α -Helix
 - B. anti-parallel β -sheet
 - C. parallel β -sheet
 - D. turn
 - E. loop
29. Which one of the following statements about protein secondary structure is false?
- A. In the classic alpha-helix and beta-sheet, every imino group is hydrogen-bonded to a carbonyl group belonging to either the same chain or a neighboring one.
 - B. Alpha-helices and beta-sheets are characterized by a number of consecutive residues having the same phi and psi dihedral angles.
 - C. Proteins are made up of regions of secondary structures which always consist of the same sequence of amino acids.
 - D. In X-ray crystallographic studies of proteins, the repeating elements of secondary structure give rise to characteristic patterns of diffracted X-ray intensity.

(背面仍有題目,請繼續作答)

30. A mutant form of polypeptide hormone angiotension II has the amino acid composition (D, R, I, M, F, P, Y, V). The following observations are made:
- Trypsin yields a dipeptide containing D and R, and a hexapeptide with all the rest.
 - Cyanogen bromide cleavage yields a dipeptide containing F and P, and a hexapeptide containing all the others.
 - Chymotrypsin cleaves the hormone into two tetrapeptides, of composition (D, R, Y, V) and (I, M, F, P)
 - The first product of carboxypeptidase cleavage is F.

What is the sequence ?

- DRYVMIFP
- FPMIDRVY
- DRVYIMPF
- RDVYIMPF
- FPIMDRVY

II. 選擇題 (31 - 40 題, 每題二分, 答錯倒扣 0.5 分, 均為單選)

Answer the following questions using the key outlined below:

- if 1, 2, and 3 are correct
- if 1 and 3 are correct
- if 2 and 4 are correct
- if only 4 is correct
- if all four are correct

31. Phosphoenolpyruvate carboxykinase

1. catalyzes the GTP-dependent conversion of oxaloacetate to phosphoenolpyruvate.
2. catalyzes the ATP- and biotin-dependent conversion of pyruvate to oxaloacetate.
3. It's gene transcription is promoted by glucagon.
4. is activated by fructose-1,6-bisphosphate.

32. Glycogen phosphorylase

1. catalyzes the hydrolysis reaction at the nonreducing ends of glycogen.
2. catalyzes the phosphorolysis reaction at the nonreducing ends of glycogen.
3. is inhibited by phosphorylation.
4. is highly regulated by covalent modification.

33. An example of proteoglycan is

1. chondroitin 4-sulfate.
2. heparin.
3. dermatan sulfate.
4. chitin.

34. In tightly coupled mitochondria, the rate of NADH consumption will

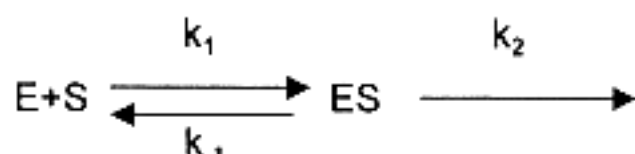
1. increase if 2,4-dinitrophenol is added to the mitochondrial suspension.
2. increase if mitochondrial Pi is depleted.
3. decrease if mitochondrial ADP is depleted.
4. increase if ATP synthase is inhibited.

35. The oxidation of 1 mole of glucose 6-phosphate by pentose phosphate pathway may result in the formation of
1. 1 mole of ribose 5-phosphate, 1 mole of NADPH, 1 mole of H^+ , and 1 mole of CO_2 .
 2. 1 mole of ribose 5-phosphate, and 2 moles of NADPH, 2 moles of H^+ , and 1 mole of CO_2 .
 3. 6 moles of NADPH, 6 moles of H^+ , 1 mole of P_i , and 6 moles of CO_2 .
 4. 12 moles of NADPH, 12 moles of H^+ , 1 mole of P_i , and 6 moles of CO_2 .
36. Glyceraldehyde-3-phosphate dehydrogenase
1. produces 2 moles of NADH per mole of glucose oxidized during glycolysis.
 2. requires the participation of inorganic phosphate.
 3. catalyzes the formation of the first high-energy compound during glycolysis.
 4. requires the coenzyme TPP.
37. Pyruvate dehydrogenase is activated by
1. high CoA/acetyl CoA.
 2. low [pyruvate].
 3. high $NAD^+/NADH$.
 4. low $[Ca^{++}]$.
38. Glycogen synthase b is activated by
1. AMP.
 2. ATP.
 3. citrate.
 4. glucose 6-phosphate.

39. Which of the following statements concerning the effect of glucagon is incorrect?
1. Glucagon initiates a cascade of reactions leading to the stimulation of glycogenolysis.
 2. Glucagon stimulates the liver phosphofructokinase activity via the formation of fructose-2,6-bisphosphate.
 3. Glucagon stimulates the fructose-1,6-bisphosphatase activity in liver.
 4. Glucagon stimulates the phosphorylation of phosphoprotein phosphatase.
40. Which of the following statements about Type I glycogen storage disease (von Gierke's disease) is correct?
1. It is caused by a deficiency of glucose-6-phosphatase.
 2. Individuals with this disease show hyperlipidemia symptom.
 3. Individuals with this disease show hypoglycemia symptom.
 4. It is caused by a deficiency of muscle phosphorylase.

III. 簡答題及問答題 (41-49 題)

41. For a Michaelis-Menten reaction,

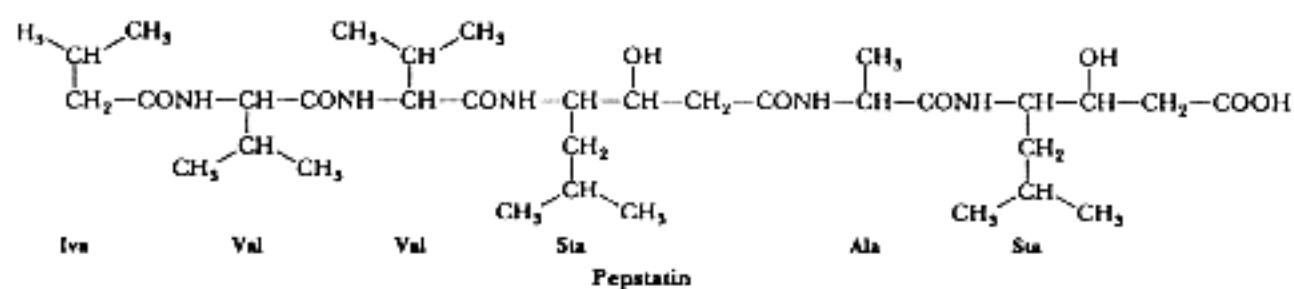


$$k_1 = 7 \times 10^7 / \text{M} \cdot \text{sec}, k_{-1} = 1 \times 10^3 / \text{sec}, k_2 = 2 \times 10^4 / \text{sec}$$

- A. What are the values of K_s and K_m ? (4%)
- B. Does substrate binding approach equilibrium or does it behave more like a steady state system? (2%)
42. Blood that has been stored for some time becomes depleted in 2,3-BPG. What happens if such blood is used in a transfusion? (4%)

(背面仍有題目,請繼續作答)

43. For a Michaelis-Menten reaction, if $V_{max} = 100 \mu\text{mol/ml sec}$, and $K_m = 2 \text{ mM}$; what is the velocity of the reaction when $[S] = 6 \text{ mM}$? (3%)
44. Pepstatin is an extremely potent inhibitor of the monomeric aspartic proteases such as pepsin, with K_i values of less than 1 nM . Base on the structure of pepstatin, suggest an explanation for the strongly inhibitory property of this peptide. (3%)



45. A rare inherited disease known as homocysteinuria results in very high levels of homocysteine in the bloodstream. Patients with this disease are at higher risk for heart attack and stroke. Supplementing the amount of folic acid in the diet reduces blood concentration of homocysteine to a safe level. Suggest an explanation for the effect of folic acid on the levels of homocysteine. (5%)
46. The 20 common amino acids can be classified as glucogenic and ketogenic according to their metabolic degradation intermediates. List 3 glucogenic intermediates and 2 ketogenic intermediates of amino acid metabolism. (5%)
47. 在基因治療之發展上，利用自殺基因的策略，被認為是癌症基因治療重要方式之一。請問有關於核酸代謝上，哪些基因可以利用為自殺基因，並請詳述其機制及如何運用。(10%)

48. 核酸序列之定序決定基因體計劃之成敗，請詳述各種核酸定序之方法及其原理。(10%)
49. 小兒科有一病童，其尿液及血液之 *xanthine* 值均高於正常值許多，利用 *Allopurinol* 治療並無法改善。該病童罹患何種遺傳疾病，在核酸代謝上有何異常。(4%)