

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：生物化學【生科系三年級】

題號：721004

※本科目依簡章規定「不可以」使用計算機

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1. The hydrophobic effect is an important driving force for protein folding and for the assembly of molecules into cellular structures. (6 分)

- (a) Give the definition of the hydrophobic effect.
- (b) What are amphiphilic (amphipathic) molecules?
- (c) Which cellular structures are composed of many amphipathic molecules that are driven together under the influence of the hydrophobic effect?

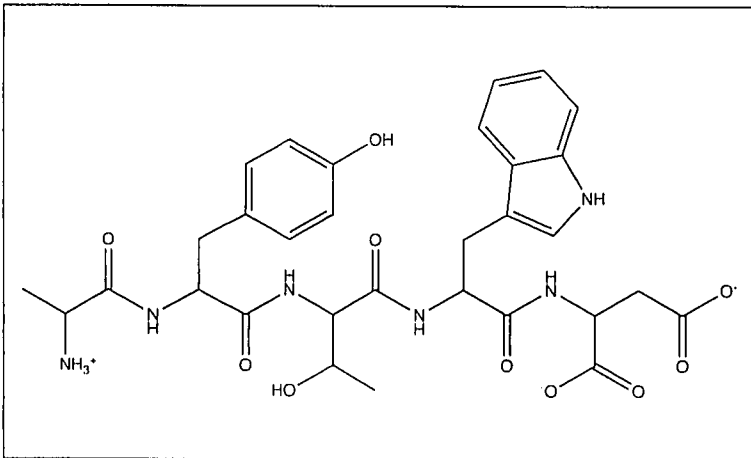
2. There are three types of RNA that are directly involved in translation. (6 分)

- (a) Name these three types of RNA.
- (b) Briefly describe the function of each of these types of RNA.

3. In general, amino acids are chiral molecules that act as building blocks for proteins. In addition, amino acids and amino acid derivative can act as extracellular messenger molecules such as hormones or neurotransmitters. (8 分)

- (a) How many different amino acids can be incorporated into proteins during translation?
- (b) Do ribosomes use L or D amino acids for protein synthesis?
- (c) Name one amino acid or amino acid derivative that can act as hormone or neurotransmitter.
- (d) Draw the predominant structure of valine at pH 10 (pK_{as} are 2.3 and 9.7).

4. The figure below shows the predominant structure of an oligopeptide at pH 7.0. (10 分)



- (a) How many amino acids are present in this peptide?
- (b) Circle one peptide bond in this peptide.
- (c) Draw a square around one alpha carbon in this peptide.
- (d) The pK_{as} of the ionizable groups in this peptide are 2.0, 4.0, and 9.0. What is the ionic charge of this molecule at pH 1.0?
- (e) What is the name of the N-terminal amino acid in this peptide?

5. The picture below shows the structure of serotonin. (12 分)

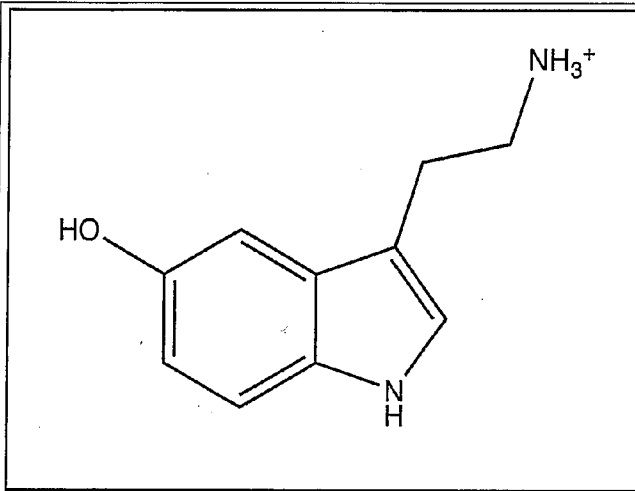
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- (a) From which amino acid is serotonin derived?
- (b) What are the structural differences between serotonin and this amino acid?
- (c) What is the function of serotonin?
- (d) Which illness can be caused by reduced levels of serotonin in the brain?
6. We are able to purify proteins because they differ from each other in various physical or chemical properties. List 5 physicochemical properties of proteins that can be used as basis for their separation. Give a method of separation based on each of these properties (match the method with the property). (10分)
7. Ion exchange chromatography is a commonly used method for separation of biomolecules. (9分)
- (a) What are the two types of ion exchange chromatography?
- (b) In what order would Arg, Val, and Glu elute from a carboxymethyl column at pH 6.0. Carboxymethyl is negatively charged at pH 6.0.
- (c) You are trying to purify a protein using ion exchange chromatography. Unfortunately, your protein remains bound to the ion exchange column or it is eluting very slowly. What are the two changes you can make, to try to elute your protein more quickly from this column?
8. What is the primary physiological function of myoglobin in most mammals? (5分)
9. It appears that the heme group in myoglobin binds the O₂. What is the function of the polypeptide? (8分)
10. The picture below shows a Fischer projection of D-glucose. (10分)

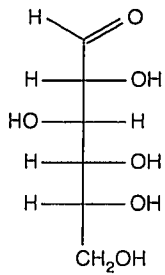
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- (a) Is glucose and aldose or a ketose?
(b) What is the name of the molecule that is formed upon oxidation of the aldehyde to a carboxyl group?
(c) Draw a Fischer projection of D-galactose, which is an epimer of glucose with respect to the C4 position.
(d) Draw a Haworth projection of β -D-glucopyranose.
(e) What is the name of the linear polymer in which glucopyranose residues are linked to each other through $\beta(1\rightarrow4)$ glycosidic bonds.

11. Describe how epinephrine promotes the utilization of stored glycogen for glycolysis and ATP production in muscles. (5 分)

12. Describe the primary, the secondary, the tertiary, and the quaternary structures of proteins. (5 分)

13. Describe the strategy for determining the amino acid sequence of proteins. (6 分)

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一、Single choice (two points for each question)

01. In an analysis of the nucleotide composition of DNA, which of the following will be found?
- A. $A = C$
 - B. $G = T$
 - C. $A = G$ and $C = T$
 - D. $A + C = G + T$
 - E. $G + C = T + A$
02. To repair a thymine dimer by nucleotide excision repair, in which order do the necessary enzymes act?
- A. Exonuclease, DNA polymerase III, RNA primase
 - B. Helicase, DNA polymerase I, DNA ligase
 - C. DNA ligase, nuclease, helicase
 - D. DNA polymerase I, DNA polymerase III, DNA ligase
 - E. Endonuclease, DNA polymerase I, DNA ligase
03. The role of a metabolite that controls a repressible operon is to
- A. bind to the promoter region and decrease its affinity for RNA polymerase
 - B. bind to the operator region and block the attachment of RNA polymerase
 - C. increase the production of inactive repressor proteins
 - D. bind to the repressor protein and inactivate it
 - E. bind to the repressor protein and activate it
04. If you were to observe the activity of methylated DNA, you would expect it to
- A. be replicating nearly continuously
 - B. be unwinding in preparation for protein synthesis
 - C. have turned off or slowed down the process of transcription
 - D. be very actively transcribed and translated
 - E. induce protein synthesis by not allowing repressors to bind to it
05. Yeast artificial chromosomes contain which of the following elements?
- A. centromere only
 - B. telomeres only
 - C. origin of replication only
 - D. centromeres and telomeres only
 - E. centromere, telomeres, and an origin of replication

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06. RFLP analysis can be used to distinguish between alleles based on differences in which of the following?
- A. restriction enzyme recognition sites between the alleles
 - B. the amount of DNA amplified from the alleles during PCR
 - C. the ability of the alleles to be replicated in bacterial cells
 - D. the proteins expressed from the alleles
 - E. the ability of nucleic acid probes to hybridize to the alleles
07. Which of the following describes peristalsis in the digestive system?
- A. a process of fat emulsification in the small intestine
 - B. voluntary control of the rectal sphincters regulating defecation
 - C. the transport of nutrients to the liver through the hepatic portal vessel
 - D. a common cause of loss of appetite, fatigue, and dehydration
 - E. smooth muscle contractions that move food through the alimentary canal
08. Most nutrients absorbed into the lymph or bloodstream are in which form?
- A. disaccharides
 - B. polymers
 - C. monomers
 - D. enzymes
 - E. peptides
09. Which of the following hormone actions will occur when more energy is required by a human?
- A. Blood insulin increases
 - B. Blood glucagon increases
 - C. Both insulin and glucagon increase
 - D. Both insulin and glucagon decrease
 - E. Thyroid hormone is increased
10. Which of the following are the only vertebrates in which blood flows directly from respiratory organs to body tissues without first returning to the heart?
- A. amphibians
 - B. birds
 - C. fishes
 - D. mammals
 - E. reptiles

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11. To adjust blood pressure independently in the capillaries of the gas-exchange surface and in the capillaries of the general body circulation, an organism would need a(n)
- A. open circulatory system
 - B. hemocoel
 - C. lymphatic system
 - D. two-chambered heart
 - E. four-chambered heart
12. Only certain cells in the body are target cells for the steroid hormone aldosterone. Which of the following is the best explanation for why these are the only cells that respond to this hormone?
- A. Only target cells are exposed to aldosterone
 - B. Only target cells contain receptors for aldosterone
 - C. Aldosterone is unable to enter nontarget cells
 - D. Nontarget cells destroy aldosterone before it can produce its effect
 - E. Nontarget cells convert aldosterone to a hormone to which they do respond
13. If a person drinks a large amount of water in a short period of time, he or she may die from water toxicity. ADH can help prevent water retention through interaction with target cells in the
- A. anterior pituitary
 - B. posterior pituitary
 - C. adrenal gland
 - D. bladder
 - E. kidney
14. Neurotransmitters are released from axon terminals via
- A. osmosis
 - B. active transport
 - C. diffusion
 - D. transcytosis
 - E. exocytosis
15. If a stimulus is to be perceived by the nervous system, which part of the sensory pathway must occur first?
- A. integration
 - B. transmission
 - C. transduction
 - D. reception
 - E. amplification

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16. What is a muscle spindle?

- A. an actin-myosin complex
- B. a troponin-tropomyosin complex
- C. axons wound around muscle fibers
- D. groups of dendrite-encircled muscle fibers
- E. muscle cells that make up muscle groups

17. What is the primary function of the Calvin cycle?

- A. use ATP to release carbon dioxide
- B. use NADPH to release carbon dioxide
- C. split water and release oxygen
- D. transport RuBP out of the chloroplast
- E. synthesize simple sugars from carbon dioxide

18. The polarity of a plant is established when

- A. the zygote divides
- B. cotyledons form at the shoot end of the embryo
- C. the shoot-root axis is established in the embryo
- D. the primary root breaks through the seed coat
- E. the shoot first breaks through the soil into the light as the seed germinates

19. According to the ABC model of floral development, which genes would be expressed in a flower with multiple sepals and petals but no stamens or carpels?

- A. A genes only
- B. B genes only
- C. C genes only
- D. A and B genes only
- E. A and C genes only

20. Which of the following is derived from the ground tissue system?

- A. root hairs
- B. cuticle
- C. periderm
- D. pith
- E. phloem

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21. Transpiration in plants requires all of the following except
- A. adhesion of water molecules to cellulose
 - B. cohesion between water molecules
 - C. evaporation of water molecules
 - D. active transport through xylem cells
 - E. transport through tracheids
22. The opening of stomata is thought to involve
- A. an increase in the osmotic concentration of the guard cells
 - B. a decrease in the osmotic concentration of the stoma
 - C. active transport of water out of the guard cells
 - D. decreased turgor pressure in guard cells
 - E. movement of K^+ from the guard cells
23. Which of the following is not a function of rhizobacteria?
- A. To produce hormones that stimulate plant growth
 - B. To produce antibiotics that protect roots from disease
 - C. To absorb toxic metals
 - D. To carry out nitrogen fixation
 - E. To supply growing roots with glucose
24. Plants growing in a partially dark environment will grow toward light in a response called phototropism. Choose the incorrect statement regarding phototropism.
- A. It is caused by a chemical signal
 - B. One chemical involved is auxin
 - C. Auxin causes a growth increase on one side of the stem
 - D. Auxin causes a decrease in growth on the side of the stem exposed to light
 - E. Removing the apical meristem prevents phototropism
25. A flash of red light followed by a flash of far-red light given during the middle of the night to a short-day plant will likely
- A. cause increased flower production
 - B. have no effect upon flowering
 - C. inhibit flowering
 - D. stimulate flowering
 - E. convert florigen to the active form

二、非選擇題(每一題各 5 分)

26. 請以天擇的模式說明細菌的抗藥性可能如何演化？
27. 為何現代的系統分類學者追求每一個分類群的單系(monophyly)？

背面有題

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28. 請以生理學的觀點說明為何飯後運動無助肌肉增長？
29. 請就族群遺傳學的觀點說明，野生物種是如何被馴化成多個人工品系？
30. 請問開放式循環這個特質是否限制陸生動物體型的演化？為什麼？