# 臺灣綜合大學系統115學年度學士班轉學生聯合招生考試試題

| 科目名稱 | 生物化學 | 類組代碼 | C07 |
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| | | 科目碼 | C0701 |

※本項考試依簡章規定所有考科均「不可」使用計算機。　　本科試題共計 5 頁

**A. Multiple choice question (50%, 2% each; one correct answer only)**

1. Which of the following carbohydrates is non-reducing due to the absence of a free anomeric carbon?
A) Fructose
B) Glucose
C) Glyceraldehyde
D) Ribose
E) Trehalose

2. Which compound is used as the standard reference for assigning the D or L configuration of carbohydrates?
A) fructose.
B) glucose.
C) sucrose.
D) ribose.
E) glyceraldehyde.

3. Which of the following nucleotide products is not generated during alkaline hydrolysis of RNA?
A) 2' -CMP.
B) 2' ,3' -cGMP.
C) 2' - AMP.
D) 3' ,5' -cAMP.
E) 3' -UMP.

4. According to Chargaff's rules, which relationship is correct for double-stranded DNA?
A) A = G.
B) A = C.
C) A = U.
D) T + C = G + A.
E) T + G = C + A.

5. When 1 mol of fructose 1,6-bisphosphate is converted into 2 mol of pyruvate in glycolysis, what is the total energy yield from this stage?
A) 1 mol of $NAD^+$ and 2 mol of ATP.
B) 1 mol of NADH and 1 mol of ATP.
C) 2 mol of NADH and 4 mol of ATP.
D) 2 mol of NADH and 2 mol of ATP.
E) 2 mol of $NAD^+$ and 4 mol of ATP.

6. Which compound cannot serve as a net source of glucose through gluconeogenesis in mammalian liver?
A) Lysine
B) glutamate
C) alanine
D) pyruvate
E) α-ketoglutarate

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7. Which standard amino acid lacks chirality because its side chain is a hydrogen atom?
A) alanine
B) glycine
C) glutamate
D) lysine
E) proline

8. Which pair of standard amino acids contains sulfur in their side chains?
A) cysteine and serine
B) cysteine and threonine
C) methionine and cysteine
D) methionine and serine
E) threonine and serine

9. Which statement correctly describes the ultraviolet absorption properties of aromatic amino acids?
A) All are strongly hydrophilic.
B) Histidine's ring structure results in its being categorized as aromatic or basic, depending on pH.
C) On a molar basis, tryptophan absorbs more ultraviolet light than tyrosine.
D) The major contribution to the characteristic absorption of light at 280 nm by proteins is the phenylalanine R group.
E) The presence of a ring structure in its R group determines whether or not an amino acid is aromatic.

10. When two amino acids join together and release a molecule of water, the reaction is classified as:
A) cleavage
B) condensation
C) group transfer
D) isomerization
E) oxidation reduction

11. The non-polypeptide component attached to glycoproteins is mainly composed of:
A) carbohydrates
B) flavin nucleotides
C) lipids
D) Metals
E) phosphates

12. Which interaction in proteins is not classified as a weak noncovalent interaction?
A) hydrogen bonds
B) hydrophobic interactions
C) ionic bonds
D) peptide bonds
E) van der Waals forces

13. What important structural property of the peptide bond was demonstrated by Pauling and Corey?
A) Peptide bonds freely rotate at physiological pH.
B) peptide bonds are essentially planar, with no rotation about the C—N axis.
C) peptide bonds in proteins are unusual, and unlike those in small model compounds.
D) peptide bond structure is extraordinarily complex.
E) All proteins have nearly identical primary structures.

 背面有題，請繼續作答。

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14. In hemoglobin, what event promotes the conformational shift from the low-affinity T state to the high-affinity R state?
A) $Fe^{2+}$ binding.
B) heme binding.
C) oxygen binding.
D) subunit association.
E) subunit dissociation.

15. The long coiled-coil tail region of myosin is mainly formed by which type of secondary structure?
A) a β structure.
B) an α helix.
C) the Fab domain.
D) the light chain.
E) the meromyosin domain.

16. Which statement best describes most ligand–protein interactions in biological systems?
A) They are relatively nonspecific.
B) They are relatively rare in biological systems.
C) They are usually irreversible.
D) They are usually transient.
E) They usually result in the inactivation of the proteins.

17. Which pair of amino acid residues is most frequently found in β-turn structures of proteins?
A) Ala and Gly.
B) hydrophobic.
C) Pro and Gly.
D) those with ionized R-groups.
E) two Cys.

18. Which statement correctly describes the function of enzyme catalysts?
A) Their catalytic activity is independent of pH.
B) They are generally equally active on D and L isomers of a given substrate.
C) They can increase the equilibrium constant for a given reaction by a thousand fold or more.
D) They can increase the reaction rate for a given reaction by a thousand fold or more.
E) They must be at the same concentration as their substrate to be effective.

19. In Michaelis–Menten enzyme kinetics, what does the steady-state assumption mean?
A) $K_m = K_s$.
B) the enzyme is regulated.
C) the ES complex is formed and broken down at equivalent rates.
D) the $K_m$ is equivalent to the cellular substrate concentration.
E) the maximum velocity occurs when the enzyme is saturated.

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20. The standard free-energy changes for the reactions below are given.

Phosphocreatine → creatine + Pi $\Delta G'^\circ = -43.0$ kJ/mol

ATP → ADP + Pi $\Delta G'^\circ = -30.5$ kJ/mol

What is the overall $\Delta G'^\circ$ for the following reaction?

Phosphocreatine + ADP → creatine + ATP

A) –73.5 kJ/mol
B) –12.5 kJ/mol
C) +12.5 kJ/mol
D) +73.5 kJ/mol
E) $\Delta G'^\circ$ cannot be calculated without Keq'.

21. The rate of oxidative phosphorylation in mitochondria is controlled primarily by:
A) feedback inhibition by $CO_2$.
B) the availability of NADH from the TCA cycle.
C) the concentration of citrate (or) the glycerol-3-phosphate shuttle.
D) the mass-action ratio of the ATD-ADP system.
E) the presence of thermogenin.

22. The three-dimensional structure of a protein is determined primarily by:
A) electrostatic guidance from nucleic acid structure.
B) how many amino acids are in the protein.
C) hydrophobic interaction with lipids that provide a folding framework.
D) modification during interactions with ribosomes.
E) the sequence of amino acids in the protein.

23. Which of the following is ***not true*** of the reaction producing malonyl-CoA during fatty acid synthesis?
A) It is stimulated by citrate.
B) It requires acyl carrier protein (ACP).
C) It requires $CO_2$ (or bicarbonate).
D) One mole of ATP is converted to ADP + Pi for each malonyl-CoA synthesized.
E) The cofactor is biotin.

24. Which amino acid contributes a nitrogen atom directly to the purine ring during de novo purine biosynthesis?
A) alanine.
B) aspartate.
C) glutamate.
D) leucine.
E) tryptophan

25. Which hormone is secreted by the pancreas in response to elevated blood glucose levels?
A) epinephrine.
B) glucagon.
C) glucose.
D) insulin.
E) trypsin.



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**B. Assay Questions (50%):**

1. Characterize the hydrogen-bonding pattern of (1) an α-helix, and (2) a β-sheet. (6%)
2. Why is carbon monoxide (CO) toxic to aerobic organisms? (4%)
3. (a) What is the effect of pH on the binding of oxygen to hemoglobin (the Bohr Effect)? (3%) (b) Briefly describe the molecular mechanism for this effect. (3%)
4. Describe two different techniques that can transfer a protein to the gas phase and ionize the macromolecule. Both techniques allow the mass spectrometer that can be applied to analyze the molecular weight of proteins. (6%)
5. What structural differences characterize amylose and cellulose? (6%)
6. Often the most powerful inhibitors of an enzyme are those that mimic the transition state of substrate. Why? (6%)
7. Use the Michaelis-Menten equation to demonstrate the following:

   (a) $V_0$ becomes independent of [S] when [S] » $K_m$ (2%)

   (b) The reaction is first order with respect to S when [S] « $K_m$ (2%)

   (c) [S] = $K_m$ when $v_0$ is one–half $V_{max}$ (2%)
8. Explain how each of the following is used in cloning in a plasmid: (a) antibiotic resistance genes (2%); (b) origin of replication (2%); (c) polylinker region. (2%)
9. What is the effect of a cis-form double bond on fatty acid structure? (4%)