

國立中央大學100學年度碩士班考試入學試題卷

所別：生物醫學工程研究所碩士班 乙組(一般生) 科目：生物化學 共 7 頁 第 1 頁

本科考試可使用計算器，廠牌、功能不拘

\*請在試卷答案卷(卡)內作答

I. 單一選擇題(每題2分，共60分)

- Which of the following is the organelle for protein assembling inside eukaryotes?  
(A) Lysosome  
(B) Mitochondrion  
(C) Rough endoplasmic reticulum  
(D) Peroxisome  
(E) Nucleolus
- Which of the following is the major contributor for stabilization of alpha-helix protein structure?  
(A) van der Waals interactions  
(B) Covalent bond  
(C) Ionic interactions  
(D) Hydrogen bond  
(E) Hydrophobic interactions
- Which of the following is correct about the melting temperature ( $T_m$ ) of DNA molecules?  
(A) Molecules contain greater proportion of A•T pairs require higher temperature to denature  
(B) Adding urea can lower the  $T_m$   
(C) The lower ion concentration, the higher  $T_m$   
(D) The lower pH, the higher  $T_m$   
(E) The  $T_m$  of DNA molecule is not related with proportion of A,T,C,G components.
- Which of the following is the pair of start-stop codons ( $5' \rightarrow 3'$ ) carried by messenger RNA?  
(A) AAC-GCU  
(B) GUU-CAA  
(C) AUG-UCA  
(D) CUG-AGG  
(E) AUG-UAA
- Which of the following biological activities is NOT energized by Adenosine triphosphate molecules?  
(A) Translocation of DNA polymerase  
(B) Translocation of RNA polymerase  
(C) Rotation of viral capsid motor leading to DNA packaging  
(D) Movement of Ribosome along mRNA during translation  
(E) Transport of chromosomes during mitosis
- The primary four amino acids for determination of overall charge of a protein are Aspartic acid, Glutamic acid, Lysine, and  
(A) Arginine  
(B) Leucine  
(C) Methionine  
(D) Asparagine  
(E) Serine

參考用

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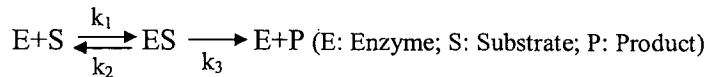
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7. Three codons (5' → 3'): CUA, CUC, & CUU can be recognized by the same tRNA with the anticodon
- (A) 3' GAU 5'
  - (B) 3' GAI 5'
  - (C) 3' AAI 5'
  - (D) 3' GGG 5'
  - (E) 3' GCA 5'

8. Which of following chaperones is an assistant for folding of translocated proteins?
- (A) Hsp70
  - (B) DnaK
  - (C) GroEL
  - (D) BiP
  - (E) Hsp40

9. Which of the following is correct regarding the catalytic reaction



- (A)  $K_m$  (Michaelis constant) is defined as the [S] that yields the maximal reaction rate
  - (B) The smaller value of  $K_m$ , the more avidly an enzyme can bind substrate
  - (C) Generally the intracellular [S] equals 1/2  $K_m$  value of the enzyme to which it binds
  - (D) The maximal velocity of the reaction is mainly dependent on the  $k_1$  and  $k_2$
  - (E) None of the above
10. Which of the following lipids does NOT be synthesized in the endoplasmic reticulum of animal cells?
- (A) Palmitate
  - (B) Phosphatidylserine
  - (C) Plasmalogen
  - (D) Glucosylcerebroside
  - (E) Cholesterol
11. What kind of enzyme is required while processing the rate-controlling step of cholesterol biosynthesis in cytoplasm?
- (A) Transferase
  - (B) Hydrolase
  - (C) Ligase
  - (D) Lyase
  - (E) Reductase
12. Which of the following statements about function of intracellular signaling molecules is NOT true?
- (A) Raising cytosolic  $[Ca^{2+}]$  can induce exocytosis of secretory vesicles in endocrine cells
  - (B) 3', 5'-Cyclic GMP can open cation channels in rod cells
  - (C) 1', 2'-Diacylglycerol can activate protein kinase C
  - (D) Inositol 1,4,5-trisphosphate can open  $K^+$  channels in the endoplasmic reticulum
  - (E) None of the above

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13. In eukaryotes, cells use ATP molecules to power many cellular processes, whereas the ATP syntheses also need energy to be carried out. Which of the following mechanism supplies the driving force to energy-requiring ATP synthesis?
- (A) Chemiosmosis
  - (B)  $\gamma$ -carboxylation
  - (C) Pyruvate dehydrogenase
  - (D) Pyruvate decarboxylase
  - (E) Citric acid cycle
14. For each restriction enzyme, bacteria also produce a modification enzyme to protect their own DNA from cleavage, which works by adding \_\_\_\_\_ to one or two DNA bases within the restriction site.
- (A) Phosphate group
  - (B) Carboxyl group
  - (C) Amino group
  - (D) Methyl group
  - (E) Hydroxyl group
15. At which cycle in polymerase chain reaction, two double-stranded DNA molecules can be first generated that are in equal length to the sequence of the region where we aim to amplify?
- (A) 2
  - (B) 3
  - (C) 4
  - (D) 5
  - (E) 6
16. Which of the following statements about protein-ligand binding is correct?
- (A) The larger the  $K_a$  (association constant), the lower the affinity.
  - (B) The larger the  $K_a$ , the faster is the binding.
  - (C) The larger the  $K_a$ , the smaller the  $K_d$  (dissociation constant).
  - (D) The  $K_a$  is equal to the concentration of ligand when half of the binding sites are occupied.
  - (E) The  $K_a$  is independent of conditions such as salt concentration and pH.
17. Myoglobin and the subunits of hemoglobin have:
- (A) very similar primary and tertiary structures.
  - (B) very similar primary structures, but different tertiary structures.
  - (C) very similar tertiary structures, but different primary structures.
  - (D) very different primary and tertiary structures.
  - (E) no obvious structural relationship.

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18. An allosteric interaction between a ligand and a protein is one in which:
- (A) two different ligands can bind to the same binding site.
  - (B) the binding of the ligand to the protein is covalent.
  - (C) multiple molecules of the same ligand can bind to the same binding site.
  - (D) the binding of a molecule to a binding site affects the binding of an additional molecule to the same site.
  - (E) the binding of a molecule to a binding site affects the binding properties of another site on the protein.
19. Which of the following is not correct concerning 2,3-bisphosphoglycerate (BPG)?
- (A) It increases the affinity of hemoglobin for oxygen.
  - (B) It binds at a distance from the heme groups of hemoglobin.
  - (C) It is normally found associated with the hemoglobin molecules that are extracted from red blood cells.
  - (D) It is an allosteric modulator.
  - (E) It binds with lower affinity to fetal hemoglobin than to adult hemoglobin.
20. The fundamental cause of sickle-cell disease is a change in the structure of:
- (A) red cells.
  - (B) hemoglobin.
  - (C) capillaries.
  - (D) blood.
  - (E) the heart.
21. An individual molecular structure within an antigen to which an individual antibody binds is known as a (n):
- (A) antigen.
  - (B) epitope.
  - (C) MHC site.
  - (D) Fab region
  - (E) Fc region.
22. The proteins of the Major Histocompatibility Complex (MHC) bind and display:
- (A) immunoglobulin fragments.
  - (B) antigen fragments.
  - (C) T cell fragments.
  - (D) B cell fragments.
  - (E) macrophage fragments.

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23. A group of proteins that functions to destroy cells with antibodies bound to them is known as the \_\_\_\_\_ system.
- (A) complement  
(B) humoral  
(C) apoptosis  
(D) interleukin  
(E) cytolysis
24. A monoclonal antibody differs from a polyclonal antibody in that monoclonal antibodies:
- (A) are produced by cells from the same organism that produced the antigen.  
(B) have only a single polypeptide chain that can recognize an antigen.  
(C) are synthesized by a population of identical, or "cloned," cells.  
(D) are labeled with chemicals that can be visualized.  
(E) are synthesized only in living organisms.
25. The average molecular weight of the 20 standard amino acids is 138, but biochemists use 110 when estimating the number of amino acids in a protein of known molecular weight. Why?
- (A) The number 110 takes into account the relatively small size of nonstandard amino acids.  
(B) The number 110 reflects the higher proportion of small amino acids in proteins, as well as the loss of water when the peptide bond forms.  
(C) The number 110 is based on the fact that the average molecular weight of a protein is 10,000 with an average of 1,000 amino acids.  
(D) The number 138 represents the molecular weight of conjugated amino acids.  
(E) The number 110 reflects the number of amino acids found in the typical small protein, and only small proteins have their molecular weight estimated this way.

26. A biochemist purifies a new protein and wishes to learn something about its structure. Treatment of this protein with the reagents listed below gives the indicated results:

Treatment	Number and size of polypeptide chain(s) detected after SDS-gel electrophoresis	
None	One	Mr 60,000
Chymotrypsin	One	Mr 60,000
Performic acid	One	Mr 60,000
Chymotrypsin and Performic acid	One	Mr 30,000; 12,000; 18,000

The protein has:

- (A) one polypeptide chain with at least two disulfide (-S-S-) bonds.  
(B) one polypeptide chain and only one disulfide bond.  
(C) two separate polypeptide chains linked by at least two disulfide bonds.  
(D) three polypeptide chains linked by two or more disulfide bonds.  
(E) three polypeptide chains and no disulfide bonds.

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27. All of the following are considered "weak" interactions in proteins except:
- (A) van der Waals forces.
  - (B) hydrogen bonds.
  - (C) ionic bonds.
  - (D) peptide bonds.
  - (E) hydrophobic interactions.
28. Thr and/or Leu residues tend to disrupt an  $\alpha$  helix when they occur next to each other in a protein because:
- (A) of electrostatic repulsion between the Thr and/or Leu side chains.
  - (B) both amino acids are highly hydrophobic.
  - (C) the R group of neither amino acid can form a hydrogen bond.
  - (D) of steric hindrance between the bulky Thr and/or Leu side chains.
  - (E) of the possible covalent interactions between the Thr and/or Leu side chains.
29. An  $\alpha$  helix would be destabilized most by:
- (A) the presence of an Arg residue near the carboxyl terminus of the  $\alpha$ -helix.
  - (B) the transmission of the electric dipole of several peptide bonds throughout the  $\alpha$  helix.
  - (C) the presence of two Lys residues near the amino terminus of the  $\alpha$  helix.
  - (D) interactions between neighboring Asp and Arg residues.
  - (E) interactions between two adjacent hydrophobic Val residues.
30. A sequence of amino acids in a certain protein is found to be -Ser-Gly-Pro-Gly-. The sequence is most probably part of a(n):
- (A)  $\beta$  turn.
  - (B) parallel  $\beta$  sheet.
  - (C)  $\alpha$  helix.
  - (D)  $\alpha$  sheet.
  - (E) antiparallel  $\beta$  sheet.

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II. 計算題(共 40 分)

1. (10 分) What is the pH of a  $10^{-8}$ M solution of HCl? (Show the answer with three decimal places)
2. (10 分) An enzyme has a  $K_m$  of  $4.7 \times 10^{-5}$ M. If the  $V_{max}$  of the preparation is  $22 \mu\text{moles} \times \text{liter}^{-1} \times \text{min}^{-1}$ , what velocity would be observed in the presence of  $2 \times 10^{-4}$ M substrate and  $5 \times 10^{-4}$ M of (a) a competitive inhibitor, (b) a noncompetitive inhibitor, (c) an uncompetitive inhibitor.  $K_i$  in all three cases is  $3 \times 10^{-4}$ M. (d) What is the degree of inhibition in all three cases?
3. (20 分) Liver alcohol dehydrogenase (ADH is relatively nonspecific and will oxidize ethanol or other alcohols, including methanol. Methanol oxidation yields formaldehyde which is quite toxic. Mistaking it for the cheap wine he usually prefers, my dog Clancy ingested about 50 mL of windshield washer fluid (a solution 50% in methanol). Knowing that methanol would be excreted eventually by Clancy's kidneys if its oxidation could be blocked, and realizing that, in terms of methanol oxidation by ADH, ethanol would act as a competitive inhibitor, I decided to offer Clancy some wine. How much of Clancy's favorite vintage (12% ethanol) must he consume in order to lower the activity of his ADH on methanol to 5% of its normal value if the  $K_M$  values of canine ADH for ethanol and methanol are 1 millimolar and 10 millimolar, respectively? (The  $K_i$  for ethanol in its role as a competitive inhibitor of methanol oxidation by ADH is the same as its  $K_M$ .) Both the methanol and ethanol will quickly distribute throughout Clancy's body fluids, which amount to about 15 L. Assume the densities of 50% methanol and the wine are both 0.9 g/mL.

參考用