國立中央大學101學年度碩士班考試入學試題卷

所別：生命科學系碩士班 分子與環境生物學組(一般生)　科目：生物化學I(含代謝)　共 3 頁 第 1 頁
生命科學系碩士班 分子與環境生物學組(在職生)

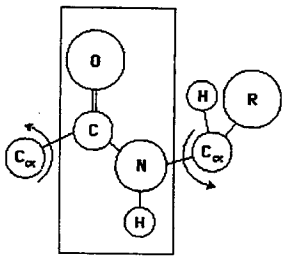
本科考試禁用計算器

＊請在試卷答案卷（卡）內作答

一、選擇題（每題2分，15題，共30分）：

1. Buffers which lack biological activity and have a less tendency to interfere with biochemical reactions include:
(A) Tris (B) Hepes (C) Phosphate (D) Both Tris and Hepes (E) All of these

2. The plane drawn behind the peptide bond shown below indicates that:



(A) region of the peptide bond that contributes to a Ramachandran plot.
(B) plane of rotation around the C_α—N bond.
(C) region of steric hindrance determined by the large C=O group.
(D) absence of rotation around the C—N bond because of its partial double-bond character.
(E) theoretical space between –180 and +180 degrees that can be occupied by the ϕ and ψ angles in the peptide bond.

3. Which of the following is *not* a reducing sugar?
(A) Glyceraldehyde (B) Glucose (C)Fructose (D)Lactose (E)Sucrose

4. Which one of the following statements is *true* of enzyme catalysts?
(A) They lower the activation energy for the conversion of substrate to product.
(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) Their catalytic activity is independent of pH.
(E) To be effective, they must be present at the same concentration as their substrate.

5. Which of the following statements about the light reactions in photosynthetic plants is *not* true?
(A) A membrane-bound ATPase couples ATP synthesis to electron transfer.
(B) No CO_2 is fixed in the light reactions.
(C) The ultimate source of electrons for the process is H_2O.
(D) The ultimate electron acceptor is O_2.
(E) The carbon assimilation ("dark") reactions are driven ultimately by the energy of sunlight.

6. Which of the following statements about sterols is *not* true?
(A) Cholesterol is a sterol that is commonly found in mammals.
(B) Sterols are soluble in water, but less so in organic solvents such as chloroform.
(C) They are more common in plasma membranes than in intracellular membranes.
(D) They are precursors of steroid hormones.
(E) All sterols share a fused-ring structure with four rings.

7. The pK_as of phosphoric acid are 2.1, 6.9, and 12.4. The ionic form that predominates at pH 3.8 is:
(A) H_3PO_4 (B) $H_2PO_4^-$ (C) HPO_4^{2-} (D) PO_4^{3-} (E) None of the above.

8. Which of the following is *not* involved in the process of assisted folding of proteins?
(A) Heat shock proteins (B) Peptide bond hydrolysis (C) Chaperonins (D) Disulfide interchange (E) Peptide bond isomerization

9. NMR and X-ray diffraction are two useful tools of structural biology. Analysis of 2-D NMR data yields a(n)_____; analysis of x-ray diffraction data yields a(n)_____.
(A) 2-D protein structure; 3-D protein structure
(B) shadow of protein's outline; estimate of protein's molecular volume
(C) table of interatomic distances; electron density map
(D) electronic density map; table of interatomic distances
(E) electron density map; count of hydrogen atoms in the molecule

10. Which of the following statements about the chemiosmotic theory is *true*?
(A) Electron transfer in mitochondria is accompanied by an asymmetric release of protons on one side of the inner mitochondrial membrane.
(B) Energy is conserved as a transmembrane pH gradient.
(C) Oxidative phosphorylation cannot occur in membrane-free preparations.
(D) The effect of uncoupling reagents is a consequence of their ability to carry protons through membranes.

注意：背面有試題

(E) All of the above are correct.

11. Which of the following statements about ATP is *not* true?
(A) It is used for short-term energy in the cell.
(B) It has two phosphoanhydride bonds.
(C) The reason for the large -ΔG° values of hydrolysis reactions is due to destabilization of products.
(D) ATP is usually complexed with Mg^{2+}.
(E) despite the very exergonic nature of the hydrolysis, ATP does not hydrolyze spontaneously due to a very high activation energy

12. In one catalytic cycle, the Na^+/K^+ ATPase transporter transports:
(A) 3 Na^+ in, 2 K^+ out, and converts 1 ATP to ADP + P_i.
(B) 3 Na^+ out, 2 K^+ in, and converts 1 ATP to ADP + P_i.
(C) 3 Na^+ out, 2 K^+ in, and converts 1 ADP + P_i to ATP.
(D) 2 Na^+ out, 3 K^+ in, and converts 1 ATP to ADP + P_i.
(E) 2 Na^+ out, 3 K^+ in, and converts 1 ADP + P_i to ATP.

13. Which of the following statements about the pentose phosphate pathway is *not* true?
(A) It generates CO_2 from C-1 of glucose.
(B) It involves the conversion of an aldohexose to an aldopentose.
(C) It is prominent in lactating mammary glands.
(D) It is principally directed toward the generation of NADPH and pentoses for the biosynthesis of fatty acids and nucleic acids.
(E) It requires the participation of molecular oxygen and generates 36 mol of ATP per mole of glucose consumed.

14. Which of the following statements is *not* true?
(A) Under anaerobic conditions, pyruvate does not form because glycolysis does not occur.
(B) Aerobically, oxidative decarboxylation of pyruvate forms acetate that enters the citric acid cycle.
(C) In yeast growing anaerobically, pyruvate is converted to ethanol.
(D) In anaerobic muscle, pyruvate is converted to lactate.
(E) Reduction of pyruvate to lactate regenerates a cofactor essential for glycolysis.

15. The following data were obtained in the experiment of an enzyme known to follow Michaelis-Menten kinetics:

V_0 (μmol/min)	Substrate added (mmol/L)
217	0.9
324	2
435	4
498	6
649	1,000

The K_m for this enzyme is approximately:
(A) 1 mM (B) 2 mM (C) 4 mM (D) 6 mM (E) 1,000 mM

二、配合題（六大題，共 48 分）

1. Match these molecules with their biological roles. **(8 points)**

(a) glycogen	____(1)structural component of plant cell walls
(b) starch	____(2)carbohydrate storage in plants
(c) chitin	____(3)exoskeleton of insects
(d) cellulose	____(4)carbohydrate storage in animal liver
(e) Vitamine A	____(5) mediates pain and inflammation
(f) Vitamine D	____(6) blood clotting
(g) prostaglandins	____(7) Ca^{2+} and phosphate metabolism
(h) thromboxanes	____(8) necessary for vision

2. Match the cofactor with its function in the citric acid cycle. A given function may be used more than once or not at all. **(6 points)**

Cofactor	Function
____ (1) NAD^+/NADH	(a) carries electron
____ (2) Coenzyme A	(b) carries small carbon-containing molecules
____ (3) biotin	(c) carries oxygen
	(d) carries small nitrogen-containing molecules

3. A biochemist is attempting to separate a DNA-binding protein (protein X) from other proteins (protein A, B and C) in a solution. The properties of these proteins are shown below. **(6 points)**

注意：背面有試題

	Molecular weight (Da)	pI (isoelectric point)	Binding to DNA
Protein X	22500	7.6	yes
Protein A	96000	7.3	yes
Protein B	21000	7.9	no
Protein C	24000	4.2	yes

The following chromatographic techniques applied to purify proteins are
(a) ion-exchange chromatography
(b) size-exclusion (gel filtration) chromatography
(c) affinity chromatography by using immobilized DNA

What type of protein separation techniques might be used to purify the protein X?
____ (1) to separate protein X from protein A?　____ (2) to separate protein X from protein B?
____ (3) to separate protein X from protein C?

4. Match the biomolecule with its appropriate function. **(8 points)**

Biomolecule	Function
____ (1) Ubiquitin	(a) membrane proteins that mediate cell adhesion
____ (2) Aquaporins	(b) regulatory subunit of calcium-dependent enzymes
____ (3) Integrins	(c) protein that acts as the "primer" for the initiation of new glycogen molecules
____ (4) Calmodulin	(d) a small polypeptide that is produced in adipocytes and is carried by the blood to the brain
____ (5) Glycogenin	(e) is essential for intracellular transport of fatty acids
____ (6) Leptin	(f) Cyclin-dependent protein kinases can regulate the progression of cells through the cell cycle by phosphorylation of proteins
____ (7) Carnitine	(g) Protein that facilitate the movement of water across membranes
____ (8) Myosin	(h) Protein that tags another protein for proteolysis.

5. There are five different tripeptides shown below. **(10 points)**
(a) Leu-Ala-Phe, (b) Trp-Glu-Tyr, (c) Glu-His-Asp, (d) Tyr-Lys-Met, (e) Gly-Cys-Arg

Which one of the above tripeptides:
____ (1) will have the greatest UV light absorbance at 280 nm?
____ (2) will yield DNP-tyrosine when reacted with l-fluoro-2,4-dinitrobenzene and hydrolyzed in acid.
____ (3) contain the largest number of hydrophobic side chains.
____ (4) contain sulfur atom.
____ (5) is most negatively charged at pH 7.

6. The following reagents are often used in protein chemistry. Match the reagent with the purpose for which it is best suited. **(10 points)**

(a) CNBr (cyanogen bromide)
(b) Edman reagent (phenylisothiocyanate)
(c) Sanger reagent (FDNB, fluorodinitrobenzene)
(d) dithiothreitol
(e) β-mercaptoethanol
(f) chymotrypsin
(g) trypsin
(h) performic acid

____ (1) hydrolysis of peptide bonds on the carboxyl side of Lys and Arg
____ (2) cleavage of peptide bonds on the carboxyl side of Met
____ (3) cleavage of peptide bonds on the carboxyl side of Phe, Tyr and Trp
____ (4) breakage of disulfide (—S—S—) bonds
____ (5) determining the amino-terminal amino acid in a polypeptide

三、簡答題（4 小題，共 22 分）

1. Please list two biological functions of the following biomolecules: (a) proteins, (b) nucleic acids, (c) polysaccharides, (d) lipids. (8 pints)
2. How do a plant adjust the components of its cell membranes to keep them as fluid as possible in a cold winter. (4 points)
3. *E. coli* is known as a gram-negative bacterial species. How to determine this? What is the structural difference between gram-negative bacteria and gram-positive bacteria? (4 points)
4. What are the general effects of epinephrine, glucagon, and insulin on glucose metabolism? (6 points)