

一、選擇題 (34分，每題2分)

1. The outer membrane of the cell wall of gram-negative bacteria contains
 - A. cellulose.
 - B. glycoproteins.
 - C. lipopolysaccharides.
 - D. gangliosides.
 - E. amylose.

2. The glycosaminoglycans are negatively charged at neutral pH. What components of these polymers confer the negative charge?
 - A. Galactose
 - B. Lectin
 - C. Lipid A
 - D. Uronic acid
 - E. None of the above

3. For the following reaction, $\Delta G^{\circ} = +23.8 \text{ kJ/mol}$.
Fructose 1,6-bisphosphate \longrightarrow Dihydroxyacetone phosphate + Glyceraldehyde 3-phosphate
The reaction as written:
 - A. cannot occur because of its large activation energy.
 - B. can never occur in a cell.
 - C. can occur in a cell only if it is coupled to another reaction for which ΔG° is positive.
 - D. may occur in cells at some concentrations of substrate and product.
 - E. none of the above.

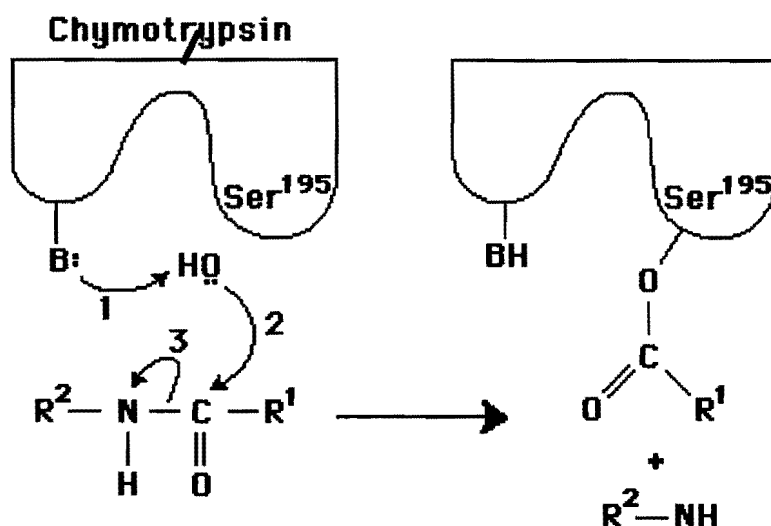
4. Consider the reaction: $A + B \longrightarrow C + D$. If the equilibrium constant (K_{eq}) for this reaction is 10,000, the standard free-energy change (ΔG°) for the reaction would be
 - A. negative.
 - B. positive.
 - C. 0.
 - D. 1.
 - E. none of the above.

(背面仍有題目,請繼續作答)

5. Which of the following enzymes acts in the citric acid cycle?
- A. 6-phosphogluconate dehydrogenase
 - B. Aldolase
 - C. Aconitase
 - D. Phosphofructokinase-1
 - E. Pyruvate kinase
6. In glycolysis, the NADH formed in the glyceraldehyde 3-phosphate dehydrogenase reaction in vigorously contracting muscle must be reoxidized to NAD^+ if glycolysis is to continue. The most important reaction involved in the reoxidation of NADH is:
- A. dihydroxyacetone phosphate \longrightarrow glycerol 3-phosphate
 - B. pyruvate \longrightarrow lactate
 - C. glucose 6-phosphate \longrightarrow fructose 6-phosphate
 - D. isocitrate \longrightarrow α -ketoglutarate
 - E. oxaloacetate \longrightarrow malate
7. Which of the following substrates *cannot* contribute to net gluconeogenesis in mammalian liver?
- A. Lactate
 - B. Glycerol
 - C. Acetate
 - D. Oxaloacetate
 - E. Succinate
8. The biological function of the pentose phosphate pathway is to
- A. act as a source of ADP biosynthesis.
 - B. supply energy.
 - C. supply NADH.
 - D. supply pentoses and NADPH.
 - E. None of the above.
9. Which of the following cofactors are required in the conversion of pyruvate to acetyl-CoA?
- A. NAD^+ , biotin, and thiamine pyrophosphate (TPP)
 - B. NAD^+ , lipoic acid, and TPP
 - C. Biotin, FAD, and TPP
 - D. Biotin, NAD^+ , and FAD
 - E. None of the above

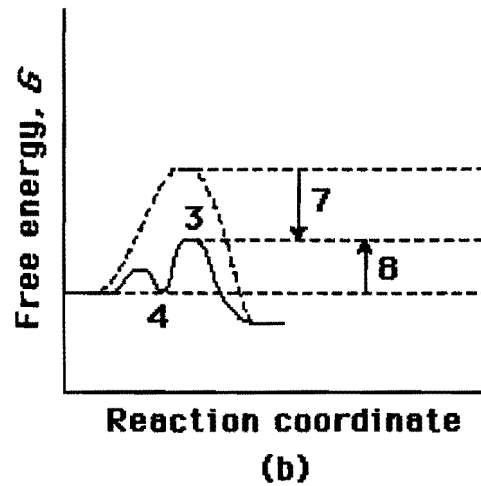
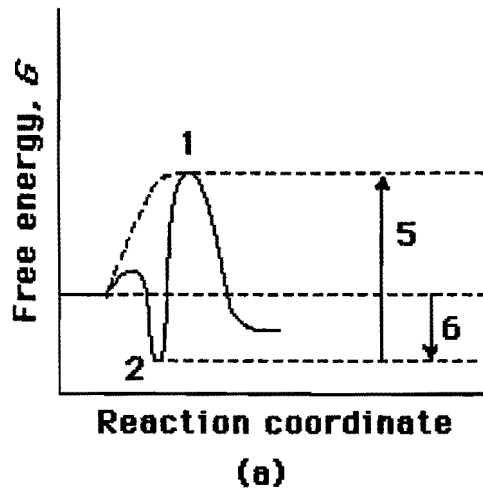
10. Glycogen phosphorylase in muscle catalyzes
- A. phosphorolytic cleavage of the terminal residue at the nonreducing ends of glycogen, producing glucose 1-phosphate.
 - B. phosphorolytic cleavage of the terminal residue at the reducing ends of glycogen, producing glucose 1-phosphate.
 - C. hydrolytic cleavage of the terminal residue at the nonreducing ends of glycogen, producing glucose 1-phosphate.
 - D. phosphorolytic cleavage of the $\alpha(1 \rightarrow 6)$ branch points.
 - E. none of the above.
11. Glycogen phosphorylase α can be allosterically inhibited by:
- A. glucagon.
 - B. AMP.
 - C. calcium.
 - D. glucose.
 - E. GDP.
12. Which of the following statements correctly describes the mode of action of the inhibitors of mitochondrial aerobic phosphorylation?
- A. Cyanide and 2,4-dinitrophenol inhibit the respiratory chain, and oligomycin inhibits the synthesis of ATP.
 - B. Oligomycin and 2,4-dinitrophenol inhibit the synthesis of ATP, whereas cyanide inhibits the respiratory chain.
 - C. Cyanide, oligomycin, and 2,4-dinitrophenol uncouple oxidative phosphorylation.
 - D. Oligomycin and cyanide inhibit synthesis of ATP, whereas 2,4-dinitrophenol inhibits the respiratory chain.
 - E. None of the above.
13. Myoglobin and the subunits of hemoglobin have:
- A. no obvious structural relationship.
 - B. very different primary and tertiary structures.
 - C. very similar primary and tertiary structures.
 - D. very similar primary structures, but different tertiary structures.
 - E. very similar tertiary structures, but different primary structures.

14. In the following diagram of the first step in the reaction catalyzed by the protease chymotrypsin, the process of general base catalysis is illustrated by the number _____, and the process of covalent catalysis is illustrated by the number _____.



- A. 1; 2
 B. 1; 3
 C. 2; 3
 D. 2; 3
 E. 3; 2
15. An allosteric interaction between a ligand and a protein is one in which:
- A. binding of a molecule to a binding site affects binding properties of another site on the protein.
 B. binding of the ligand to the protein is covalent.
 C. multiple molecules of the same ligand can bind to the same binding site.
 D. binding of a molecule to a binding site affects binding of additional molecules to the same site.
 E. two different ligands can bind to the same binding site.
16. An enzyme-catalyzed reaction was carried out with the substrate concentration initially a thousand times greater than the K_m for that substrate. After 9 minutes, 1% of the substrate had been converted to product, and the amount of product formed in the reaction mixture was 12 μmol . If, in a separate experiment, one-third as much enzyme and twice as much substrate had been combined, how long would it take for the same amount (12 μmol) of product to be formed?
- A. 1.5 min
 B. 13.5 min
 C. 27 min
 D. 3 min
 E. 6 min

17. Compare the two reaction coordinate diagrams below and select the answer that correctly describes their relationship. In each case, the single intermediate is the ES complex.



- A. (a) describes a strict “lock and key” model, whereas (b) describes a transition-state complementarity model.
- B. The activation energy for the *catalyzed* reaction is #5 in (a) and is #7 in (b).
- C. The activation energy for the *uncatalyzed* reaction is given by #5 + #6 in (a) and by #7 + #4 in (b).
- D. The contribution of binding energy is given by #5 in (a) and by #7 in (b).
- E. The ES complex is given by #2 in (a) and #3 in (b).

二、簡答與問答題 (66 分)

Question 18-22. Please write down the key words best defined by each description of the followings:

Note: Don't exceed three words in each description!

18. The randomness or disorder of the components of a chemical system (3%)
19. A type of macromolecules combining with lipids to form several classes of lipoprotein particles, spherical complexes with hydrophobic lipids in the core and hydrophilic amino acid side chains at the surface. (3%)
20. The type of processing reactions altering some newly made proteins, both prokaryotic and eukaryotic, to attain their final biologically active conformations. (3%)
21. The effect of pH and CO₂ concentration on the binding and release of oxygen by hemoglobin (3%)
22. A sensitive diagnostic biochemical measurement on blood and urine samples is essential in the diagnosis and treatment of diabetes. For example, the patient fasts overnight, then drinks a test dose of 100 g of glucose dissolved in a glass of water. The blood glucose concentration is measured before the test dose and at 30 min intervals for several hours thereafter. (3%)

(背面仍有題目,請繼續作答)

23. Describe five possible fates for fatty acids in the liver. (10%; 2% each)
24. Proteins in a family of ligand-activated transcription factor, the peroxisome proliferator-activated receptors (PPARs), respond to changes in dietary lipid by altering the expression of gene involved in fat metabolism. Please describe the (1) members of PPARs (5%) (2) mode of action of PPARs (5%), and (3) metabolic integration by these PPARs (6%), in detail.
25. A 20-year-old man suffering from Lesch-Nyhan syndrome and multiple myeloma signed an informed consent to donate his blood to a research institute. However, when a laboratory technician tried to isolate myeloma cells from this patient's peripheral blood, he mixed up the cells with a previously established myeloma cell line obtained from another patient who was not a Lesch-Nyhan syndrome patient.
- (a) If you are the technician, how do you remove the contaminated cells and establish the new patient's myeloma cell line? (5%)
- (b) If the new myeloma cell line is successfully established, what are the potential applications in biomedicine? (please describe in detail) (10%)
26. A retrovirus has been genetically modified to carry herpes simplex virus thymidine kinase gene.
- (a) How can you verify such recombinant retrovirus by both biochemical and molecular approaches? (5%)
- (b) What are the biomedical applications of this recombinant retrovirus? (5%)