

國立臺北科技大學 101 學年度碩士班招生考試

系所組別：3713 有機高分子研究所甲組

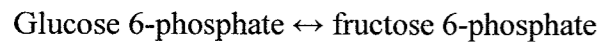
第二節 生物化學 試題 (選考)

第一頁 共四頁

注意事項：

1. 試題 1~25 共 25 題，配分共 50 分。
2. 試題 26 共 1 題，配分共 10 分。
3. 試題 27~34 共 8 題，配分共 40 分。
4. 請標明大題、子題編號作答，不必抄題。
5. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. When a mixture of glucose 6-phosphate and fructose 6-phosphate is incubated with the enzyme phosphohexose isomerase, the final mixture contains twice as much glucose 6-phosphate as fructose 6-phosphate. Which one of the following statements is most nearly correct, when applied to the reaction below? ($R = 8.315 \text{ J/mol}\cdot\text{K}$ and $T = 298 \text{ K}$, $\ln 0.5 = -0.693$)



- A) ΔG° is $+1.7 \text{ kJ/mol}$.
B) ΔG° is -1.7 kJ/mol .
C) ΔG° is incalculably large and negative.
D) ΔG° is incalculably large and positive.
E) ΔG° is zero.
2. Which of the following best represents the backbone arrangement of two peptide bonds?
- A) $\text{C}_\alpha\text{—N—C}_\alpha\text{—C—C}_\alpha\text{—N—C}_\alpha\text{—C}$
B) $\text{C}_\alpha\text{—N—C—C—N—C}_\alpha$
C) $\text{C}_\alpha\text{—C—N—C}_\alpha\text{—C—N}$
D) $\text{C—N—C}_\alpha\text{—C}_\alpha\text{—C—N}$
E) $\text{C}_\alpha\text{—C}_\alpha\text{—C—N—C}_\alpha\text{—C}_\alpha\text{—C}$
3. Compounds that generate nitrous acid (such as nitrites, nitrates, and nitrosamines) change DNA molecules by:
- A) breakage of phosphodiester bonds.
B) deamination of bases.
C) depurination.
D) formation of thymine dimers.
E) transformation of A \rightarrow T.

4. Which of the following deoxyoligonucleotides will hybridize with a DNA containing the sequence (5')AGACTGGTC(3')?
- A) (5')CTCATTGAG(3')
B) (5')GACCAGTCT(3')
C) (5')GAGTCAACT(3')
D) (5')TCTGACCAG(3')
E) (5')TCTGGATCT(3')
5. In a highly basic solution, pH = 13, the dominant form of glycine is:
- A) $\text{NH}_2\text{—CH}_2\text{—COOH}$.
B) $\text{NH}_2\text{—CH}_2\text{—COO}^-$.
C) $\text{NH}_2\text{—CH}_3^+\text{—COO}^-$.
D) $\text{NH}_3^+\text{—CH}_2\text{—COOH}$.
E) $\text{NH}_3^+\text{—CH}_2\text{—COO}^-$.
6. Enzymes are biological catalysts that enhance the rate of a reaction by:
- A) decreasing the activation energy.
B) decreasing the amount of free energy released.
C) increasing the activation energy.
D) increasing the amount of free energy released.
E) increasing the energy of the transition state.
7. Which one of the following is not among the six internationally accepted classes of enzymes?
- A) Hydrolases
B) Ligases
C) Polymerases
D) Oxidoreductases
E) Transferases
8. Kendrew's studies of the globular myoglobin structure demonstrated that:
- A) "corners" between α -helical regions invariably lacked proline residue.
B) highly polar or charged amino acid residues tended to be located interiorly.
C) myoglobin was completely different from hemoglobin, as expected.
D) the structure was very compact, with virtually no internal space available for water.
E) the α helix predicted by Pauling and Corey was not found in myoglobin.
9. 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.

注意：背面尚有試題

10. D-Glucose is called a reducing sugar because it undergoes an oxidation-reduction reaction at the anomeric carbon. One of the products of this reaction is:
- D-galactose.
 - D-gluconate.
 - D-glucuronate.
 - D-ribose.
 - muramic acid.
11. Restriction enzymes:
- act at the membrane to restrict the passage of certain molecules into the cell.
 - are highly specialized ribonucleases that degrade mRNA soon after its synthesis.
 - are sequence-specific DNA endonucleases.
 - are very specific proteases that cleave peptides at only certain sequences.
 - catalyze the addition of a certain amino acid to a specific tRNA.
12. Which of the following statements about gluconeogenesis in animal cells is true?
- A rise in the cellular level of fructose-2,6-bisphosphate stimulates the rate of gluconeogenesis.
 - An animal fed a large excess of fat in the diet will convert any fat not needed for energy production into glycogen to be stored for later use.
 - The conversion of fructose 1,6-bisphosphate to fructose 6-phosphate is *not* catalyzed by phosphofructokinase-1, the enzyme involved in glycolysis.
 - The conversion of glucose 6-phosphate to glucose is catalyzed by hexokinase, the same enzyme involved in glycolysis.
 - The conversion of phosphoenol pyruvate to 2-phosphoglycerate occurs in two steps, including a carboxylation.
13. The amino acid substitution of Val for Glu in Hemoglobin S results in aggregation of the protein because of _____ interactions between molecules.
- covalent
 - disulfide
 - hydrogen bonding
 - hydrophobic
 - ionic
14. Saturated fatty acids are degraded by the stepwise reactions of β oxidation, producing acetyl-CoA. Under aerobic conditions, how many ATP molecules would be produced as a consequence of removal of each acetyl-CoA?
- 2
 - 3
 - 4
 - 5
 - 6
15. The PCR reaction mixture does *not* include:
- all four deoxynucleoside triphosphates.
 - DNA containing the sequence to be amplified.
 - DNA ligase.
 - heat-stable DNA polymerase.
 - oligonucleotide primer(s).
16. Almost all of the oxygen (O_2) one consumes in breathing is converted to:
- acetyl-CoA.
 - carbon dioxide (CO_2).
 - carbon monoxide and then to carbon dioxide.
 - none of the above.
 - water.
17. Which of the following statements about sterols is true?
- The principal sterol of animal cells is ergosterol.
 - Sterols are found in the membranes of all living cells.
 - Sterols are soluble in water, but less so in organic solvents such as chloroform.
 - Stigmasterol is the principal sterol in fungi.
 - All sterols share a fused-ring structure with four rings.
18. For amino acids with neutral R groups, at any pH below the pI of the amino acid, the population of amino acids in solution will have:
- a net negative charge.
 - a net positive charge.
 - no charged groups.
 - no net charge.
 - positive and negative charges in equal concentration.
19. In the laboratory, recombinant plasmids are commonly introduced into bacterial cells by:
- electrophoresis – a gentle low-voltage gradient draws the DNA into the cell.
 - infection with a bacteriophage that carries the plasmid.
 - microinjection.
 - mixing plasmids with an extract of broken cells.
 - transformation – heat shock of the cells incubated with plasmid DNA in the presence of $CaCl_2$.
20. The conversion of glutamate to an α -ketoacid and NH_4^+ :
- does not require any cofactors.
 - is a reductive deamination.
 - is accompanied by ATP hydrolysis catalyzed by the same enzyme.
 - is catalyzed by glutamate dehydrogenase.
 - requires ATP.

21. Which of these is a general feature of the lipid bilayer in all biological membranes?
- Individual lipid molecules are free to diffuse laterally in the surface of the bilayer.
 - Individual lipid molecules in one face (monolayer) of the bilayer readily diffuse (flip-flop) to the other monolayer.
 - Polar, but uncharged, compounds readily diffuse across the bilayer.
 - The bilayer is stabilized by covalent bonds between neighboring phospholipid molecules.
 - The polar head groups face inward toward the inside of the bilayer.
22. Which of the following is a dominant feature of the outer membrane of the cell wall of gram-negative bacteria?
- Amylose
 - Cellulose
 - Glycoproteins
 - Lipopolysaccharides
 - Lipoproteins
23. Humans maintain a nearly constant level of hemoglobin by continually synthesizing and degrading it. This is an example of a(n):
- dynamic steady state.
 - equilibrium state.
 - exergonic change.
 - free-energy change.
 - waste of energy.
24. Which of these amino acids can be directly converted into a citric acid cycle intermediate by transamination?
- glutamic acid
 - serine
 - threonine
 - tyrosine
 - proline
25. Compare the following sequences taken from four different proteins, and select the answer that best characterizes their relationships.
- | | A | B | C |
|---|----------------|------------------|------------------|
| 1 | DVEKGGKIDIMKCS | HTVEKGGKHKTGPNLH | GLFGRKTGQAPGYSYT |
| 2 | DVQRALKIDNNLGQ | HTVEKGAKHKTAPNVH | GLADRIAYQAKATNEE |
| 3 | LVTRPLYIFPNEGQ | HTLEKAAKHKTGPNLH | ALKSSKDLMFTVINDD |
| 4 | FFMNEDALVARSSN | HQFAASSIHKNAQFH | NLKDSKTYLKPVISET |
- Based only on sequences in column B, protein 4 reveals the greatest evolutionary divergence.
 - Comparing proteins 1 and 2 in column A reveals that these two proteins have diverged the most throughout evolution.

- Protein 4 is the protein that shows the greatest overall homology to protein 1.
- Proteins 2 and 3 show a greater evolutionary distance than proteins 1 and 4.
- The portions of amino acid sequence shown suggest that these proteins are completely unrelated.

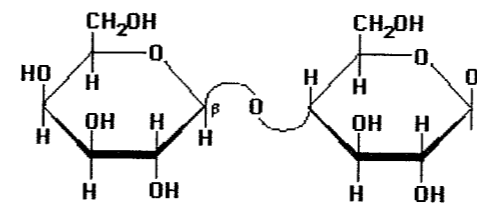
26. Match these molecules with their biological roles.

- (a) glycogen (b) starch (c) trehalose (d) chitin (e) cellulose (f) peptidoglycan
(g) hyaluronate (h) proteoglycan (i) Mass spectrometry (j) SDS (sodium dodecyl sulfate)
- ___ viscosity, lubrication of extracellular secretions
___ carbohydrate storage in plants
___ transport/storage in insects
___ exoskeleton of insects
___ structural component of bacterial cell wall
___ structural component of plant cell walls
___ extracellular matrix of animal tissues
___ carbohydrate storage in animal liver
___ determine protein molecular weight
___ separate proteins exclusively on the basis of molecular weight

27. Proteins are constantly being synthesized in a living cell. Why doesn't the number of protein molecules become too great for the cell to contain, leading to cell destruction?

28. Describe the concept of "induced fit" in ligand-protein binding.

29. In the following structure:



- How many of the monosaccharide units are furanoses and how many are pyranoses?
- What is the linkage between the two monosaccharide units?
- Is this a reducing sugar? Explain.

30. How are a nucleoside and a nucleotide similar and how are they different?

31. The citric acid cycle is frequently described as the major pathway of aerobic catabolism, which means that it is an oxygen-dependent degradative process. However, none of the reactions of the cycle directly involves oxygen as a reactant. Why is the pathway oxygen-dependent?

32. Why are glycine and proline often found within a β turn?

33. Fifteen μg of an enzyme of M_r 30,000 working at V_{\max} catalyzes the conversion of 60 μmol of substrate into product in 3 min. What is the enzyme's turnover number?

34. Describe two major differences between chemical synthesis of polypeptides and synthesis of polypeptides in the living cell.