

九十三學年度 生科院甲組、乙組、生科院（結構生物學程）甲組 碩士班入學考試

科目 生物化學 科號 0801、0901、1101 共 6 頁第 1 頁 *請在試卷【答案卷】內作答

請將選擇題的答案劃在答案卡上。問答題則請用答案卷作答。

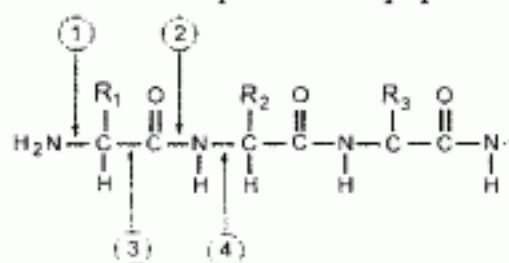
I. 選擇題（每題 1.5 分，共 75 分。每題只有一個正確答案，答錯不倒扣）

1. General Chemistry. In a cationic exchange column chromatography, the stationary phase is sulfonate polystyrene micro beads. Which description is correct? (A) Positively charged amino acid eluted first. (B) Positively charged amino acid eluted last. (C) Neutrally charged amino acid eluted first. (D) Neutrally charged amino acid eluted last. (E) None of the above.
2. General Chemistry. During protein folding process from random coil to natural form. (A) $\Delta G < 0$, $\Delta H < 0$, $\Delta S < 0$. (B) $\Delta G = 0$, $\Delta H = 0$, $\Delta S = 0$. (C) $\Delta G > 0$, $\Delta H > 0$, $\Delta S > 0$. (D) $\Delta G < 0$, $\Delta H > 0$, $\Delta S < 0$. (E) None of the above.
3. General Chemistry. L-ascorbic acid (Vitamin C). The prefix "L-" indicates (A) Optical rotation and "L-" means "left." (B) Optical rotation, but "L-" does not mean "left." (C) Absolute configuration, irrelevant of optical property. (D) Absolute conformation, irrelevant of optical property. (E) None of the above.
4. General Chemistry. Mercaptoethanol (ME) is often added to a biological solution to (A) Induce a reduction reaction of substrate. (B) Induce an oxidation reaction of substrate. (C) Kill Gram-positive bacteria in solution. (D) Kill Gram-negative bacteria in solution. (E) Denature DNA and RNA in solution.
5. General Chemistry. Nitric oxide (NO^\bullet) is synthesized by NO synthase (NOS) *in vivo*. NOS is a multi-complex protein. Based on the chemical properties of NO^\bullet , which of the following predictions about NOS can be ruled out first: (A) Has an ATP binding domain. (B) Has a GTP binding domain. (C) Has a heme binding domain. (D) Has a citrulline binding domain (E) Has an arginine binding domain.
6. DNA structure. Predict that DNA molecules in chromosomes are packed as (A) Most likely B-form. (B) Very unlikely B-form. (C) B-form is major and Z-form is minor. (D) A-, B-, and Z-forms mixed randomly in chromosomes. (E) Z-form major, B-form minor.
7. Circular dichroism (CD) is most sensitive for (A) α helical conformation of protein. (B) β sheet of protein. (C) Left-handed DNA. (D) Right-handed DNA. (E) Single-stranded RNA.
8. Fluorescence. Which description about fluorescence is correct? (A) Excitation at shorter wavelength; emission at longer wavelength. (B) Excitation at longer wavelength; emission at shorter wavelength. (C) Excitation wavelength equals emission wavelength. (D) Sometimes excitation wavelength is longer than emission wavelength. (E) Sometimes excitation wavelength is shorter than emission wavelength.
9. NMR. Which description about NMR is incorrect? (A) NMR can be used to study protein sequence and conformation. (B) COSY is for through bond interaction; NOESY is for through space interaction. (C) Exchangeable amide protons give sharp resonance absorption. (D) Hydrogen-bonded protons are in the downfield region. (E) Hydrides are in the upfield region.

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10. UV-VIS. Which description about UV-VIS is **incorrect**? (A) From 200 to 350 nm is UV. (B) From 350 to 700 nm is VIS. (C) UV requires π electrons. (D) UV and VIS requires a time change of dipole moment. (E) Gas phase UV-VIS spectrum is identical to solution UV-VIS spectrum.
11. All of the following are functions of the citrate acid cycle EXCEPT
(A) the generation of NADH and reduced flavins. (B) the formation of α -ketoglutarate needed for transamination. (C) the oxidation of acetyl-CoA produced primarily by glycolysis and the oxidation of fatty acids. (D) the net synthesis of oxaloacetate from acetyl-CoA. (E) the formation of GTP from GDP.
12. Which vitamins participate in the reactions of the citrate acid cycle?
(A) riboflavin and niacin (B) pyridoxine and thiamine (C) niacin and ascorbic acid (D) pantothenic acid and folic acid (E) thiamine and biotin.
13. The following molecules, without further metabolism, can cross the inner membrane of mitochondria EXCEPT (A) oxygen (B) inorganic phosphate (C) acetyl CoA (D) pyruvate (E) ATP
14. Which site is most important for fatty acid biosynthesis?
(A) adipose tissue--endoplasmic reticulum (B) brain--lysosomes (C) heart--mitochondria (D) intestine--Golgi apparatus (E) liver--cytoplasm
15. Oxidation of one molecule of pyruvate by the combined action of pyruvate dehydrogenase complex and citric acid cycle can generate how many pairs of electrons which can transfer through the electron transport system?
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7
16. Cyanide is poisonous because it (A) binds to hemoglobin. (B) interferes with respiratory control. (C) forms addition compounds with important aldehydes such as pyridoxal. (D) reacts with cytochrome oxidase. (E) inhibits cytochrome P-450 monooxygenases.
17. Which of the following tissues has the lowest respiratory rate?
(A) red blood cell (B) brain (C) liver (D) adipose tissue (E) skeletal muscle
18. The order in which the following cofactors are used in the pyruvate dehydrogenase complex is
1. thiamine pyrophosphate; 2. lipoic acid; 3. CoA; 4. FAD; 5. NAD⁺
(A) 1,2,3,4,5 (B) 1,2,3,5,4 (C) 1,3,2,4,5 (D) 5,1,2,3,4 (E) 4,1,2,5,3
19. Which arrow points to a peptide bond?



- (A) 1 (B) 2 (C) 3 (D) 4 (E) none of the above.

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20. Which enzyme is common to both glycolysis and gluconeogenesis?
(A) phosphofructokinase-1 (B) glyceraldehyde 3-phosphate dehydrogenase (C) PEP carboxykinase (D) glucokinase (E) pyruvate carboxylase
21. The pH of blood, normally at 7.4, decreases to 7.0. The proton concentration (A) decreases 2.5 fold. (B) decreases 4 fold. (C) increases 2.5 fold. (D) increases 4 fold. (E) increases 6 fold.
22. During photosynthesis, the conversion of light energy to chemical energy begins when an excited pigment molecule that (A) undergoes fluorescence. (B) loses energy as heat. (C) is transported across a proton channel. (D) increases its molecular motion. (E) undergoes an oxidation reaction.
23. In fructose, a six carbon furanose, the anomeric carbon is (A) C1 (B) C2 (C) C3 (D) C4 (E) C5.
24. Which of the following pH values is the closest to the pI for an amino acid with a $pK_1 = 2.2$, $pK_2 = 10.0$, and $pK_R = 4.4$?
(A) 3.3 (B) 6.1 (C) 7.2 (D) 8.3 (E) none of the above.
25. The following species participate in one electron transfers:
(A) the reaction center of photosystem I. (B) the reaction center of photosystem II. (C) cytochrome c. (D) copper in Complex IV. (E) all of the above.
26. ATP synthesis rate of mitochondria will not be affected by inhibiting (A) Complex I. (B) Complex II. (C) Complex III. (D) Complex IV. (E) none of the above.
27. The number of photons required to synthesize one NADPH in the chloroplast is: (A) 2 (B) 4 (C) 6 (D) 8 (E) 16
28. Upon the addition of 2,4-dinitrophenol (DNP) to a suspension of mitochondria carrying out oxidative phosphorylation, all of the following occur EXCEPT:
(A) the P/O ratio drops from a value of approximately 2.5 to 0. (B) oxidation of NADH increases. (C) the proton gradient dissipates. (D) oxygen consumption decreases. (E) excess heat is generated.
29. Which of the following is true of the compound fructose-2,6-bisphosphate?
(A) It is formed by a phosphorylation of fructose-1,6-bisphosphate. (B) It donates its phosphoryl group to ADP in a substrate-level phosphorylation reaction. (C) Its formation is catalyzed by phosphofructokinase-1. (D) It is an intermediate in glycolysis. (E) It is an allosteric activator of the enzyme that catalyzes the committed step of glycolysis.
30. Ubiquinone can be selectively removed from mitochondria using lipid solvents. Assuming that all else remains the same in the mitochondria, which of the following situations would you expect? (A) No ATP would be able to be made. (B) Complex I could be reduced; all other electron transfer components would remain oxidized. (C) Complexes I and II could be reduced; all other electron transfer components would remain oxidized. (D) Complex I could be oxidized; all other electron transfer components would remain reduced. (E) Complexes I and II could be oxidized; all other electron transfer components would remain reduced.

國立清華大學 命題紙

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31. The reaction of deoxyribonucleotide synthesis is (A) oxidation. (B) phosphorylation. (C) reduction. (D) dephosphorylation. (E) adenylation.
32. Metabolic channeling is (A) when the product of one reaction is the substrate for the next. (B) when metabolites are transferred from one cellular compartment to another. (C) when metabolites are committed to a specific pathway in the reaction catalyzed by a highly regulated enzyme. (D) a cellular system that channels metabolites from one metabolic pathway to another.
33. The regulation of nitrogen fixation involves all the following EXCEPT (A) ADP inhibits the activity of nitrogenase. (B) the nitrogenase reductase undergoes modification by ADP-ribosylation. (C) NADH inhibits the gene expression of the nif cluster of genes. (D) H_2 serves as a competitive inhibitor of nitrogenase.
34. The coenzyme required in the transamination reactions is (A) biotin. (B) pyridoxal phosphate. (C) tetrahydrofolate. (D) vitamin B_{12} .
35. In the urea cycle, the molecule which is synthesized in the cytoplasm and transported to the mitochondrial matrix for subsequent reaction is (A) citrulline. (B) ornithine. (C) argininosuccinate. (D) aspartate.
36. A key intermediate at the branch point in the synthesis of tryptophan, phenylalanine and tyrosine is (A) shikimate. (B) chorismate. (C) phosphoenolpyruvate. (D) ornithine.
37. What molecule is the donor of amino group in the formation of carbamoyl phosphate catalyzed by carbamoyl phosphate synthetase II in mammals? (A) ammonia (B) glycine (C) glutamine (D) aspartate
38. Lesch-Nyhan Syndrome is characterized by a lack of (A) adenosine deaminase. (B) guanylate kinase. (C) adenine phosphoribosyltransferase. (D) hypoxanthine-guanine phosphoribosyltransferase.
39. The initial, common intermediate in purine catabolism for both AMP and GMP is (A) inosine. (B) uric acid. (C) hypoxanthine. (D) xanthine.
40. Fluorouracil is an effective inhibitor of (A) thymidylate synthase. (B) ribonucleotide reductase. (C) xanthine oxidase. (D) carbamoyl phosphate synthetase II.
41. What motor protein generates the sliding of microtubules that leads to bending of cilia? (A) actin (B) myosin (C) dynein (D) kinesin (E) tubulin.
42. Which of the following would indicate that an enzyme is more efficient than a second enzyme? (A) it has a higher V_{max} . (B) it has a higher affinity for substrate. (C) it has a higher turnover number. (D) it has a higher k_{cat}/K_m . (E) it has a lower ΔG for the catalyzed transition state.
43. Which subunit of the following F1 subunits contains a catalytic site that bind ADP and P_i to form ATP: (A) α (B) β (C) γ (D) δ (E) ϵ .
44. Which immunoglobulin is the major antibody of colostrum, the initial milk secretion from a mother's breasts after child birth? (A) IgM (B) IgG (C) IgA (D) IgD (E) IgE
45. On a Lineweaver-Burk plot, which of the following statement is true? (A) The value of the X-intercept is equal to $-1/K_M$. (B) The value of the Y-intercept is equal to $-1/K_M$. (C) The slope is equal to V_{max}/K_M . (D) The value of the X intercept is equal to V_{max} . (E) The value of the Y-intercept of is equal to V_{max} .

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46. Which of the following statements concerning the reaction catalyzed by ATCase is true? (A) One ATP molecule is used in the ATCase reaction. (B) CTP is a feedback activator of ATCase. (C) Aspartate is a positive homotropic effector of ATCase. (D) Adding CTP to the reaction decreases the V_{max} of the ATCase reaction. (E) All of the above are true.
47. The distal histidine of hemoglobin chains: (A) reduces the binding of BPG to hemoglobin. (B) reduces the binding of carbon monoxide to the heme iron. (C) links the beta globin chains to each other. (D) links the alpha globin chains to each other.
48. Enzymes are able to: (A) alter the concentration of products and reactants at reaction equilibrium. (B) bind to and reduce the free energy of the products. (C) bind to and reduce the free energy of the transition state. (D) both a and b.
49. Which end of a microtubule is usually anchored in a microtubule organizing center (MTOC)? (A) plus (B) minus (C) middle (D) all of above.
50. Which of the following describes the initial rate condition for enzyme kinetics? (A) $[E] = [ES] = [EP]$. (B) rate of product formation equals rate of substrate utilization. (C) $[P] = 0$; $[ES]$ is increasing. (D) $[ES] = 0$; $[P]$ is increasing. (E) $[ES]$ is constant and depends of $[S]$.

II. 問答題（共 25 分）

1. Define 'isozyme'. (2%)
2. What is 'prochiral'? (3%)
3. The following questions test your knowledge of general chemistry. (Total 20%)
 - (A) Among the 20 amino acids, which amino acids are capable of undergoing phosphorylation and dephosphorylation reactions? (3%)
 - (B) Only one of these amino acids in (A) is frequently used for *in vivo* reversible phosphorylation and dephosphorylation reaction. Which amino acid is this? Use chemical structure to explain the reason why this particular amino acid is a preferred choice for *in vivo* reversible phosphorylation (3%)
 - (C) Coenzyme A (CoA) has an active sulfhydryl functional group. Write one biological reaction that involves CoA (3%)
 - (D) From the viewpoint of molecular evolution, explain why the biology world uses sulfhydryl group instead of hydroxyl group? (3%)
 - (E) Why do most type II restriction endonucleases form homodimers? (3%)
 - (F) Why are there always two DNA polymerase molecules in the replication fork? (3%)

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- (G) The molecular structure of FADH_2 is shown below. It can release two electrons in an oxidation reaction. Draw the structure in your answer sheet and circle the atom or atoms which donate electrons in a redox reaction. (2 %)

