

九十二學年度 生命科學院研究 系(所) 甲、乙 組碩士班研究生招生考試

科目 生物化學 科號 0801, 0901 共 4 頁第 1 頁 *請在試卷【答案卷】內作答

請將是非題和選擇題的答案畫在答案卡上。問答題則請用答案卷作答。

I. 是非題 (A statement is regarded here as false if any part of it is false. If you believe a statement to be true, mark 'A' in answer sheet; if false, mark 'B'. A positive grade will be given for a correct answer, an equal negative grade for an incorrect answer, and a zero grade for no answer. 每題1分, 共5分)

1. Insulin is secreted in response to low level of glucose.
2. Glucagon and epinephrine have opposing effects on glycogen metabolism.
3. The effects of hormones that regulate glycogen metabolism are mediated by cyclic AMP.
4. Reducing equivalents for ribonucleotide reduction are provided by thioredoxin or glutathione systems.
5. Ribonucleotide reductases employ radical chemistry for biosynthesis of deoxyribonucleotides.

II. 選擇題 - **Part A** (每題 1 分, 共 25 分. 每題只有一個正確答案)

1. Which effector activates glycolysis most effectively in skeletal muscle during exercise? (a) ATP (b) ADP (c) AMP (d) fructose-2,6-bisphosphate.
2. A passive diffusion of molecules down a concentration gradient will usually induce an increase in the (a) enthalpy (b) energy (c) free energy (d) entropy of the system.
3. Which of the following sugars is a pentose? (a) threose (b) xylose (c) erythrose (d) galactose.
4. During SDS polyacrylamide gel electrophoresis, the migration rate of a protein mainly depends on the (a) amino acid composition (b) molecular weight (c) isoelectric point (d) secondary structure.
5. At equilibrium, the most abundant tautomeric form for fructose in water is (a) α -pyranose (b) α -furanose (c) β -pyranose (d) β -furanose.
6. Suppose the pH of solution A is 8.3, and that of solution B is 2.4. What is the ratio of hydrogen ion concentrations, $[H^+]_{\text{Sol A}} / [H^+]_{\text{Sol B}}$? (a) 8.4/2.4 (b) 2.4/8.4 (c) 10^{-6} (d) 10^6 .
7. Chitin is a homopolymer of (a) N-acetylglucosamine (b) glucuronic acid (c) xylose (d) glucose.
8. Which of the following fatty acids has the highest melting temperature? (a) 12:0 (b) 14:0 (c) 12:1 (d) 14:1.
9. If the concentration of a substrate is 4 times the value of the dissociation constant, what fraction of the enzyme catalytic sites are bound to substrate? (a) 0.6 (b) 0.7 (c) 0.8 (d) 0.9.
10. Cholesterol is a weakly amphipathic molecule, because of the (a) hydroxyl (b) aldehyde (c) carboxyl (d) keto group at one end of the molecules.
11. An uncoupler such as 2,4-dinitrophenol can (a) inhibits electron transport by binding to cytochrome b (b) inhibits ATP production by binding to the ATP synthase (c) competes with coenzyme Q at the active site of complex III (d) dissipates the mitochondrial transmembrane pH gradient.

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12. Cytochrome molecule contains a (a) Mg (b) Cu (c) Fe (d) Mn atom.
13. If the concentration of K^+ on one side of the membrane is 10 times higher than that on the other side, the electric potential difference across the membrane at room temperature would be approximately (a) 30 (b) 60 (c) 90 (d) 120 mV.
14. The enzyme that catalyzes the reaction: α -ketoglutaric acid + L-Alanine \rightarrow Puruvate + L-glutamic acid is (a) a transferase (b) an isomerase (c) an oxidoreductase (d) a dehydrogenase.
15. Both liver and muscle can degrade glycogen, but only liver can export the glucosyl residues into the blood. This is because (a) muscle cannot convert glucose-6-phosphate to free glucose (b) muscle cannot convert glucose-1-phosphate to glucose-6-phosphate (c) muscle cannot convert the glucosyl residues of glycogen to glucose-1-phosphate (d) muscle has no glucose transporter.
16. The most abundant enzyme in chloroplast is (a) glyceraldehydes-3-phosphate dehydrogenase (b) ribulose-1,5-bisphosphate carboxylase (c) ribulose-5-phosphate kinase (d) sedoheptulose-1,7-bisphosphatase.
17. During Q-cycle of the electron transport of mitochondria, QH_2 transfers its first electron to FeS center, and then transfers the second electron to (a) cyt c_1 (b) cyt c (c) cyt b (d) plastocyanin.
18. All of the following are components of the chloroplast electron transport system except (a) copper (b) cytochromes (c) coenzyme A (d) iron-sulfur centers.
19. The electron transport sequence in chloroplast is (a) photosystem I \rightarrow cyt b_6/f \rightarrow photosystem II (b) photosystem I \rightarrow photosystem II \rightarrow cyt b_6/f (c) photosystem II \rightarrow photosystem I \rightarrow cyt b_6/f (d) photosystem II \rightarrow cyt b_6/f \rightarrow photosystem I.
20. The F_0 of F_0F_1 -ATP synthase mainly functions as a (a) H^+ channel (b) ATP synthase (c) kinase (d) ATP hydrolase.
21. The standard reduction potential of NADH is around (a) -0.67 (b) -0.32 (c) -0.14 (d) 0.42 V.
22. Which of the following compounds has the highest phosphate transfer potential? (a) pyrophosphate (b) ATP (c) creatine phosphate (d) phosphoenolpyruvate.
23. Pyruvate kinase is not inhibited by (a) fructose-1,6-bisphosphate (b) ATP (c) fatty acid (d) acetyl-CoA.
24. Within cells, most ATP molecules are chelated as a complex with (a) Na^+ (b) K^+ (c) Ca^{2+} (d) Mg^{2+} .
25. The biological function of glycosidase is to (a) synthesize glycoproteins (b) cleave glycosidic bonds (c) phosphorylate glycoproteins (d) cleave the phosphate linkage of glycoproteins.

III. 選擇題 - Part B (每題 2 分, 共 20 分. 每題只有一個正確答案)

1. The most important/characteristic "bond" type for maintaining secondary structures in protein assemblies is: (a) hydrophobic (b) van der Waals (c) hydrogen (d) covalent (e) ion pair.

國立清華大學 生命題紙

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2. The tertiary structure of a protein refers to the: (a) Sequence of amino acids (b) Presence of α -helices or β -sheets (c) Unique three dimensional folding of the molecule (d) Interactions of a protein with other subunits of enzymes (e) Interaction of a protein with a nucleic acid.
3. Proteins 1 and 2 interact strongly. A significant part of the interaction is between the amino acid side chains Arg (Protein 1) and Glu (protein 2). Assume that a mutation occurs in protein 2 that changes the amino acid to one of the amino acids, Asp, Ser, Lys or Leu, what change should disrupt the interaction between proteins 1 and 2 the most? the least? (a) The most: aspartic acid; the least: leucine (b) The most: lysine; the least: serine (c) The most: Serine; the least: aspartic acid (d) The most: lysine; the least: aspartic acid (e) The most: aspartic acid; the least: serine.
4. An oligopeptide 5 amino acid long is split into various smaller fragments, and the amino acid sequences of some of the fragments are determined. The identified fragments include: his-gly-ser, ala-his, and ala-ala. Predict the primary sequence of the polypeptide. (a) his-gly-ser-ala-ala (b) ala-his-gly-ser-ala (c) ala-ala-his-gly-ser (d) his-gly-ser-ala-ala (e) cannot be determined without more information.
5. Insufficient Vitamin B₁₂ often creates an apparent folate deficiency by trapping which folate intermediate? (a) folic acid (b) dihydrofolate (DHF) (c) tetrahydrofolate (THF) (d) N⁵-methyl THF (e) N¹⁰-formyl THF.
6. Buildup of which metabolite in serum is a specific indicator of a vitamin B₁₂ deficiency? (a) methylmalonic acid (b) methylmalonyl CoA (c) N⁵-methyl THF (d) methionine (e) succinyl CoA.
7. Folate derivatives are required for the synthesis of which DNA nucleotides? (a) adenylate and guanylate (b) cytidylate and thymidylate (c) all four nucleotides (d) thymidylate only (e) adenylate, guanylate, and thymidylate.
8. The enzymes that are dephosphorylated by insulin action are phosphorylated via glucagon and/or epinephrine action. Which kinase is responsible for these phosphorylation events? (a) Protein kinase C (b) Calmodulin-dependent kinase (c) Protein kinase A (d) Receptor tyrosine kinase (e) β -ARK.
9. Insulin regulates all of the following enzymes in liver. Which of these enzymes are also regulated by insulin in muscle? (a) Glycogen synthase/Glycogen phosphorylase (b) phosphofructokinase-1 (PFK-1) (c) phosphofructokinase-2 (PFK-2) (d) glucokinase (e) All of above.
10. Identify an enzyme that does not have glucose-6-phosphate as a substrate (a) Glucose-6-phosphate dehydrogenase (b) Glucose-6-phosphatase (c) Hexokinase (d) Phosphoglucosomerase (e) Phosphoglucosomutase.

IV. 問答題 (共 50 分)

1. What is an anaplerotic reaction? (5%)
2. Protein concentration often can be determined by measuring absorbance at 280 nm. Why? (5%)

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3. Which five of the following amino acids are derived from α -ketoglutarate? (Glutamate, Proline, Cysteine, Aspartate, Glutamine, Arginine, Ornithine, Serine, lysine, Histidine) (7%)
4. Basics (Total 13%)
 - (a) Whenever you see 1.414 this number, you think of $2^{1/2}$. When you see 0.693, you think of _____. (2%)
 - (b) Suppose the decay rate of ^{32}P radioisotope is k . In order to dispose ^{32}P waste, you have to wait for 5 half lives ($t_{1/2}$). Express ($5 t_{1/2}$) in terms of k . Show calculation on your answer sheet. (3%)
 - (c) Carbon monoxide causes intoxication. But carbon dioxide and nitrogen are not as toxic as carbon monoxide. Why? Give biochemical explanations. (5%)
 - (d) What is the basic biochemical reaction(s) when you perm hair (燙髮)? (3%)
5. Integrated Metabolism (Total 20%)
 - (a) Eskimos (愛斯基摩人) rely on animal sources as their major food supply. If you are a doctor and wish to study the diseases of Eskimos, what kind of metabolic disorders will you think of? List at least two diseases, exclude heart disease and cancers on digestive tract. Please write the biochemical reactions which support your reasoning. (5%)
 - (b) Epidemiology (流行病學) studies showed that Eskimos do not show significant prevalence of heart disease. At least the heart disease is not a serious problem. If this is a true result, what biological and/or metabolic explanations can you think of? (5%)
 - (c) One old Chinese tradition for woman after giving birth to baby is to simmer chicken (燉雞) with linseed oil (亞麻油). Is this tradition helpful or not helpful for a new mother? What is your opinion about this custom? Hint: Do you agree with this tradition or not? Regardless of agree or disagree, please use human biochemical reactions to support your viewpoints. (5%)
 - (d) G6PD deficiency is a genetic disease. What is G6PD? Which biochemical reaction does it fail in this disease? Why does it cause severe metabolic disorder and why does it cause hemolysis of the patients? (5%)