

國 立 清 華 大 學 命 題 紙

八十六學年度

生命科學

系(所)

分生組甲乙丙
生醫組甲乙

組碩士班研究生入學考試

科目

生物化學

科號

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*請在試卷【答案卷】內作答

1. Multiple choices. (25%, one point each) (請將答案寫在選擇題答案格內)

- 水解下列 phosphorylated compounds, 何者能放出最多的 free energy: (a) ATP (b) glucose 6-phosphate (c) phosphoenolpyruvate (d) creatine phosphate.
- Enzyme 中的 prosthetic group — biotin 主要可攜帶下列那一種 group: (a) phosphoryl (b) acyl (c) methyl (d) CO₂.
- Vitamin B₂ 又名 (a) riboflavin (b) niacin (c) ascorbate (d) pantothenate.
- Ribulose 是一種 (a) triose (b) pentose (c) hexose (d) heptose.
- 有五個碳的 aldose 最多應有幾種 stereoisomers: (a) 4 (b) 6 (c) 8 (d) 16.
- 下列的糖類何者不具有 anomer: (a) glucose (b) sucrose (c) maltose (d) galactose.
- 構成 cellulose 長鏈的 bonds 是 (a) α -1,4 (b) α -1,6 (c) β -1,4 (d) β -1,6 glycosidic bond.
- 要把 aldose 轉變成 ketose 需要那一種酵素: (a) isomerase (b) epimerase (c) aldolase (d) mutase.
- 在 glycolysis pathway 中, 下列那一種酵素不是主要調控的位置 (a) hexokinase (b) pyruvate kinase (c) phosphoglycerate kinase (d) phosphofructokinase.
- Citric acid cycle 中, 每繞一圈可釋放出幾個 CO₂: (a) 1 (b) 2 (c) 3 (d) 4.
- 下列何者不是 pyruvate dehydrogenase complex 的 prosthetic group: (a) NAD⁺ (b) FAD (c) TPP (d) lipoamide.
- 下列那一種 compounds 不屬於 citric acid cycle: (a) malate (b) oxaloacetate (c) glyoxylate (d) succinate.
- 下列那一種酵素不是 citric acid cycle 的主要調控位置: (a) citrate synthase (b) isocitrate dehydrogenase (c) succinate dehydrogenase (d) α -ketoglutarate dehydrogenase.
- 在 citric acid cycle 的 9 個 reactions 中不會生產 (a) ATP (b) GTP (c) NADH (d) FADH₂.
- 有一分子在 pH=4 時的 redox potential 是 -0.2 V, 當 pH=7 時它的 redox potential 應是 (a) -0.32 V (b) -0.38 V (c) -0.42 V (d) +0.24 V.
- Mitochondria 的電子傳遞系統中, 那一個 complex 不具 H⁺ pump 的功能: (a) NADH-Q reductase (b) succinate-Q reductase (c) cytochrome reductase (d) cytochrome oxidase.

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17. 下列那一項不是 mitochondria 的 F_1F_0 ATPase 的功能: (a) nucleotide binding (b) H^+ conducting (c) ATP hydrolysis (d) ATP translocating.
 18. 一分子 glucose 完全分解成 H_2O 和 CO_2 時約可產生多少 ATP: (a) 34 (b) 30 (c) 26 (d) 22.
 19. Transketolase 可以移動幾個碳: (a) 1 (b) 2 (c) 3 (d) 4
 20. 下列那一種分子不是 pentose phosphate pathway 的產物 (a) NADPH (b) NADH (c) CO_2 (d) glyceraldehyde 3-phosphate
 21. 下列那一種波長的光對高等植物的光合作用最有效能: (a) 500 nm (b) 550 nm (c) 600 nm (d) 650 nm.
 22. 高等植物光合作用的 reaction center 是由什麼構成的: (a) chlorophyll (b) quinone (c) cytochrome (d) Fe-S center.
 23. 光合作用中 reaction center 的 charge separation 是在什麼 time scale 下發生: (a) 10^{-14} sec (b) 10^{-12} sec (c) 10^{-9} sec (d) 10^{-6} sec.
 24. 光合作用的電子傳遞系統不能產生 (a) O_2 (b) NADPH (c) NADH (d) ATP.
 25. 在一個 metabolic pathway 中, 調控的位置不能選在 (a) exothermic reaction (b) rate-limiting reaction (c) reversible reaction (d) first reaction.
2. (a) Which amino acids can be phosphorylated (i.e., add phosphate group)? Sketch the phosphorylated molecular structure. (2.5%)
(b) Among these amino acids in question 2(a), which one is most easily phosphorylated? Explain why. (2.5%)
 3. (a) How do you cleave a C=C double bond in an organic reaction? Draw the stepwise reaction and the necessary reagent(s) for each step. (2.5%)
(b) In a living cell, how a C=C double bond is cleaved? Draw the stepwise reaction and the necessary enzyme(s) for each step. (2.5%)

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科目 生物化學 科號 0901 1003
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4. Mammals rely on oxygen, water, and various energy sources to maintain life process. Hibernating animals seldom take up water during hibernation. How can hibernating animals survive without drinking water? List any possible biochemical reaction(s) to elucidate your rationale. (5%)
5. How do you purify the DNA in *E. coli* cells? Give stepwise procedures and start from
- (1) Collect bacteria by centrifugation at 3,500 g for 10 min at 4°C.
 - (2)
 - (3)
 - (4)
 -
 - etc. (5%)
6. What is HPLC? Explain as much as possible concerning normal phase and reversed phase HPLC. (5%)
- Hint: Describe the mobile and stationary phase in each case.
7. (a) If a solution of Arg, Val, His, and Glu at pH 6 were loaded on a strong cation exchange column and eluted from the column with an increasing salt (NaCl) gradient, what would be the order in which these amino acids would elute from the column? Explain your reason. Please also draw the chemical structures of these amino acids. (pKa values: a-COOH, 2.3; a-NH₂, 9.5; pK_C, 8.4; pK_Y, 10.5; pK_D, 3.9; pK_E, 4.1; pK_K, 10.5; pK_R, 12.5; pK_H, 6.0.) (4%)
- (b) Consider the oligopeptide, AEFFLAMDP, which forms an α -helix. Which amino acid residue would you expect to be on the same side (face) of the "tubular" helix as is the initial alanine residue? Explain your reason. (2%)

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8. Most of the processes that occur in an organism are the result of interactions between molecules such as a receptor protein and its ligand.
- Describe the common characteristics of these molecular interactions. (3%)
 - You are attempting to develop a colorimetric method to detect the protein-ligand binding. List several requirements that a colorimetric probe must meet in order to be effective. (3%)
9. A glass of milk is acidified to pH 4.6 and heated at 40°C with constant stirring for 30 minutes.
- What would happen to the contents of milk afterwards? (2%)
 - Is this process reversible? How are you going to do? Please explain your reason at a molecular level. (3%)
 - Suppose you attempt to prove your hypothesis. What kind of experiments will you perform? You need to include the materials and methods. (3%)
10. The following reagents are often used in protein chemistry. Describe their tasks briefly. (5%)
- dabsyl chloride
 - sodium dodecyl sulfate
 - colchicine
 - phenyl isothiocyanate
 - dicyclohexylcarbodiimide

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11. Explain the biochemical basis for the following statements. (12%):
- As a coenzyme, pyridoxal phosphate is covalently bound to enzymes with which it functions, yet during catalysis the coenzyme is not covalently bound.
 - Despite that the nitrogen of glutamate can be redistributed by transamination, glutamate is not a good supplement for nutritionally poor proteins.
 - Attenuation is not found to be involved in eucaryotic gene regulation.
 - Only the hybrids will grow in HAT medium when fusing two cells of different origins which are respectively HGPRT⁻ and TK⁻.
12. Outline an experimental approach to determining the half-life of a particular protein in a given mammalian cell. (5%).
13. Upon activation of a receptor, a G protein exchanges bound GDP or GTP, rather than phosphorylating GDP that is already bound. Similarly, the α subunit-GTP complex has a slow GTPase activity that hydrolyzes bound GTP, rather than exchanging it for GDP. Describe experimental evidence that would be consistent with these conclusions. (8%).