

八十四學年度 生命科學 所 甲 乙 組碩士班研究生入學考試

目 生物化學 科號 1005 共 6 頁第 1 頁 \*請在試卷【答案卷】內作答

**1. General chemistry (total 15%)**

- (1) All the biological processes follow the rules of thermodynamics. You frequently encounter the symbols of G, H, and S. These are thermodynamic terms. What are G, H, and S (spell the names in English)? (3%)
- (2) What is the relationship between G, H, and S? Write the equation. (2%)
- (3) What is the criteria for a spontaneous reaction? Write the equation. (2%)
- (4) What is the relation between G and equilibrium constant K? Write the equation. (2%)
- (5) What is Michaelis-Menten constant? Write the equation and explain. (4%)
- (6) Oxygen molecule  $O_2$  reacts with hydrogen molecule  $H_2$  to form water. Which one is reduced? ( $O_2$  or  $H_2$ )? (2%)

**2. Enzymes and proteins (total 15%)**

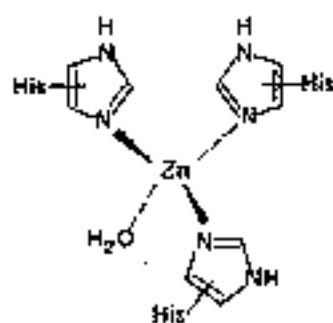
- (1) The concentration-velocity data shown below were obtained for an enzyme catalyzing a reaction for substrate S to product P. Determine  $K_M$  and  $V_{max}$ . (10%) (下一頁附有方格紙)

[S]	Rate of product formation
(M)	(nmoles <sup>-1</sup> x liter <sup>-1</sup> x min <sup>-1</sup> )
$2.5 \times 10^{-6}$	24
$3.3 \times 10^{-6}$	30
$4.0 \times 10^{-6}$	34
$5 \times 10^{-6}$	40
$1 \times 10^{-5}$	60
$4 \times 10^{-5}$	96
$1 \times 10^{-4}$	109
$2 \times 10^{-3}$	119
$1 \times 10^{-2}$	120

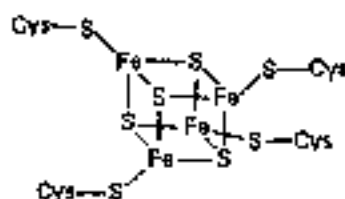
八十四學年度 生命科學 所 甲 乙 網碩士班研究生入學考試

科目 生物化學 科號 1005 共 6 頁第 2 頁 \*請在試卷【答案卷】內作答

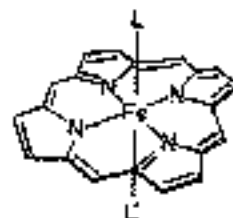
(2) Some proteins contain firmly bound metal ions that are essential for their function. Examples of metal-binding proteins are shown in the following, with the partial structures of the amino acid side chains to which they are attached. What are those proteins? Please mention one protein for each example. (5%)



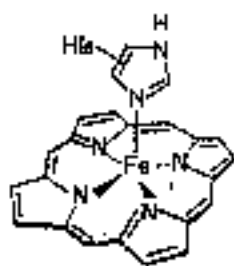
a



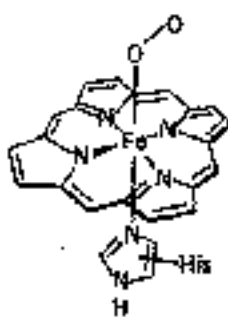
b



c



d



e

八十四學年度生命科學 0001 所 甲 乙 組碩士班研究生入學考試  
科目 生物化學 科號 1005 共 6 頁第 3 頁 \*請在試卷【答案卷】內作答

### 3. Metabolism (total 20%)

(1) Many cellular activities in eukaryote cells are carried out in different cellular components, besides in the cytoplasm. Please indicate the cellular locations of the following enzymes:

cytosolic enzymes indicate as--C

mitochondrial enzymes, matrix side indicate as---MM

mitochondrial enzymes, cytosolic side indicate as---MC

transmembrane enzymes indicate as---TM

peripheral membrane enzymes indicate as---PM

Please use C, MM, MC, TM, PM to specify the locations (some might involve multiple locations): (10%) You can specify other positions.

(a) Enzymes for glycolysis pathway

(b) Enzymes for fatty acid synthesis

(c) Enzymes for urea cycle

(d) Acetyl-CoA dehydrogenase (in the oxidation of fatty acid)

(e) Succinate dehydrogenase (in the citric acid cycle)

(f) ATP synthase complex (in oxidative phosphorylation)

(g) ATP synthase complex (in photo-phosphorylation)

(h) Cytochrome C

(i) Pyruvate dehydrogenase complex

(j) Adenylate cyclase

(2) Many cellular activities, including the metabolic pathways, are elucidated by using specific inhibitors. Please briefly identify the following compounds (what are their most prominent effects on cellular activities?) (10%)

(a) Chloramphenicol

(d) Dinitrophenol

(b) Malonate

(e) Puromycin

(c) Cyanide

八十四學年度 生命科學 所 甲 乙 組碩士班研究生入學考試

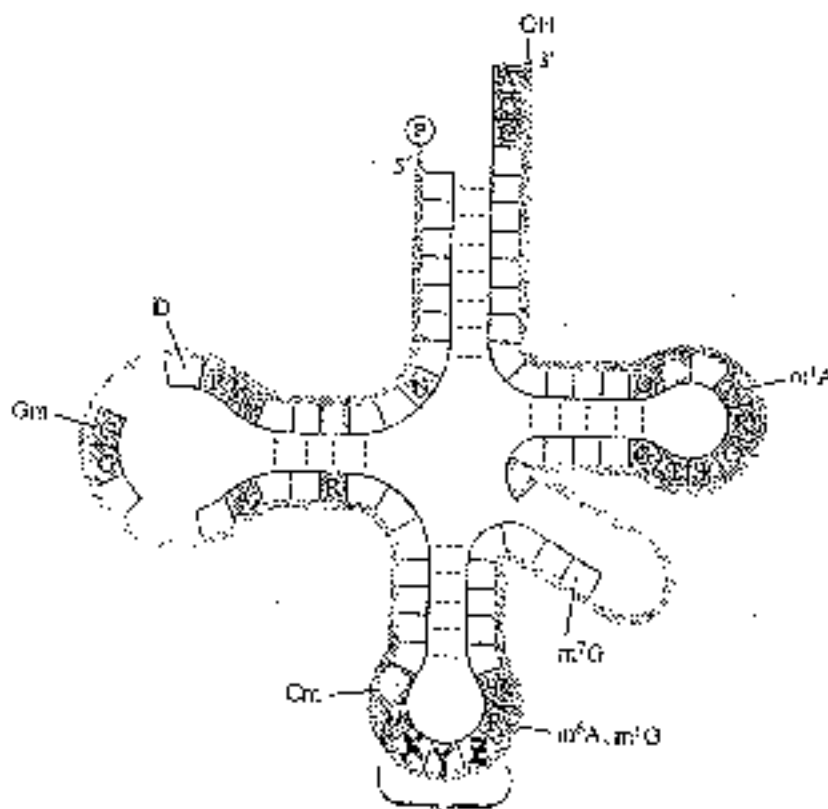
科目 生物化學 科號 1005 共 6 頁第 4 頁 \*請在試卷【答案卷】內作答

**4. Nucleic acids (total 15%)**

- (1) From the viewpoint of evolution, why does nature select G, C, A, T for DNA and G, C, A, U for RNA? What would happen if the natural selection was reversed, i.e., G, C, A, T for RNA, and G, C, A, U for DNA? (5%)
- (2) Give definition for linking number, writhe, and twist. (5%)
- (3) In *E. coli*, why is the natural occurring DNA negatively supercoiled? (5%)

**5. Genes and gene regulation (total 15%)**

- (1) The following figure represents a macromolecule. What is it? (2%)



- (2) Please refer to the attached genetic code on page 5 (see next page), and if X=A, Y=C, Z=U in the above structure, which amino acid will be incorporated? (3%)

甲

八十四學年度 生命科學 0901 所 乙 組碩士班研究生入學考試

科目 生物化學 科號 1005 共 6 頁第 5 頁 \*請在試卷【答案卷】內作答

The genetic code

First position	Second position				Third position
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

(3) There are positive (activator) and negative (repressor) controls for gene expression such as lac operon. However, this simple on/off switch is not enough. For a more efficient gene expression, a more complicated systems are required. A well-regulated gene expression should be able to sense a gradual change for the concentration of a nutrient. How does an operon achieve this kind of fine tuning in responding to the gradual changes of a nutrient, such as amino acid? (10%)

八十四學年度 生命科學 0901 所 甲 乙 組碩士班研究生入學考試

科目 生物化學 科號 1005 共 8 頁第 8 頁 \*請在試卷【答案卷】內作答

**6. Historical (total 20%)**

(1) What are Frederick Sanger's two most important contributions to biochemistry? Please describe these two methods that he developed. Write the chemical reactions and reagents used. (10%)

(2) What is protein G? Please describe its physiological function and working mechanism. (10%)