

國立嘉義大學九十七學年度

應用化學系碩士班(乙組)招生考試試題

科目：生物化學

I. Single Choice (60%)

- Which of the following statements about a plot of V_0 vs. $[S]$ for an enzyme that follows Michaelis-Menten kinetics is *false*?
(A) As $[S]$ increases, the initial velocity of reaction V_0 also increases.
(B) At very high $[S]$, the velocity curve becomes a horizontal line that intersects the y-axis at K_m .
(C) K_m is the $[S]$ at which $V_0 = 1/2 V_{max}$.
(D) The shape of the curve is a hyperbola.
(E) The y-axis is a rate term with units of $\mu\text{m}/\text{min}$.
- The following data were obtained in a study of an enzyme known to follow Michaelis-Menten kinetics:

V_0 ($\mu\text{mol}/\text{min}$)	Substrate added (mmol/L)
217	0.8
325	2
433	4
488	6
647	1,000

The K_m for this enzyme is approximately:

(A) 1 mM ; (B) 1,000 mM. ; (C) 2 mM ; (D) 4 mM ; (E) 6 mM.

- Which one of the following statements about enzymes that interact with DNA in DNA replication is true?
(A) *E. coli* DNA polymerase I is unusual in that it possesses only a $5' \rightarrow 3'$ exonucleolytic activity.
(B) Endonucleases degrade circular but not linear DNA molecules.
(C) Exonucleases degrade DNA at a free end.
(D) Many DNA polymerases have a proofreading $5' \rightarrow 3'$ exonuclease.
(E) Primases synthesize a short stretch of DNA to prime further synthesis.
- Which of the following is a dominant feature of the outer membrane of the cell wall of gram negative bacteria?
(A) Amylose; (B) Cellulose; (C) Glycoproteins; (D) Lipopolysaccharides; (E) Lipoproteins.
- The reaction of the citric acid cycle that is most similar to the pyruvate dehydrogenase complex-catalyzed conversion of pyruvate to acetyl-CoA is the conversion of:
(A) citrate to isocitrate; (B) fumarate to malate; (C) malate to oxaloacetate; (D) succinyl-CoA to succinate; (E) α -ketoglutarate to succinyl-CoA.
- Which of the following cofactors is required for the conversion of succinate to fumarate in the citric acid cycle?
(A) ATP; (B) Biotin; (C) FAD; (D) NAD^+ ; (E) NADP^+ .
- Which of the following statements about the chemiosmotic theory is correct?
(A) Electron transfer in mitochondria is accompanied by an asymmetric release of protons on *one* side of

the inner mitochondrial membrane.

- (B) It predicts that oxidative phosphorylation can occur even in the absence of an intact inner mitochondrial membrane.
(C) The effect of uncoupling reagents is a consequence of their ability to carry electrons through membranes.
(D) The membrane ATP synthase has no significant role in the chemiosmotic theory.
(E) All of the above are correct.
- In homologous genetic recombination, RecA protein is involved in:
(A) formation of Holliday intermediates and branch migration.
(B) introduction of negative supercoils into the recombination products.
(C) nicking the two duplex DNA molecules to initiate the reaction.
(D) pairing a DNA strand from one duplex DNA molecule with sequences in another duplex, regardless of complementarity
(E) resolution of the Holliday intermediate.
- During oxidative phosphorylation, the proton motive force that is generated by electron transport is used to:
(A) create a pore in the inner mitochondrial membrane.
(B) generate the substrates (ADP and P_i) for the ATP synthase.
(C) induce a conformational change in the ATP synthase.
(D) oxidize NADH to NAD^+ .
(E) reduce O_2 to H_2O .
- Oxidative phosphorylation and photophosphorylation share all of the following *except*:
(A) chlorophyll; (B) involvement of cytochromes; (C) participation of quinones; (D) proton pumping across a membrane to create electrochemical potential; (E) use of iron-sulfur proteins.
- Which of the following is *not* usually essential for the catalytic activity of ribozymes?
(A) Correct base pairing; (B) Correct base sequence; (C) Correct interaction with protein; (D) Correct secondary structure ; (E) Correct three-dimensional structure.
- Almost all of the oxygen (O_2) one consumes in breathing is converted to:
(A) acetyl-CoA; (B) carbon dioxide (CO_2) ; (C) carbon monoxide and then to carbon dioxide; (D) none of the above ; (E) water.
- In bacteria the elongation stage of protein synthesis does *not* involve:
(A) aminoacyl-tRNAs; (B) EF-Tu; (C) GTP; (D) IF-2; (E) peptidyl transferase.
- The tryptophan operon of *E. coli* is repressed by tryptophan added to the growth medium. The tryptophan repressor probably:
(A) binds to RNA polymerase when tryptophan is present; (B) binds to the *trp* operator in the absence of tryptophan; (C) binds to the *trp* operator in the presence of tryptophan; (D) is a DNA sequence; (E) is an attenuator.

15. Hormone-activated phospholipase C can convert phosphatidylinositol 4,5-bisphosphate to:
 (A) diacylglycerol + inositol triphosphate; (B) diacylglycerol + inositol + phosphate; (C) glycerol + inositol + phosphate; (D) glycerol + phosphoserine; (E) phosphatidyl glycerol + inositol + phosphate.
16. An allosteric interaction between a ligand and a protein is one in which:
 (A) binding of a molecule to a binding site affects binding of additional molecules to the same site.
 (B) binding of a molecule to a binding site affects binding properties of another site on the protein.
 (C) binding of the ligand to the protein is covalent.
 (D) multiple molecules of the same ligand can bind to the same binding site.
 (E) two different ligands can bind to the same binding site.
17. In hemoglobin, the transition from T state to R state (low to high affinity) is triggered by:
 (A) Fe^{2+} binding; (B) heme binding; (C) oxygen binding; (D) subunit association; (E) subunit dissociation.
18. Which of the following parts of the IgG molecule are *not* involved in binding to an antigen?
 (A) Fab; (B) Fc; (C) Heavy chain; (D) Light chain; (E) Variable domain.
19. Topoisomerases can:
 (A) change the linking number (Lk) of a DNA molecule; (B) change the number of base pairs in a DNA molecule; (C) change the number of nucleotides in a DNA molecule; (D) convert D isomers of nucleotides to L isomers; (E) interconvert DNA and RNA.
20. An Okazaki fragment is a:
 (A) fragment of DNA resulting from endonuclease action; (B) fragment of RNA that is a subunit of the 30S ribosome; (C) piece of DNA that is synthesized in the $3' \rightarrow 5'$ direction; (D) segment of DNA that is an intermediate in the synthesis of the lagging strand; (E) segment of mRNA synthesized by RNA polymerase.

II. Short Questions (40%)

- II-1 (a) Define "reducing sugar."
 (5%) (b) Sucrose is a disaccharide composed of glucose and fructose ($Glc(\alpha 1 \rightarrow 2)Fru$). Explain why sucrose is not a reducing sugar, even though both glucose and fructose are.

- II-2 Match the cofactors below with their roles in the pyruvate dehydrogenase complex reaction.
 (10%) Cofactors:
 Coenzyme A (CoA-SH); NAD^+ ; Thiamine pyrophosphate (TPP); FAD; Lipoic acid in oxidized form
Roles:
 A. _____ Attacks and attaches to the central carbon in pyruvate.
 B. _____ Oxidizes $FADH_2$.
 C. _____ Accepts the acetyl group from reduced lipoic acid.
 D. _____ Oxidizes the reduced form of lipoic acid.
 E. _____ Initial electron acceptor in oxidation of pyruvate.

- II-3 In what order do the following five steps occur in the photochemical reaction centers?
 (5%)
 1. Excitation of the chlorophyll *a* molecule at the reaction center
 2. Replacement of the electron in the reaction center chlorophyll
 3. Light excitation of antenna chlorophyll molecule
 4. Passage of excited electron to electron-transfer chain
 5. Electron transfer to neighboring chlorophyll
 Please give an order.

- II-4 (a) (6%)現有protein一級序列中，被分析出含有一碎片序列為KRG，請畫出此peptide片段之化學結構。
 (10%) (b) 此protein利用trypsin切碎後的混合物中，發現除上述KRG片段外，還含有GNA及KRGGG，如何從此混合物中，精準的純化出KRG之peptide碎片，請簡略敘述單離純化之方法。

- II-5 DNA序列d-(5'-TCGCAT-3'):
 (10%) (a) (3%)當利用此段DNA當模版 (template)，(若忽略掉其他製成因素，如promoter及starting codes)，經transcription後，請問所做出的RNA序列為何？(請註明5'端到3'端的方向)
 (b) (2%)以此段DNA經translation，請問所做出RNA進行translation，產生的第一個氨基酸為何？
 (c) (5%) 現有一可導致癌症之化學物，例如：DMS (甲基化試劑)或鎳金屬離子(Ni^{2+})，可與DNA的guanine的N-7位置做共價鍵結形成DNA加成物，被修飾後的DNA鹼基，會導致DNA複製到此位置時，無法進行下去。此修飾過的單股DNA甚至會造成轉錄及轉譯無法進行。現有金屬離子與下列DNA序列d-(5'-TCGCAT-3')中的guanine作用後，用此被修飾過的單股DNA作為DNA transcription用的模版，來製造RNA (假設忽略掉其他製成因素時)，請問所複製出來的最有可能RNA序列為何？(請畫出此RNA序列之化學結構，並註明從5'端到3'端的方向)。