國　立　清　華　大　學　命　題　紙

97 學年度 生醫工程與環境科學 系（所）甲組（分子生醫光電組）碩士班入學考試

科目 生物化學 科目代碼 2502 共 6 頁第 1 頁 *請在【答案卷卡】內作答

單一選擇題： 25 題，每題 2 分，答錯到扣 0.5 分；簡答題： 5 題，每題 10 分。

A:單一選擇題: （*務必使用電腦答案卡作答，否則不與計分）

1. Which amino acids contain reactive aliphatic hydroxyl groups?

(A) serine and methionine
(B) serine and threonine
(C) methionine and threonine
(D) cysteine and methionine
(E) cysteine and threonine

2. Which of the following amino acid residues would most likely be buried in the interior of a water soluble, globular protein?

(A) Asp (B) Ser (C) Phe (D) Lys (E) Gln

3. What are the common promoter regions found in bacterial genes?

(A) a Pribnow box about –10 and a –35 region
(B) a TATA box about –25 and a CAAT box about –75
(C) a Pribnow box about –10 and a TATA box about –25
(D) a TATA box about –25 and a –35 region
(E) None of the above.

4. Which of the following is correct concerning the adaptor molecule tRNA?

(A) tRNA contains an anticodon sequence that serves as the template recognition site.
(B) The amino acid is attached to the 5' end of tRNA.
(C) tRNA contains a poly A tail at the 3' end.
(D) tRNA is the smallest RNA in the cell.
(E) tRNA serves as the gene in some viruses.

5. What do Northern, Southern, and Western blots detect, respectively?

(A) DNA, RNA, and protein
(B) DNA, protein, and RNA
(C) RNA, DNA, and protein
(D) protein, DNA, and RNA
(E) RNA, protein, and DNA

6. Riboflavin is a water-soluble organic substance that is not synthesized by humans. Metabolically, it is chemically converted into a substance called flavin adenine dinucleotide, which is required by succinate dehydrogenase. Which of the following statements is most correct?

(A) Riboflavin is a coenzyme
(B) Flavin adenine dinucleotide is a vitamin
(C) Succiniate dehydrogenase is a coenzyme.
(D) Flavin adenine dinucleotide is a coenzyme.
(E) None of the above

7. Given are five K_M values for the binding of substrates to a particular enzyme. Which has the strongest affinity when k_{-1} is greater than k_2 ?

(A) 150 mM (B) 0.15 mM (C) 150 μM (D) 1.5 nM (E) 15000 pM

8. Examples of covalent modification include

(A) phosphorylation and dephosphorylation
(B) acetylation.
(C) ubiquination.
(D) All of the above.
(E) a and b only

9. Allosteric proteins

(A) contain distinct regulatory sites and have multiple functional sites.
(B) display cooperativity.
(C) always consist of several identical subunits.
(D) a and b
(E) a, b, and c

10. What two 3-carbon molecules are generated by the cleavage of fructose-1,6-bisphosphate?

(A) glyceraldehyde-3-phosphate and 3-phosphoglycerate
(B) glyceraldehyde-3-phosphate and dihydroxyacetone phosphate
(C) pyruvate and phosphoenolpyruvate
(D) enolase and 2-phosphoglycerate
(E) glyceraldehyde-3-phosphate and pyruvate

11. What reaction is catalyzed by aldolase?

(A) isomerization of DHAP to GAP
(B) ligation of GAP and DHAP
(C) reversible cleavage of F-1,6-BP to DHAP and GAP
(D) cleavage of DHAP to GAP
(E) irreversible aldol condensation of DHAP and GAP

12. What is the chemical effect of oligomycin on aerobic metabolism?

(A) The flow of electrons from NADH to CoQ is blocked
(B) The flow of electrons from Cyt a-a3 to oxygen is blocked.
(C) Oligomycin blocks the proton transfer through Fo of ATP synthase and therefore blocks the phosphorylation of ADP to form ATP.
(D) The transport of ATP out of and ADP into the mitochondria is blocked
(E) Oxidative phosphorylation is uncoupled from electron transport and all the energy is lost as heat.

13. Choose the correct path taken by a pair of electrons as it travels down the electron-transport chain.

(A) NADH → complex I → CoQ → Complex III → Cyt c → complex IV → O_2

(B) $FADH_2$ → complex I → CoQ → Complex III → Cyt c → complex IV → O_2

(C) NADH → complex I → complex II→ Complex III → Cyt c → complex IV → O_2

(D) $FADH_2$ → complex II → CoQ → Complex III → Cyt c → complex IV → O_2

(E) a and d

14. In the Calvin cycle, 3-phosphoglycerate is converted into which hexose phosphate?

(A) glucose 1-phosphate

(B) glucose 6-phosphate

(C) fructose 6-phosphate

(D) All of the above.

(E) None of the above.

15. Which coenzyme is required by glyceraldehyde 3-phosphate dehydrogenase in chloroplasts to convert 3-phosphoglycerate into glyceraldehyde-3-phosphate?

(A) NADH

(B) NADPH

(C) NAD^+

(D) $NADP^+$

(E) thiamine pyrophosphate

16. How is acetyl carboxylase globally regulated?

(A) allosteric inhibitors and activators

(B) The enzyme is switched off by phosphorylation and activated by dephosphorylation.

(C) zymogen activation

(D) the binding of c-AMP.

(E) None of the above.

17. Light absorbed by a chlorophyll *a* causes

(A) an electron to move from the photon to the chlorophyll

(B) an electron to move from ground state to an excited state

(C) an electron to move to a neighboring water molecule.

(D) an electron to move from chlorophyll to ADP

(E) none of the above

18. What is the original source of electrons used to neutralize the special pair in photosystem II?

(A) reduced cytochrome bf. (B) NADH (C) H_2O. (D) membrane lipids. (E) ferredoxin.

19. The peptide glutathione

(A) has a glutamate residue linked to glycine through its α-amine.

(B) plays a role in the synthesis of the purine guanine

(C) is required to catalyze the transimination of glutamate from α-ketoglutarate

(D) is used to detoxify cells by reacting with organic peroxides

(E) Functions as a one carbon transfer molecule

20. HMG CoA is synthesized from acetyl CoA and

(A) oxaloacetate

(B) acetoacetyl CoA

(C) acetyl CoA

(D) farnesyl pyrophosphate

(E) mevalonate

21. The major carrier(s) of dietary fat from the intestine is (are)

(A) VLDL. (B) chylomicrons. (C) HDL. (D) LDL. (E) IDL

22. Which of the following is (are) true?

(A) Naturally occurring DNA usually has negative supercoiling.

(B) Forms with same linking number can be interconverted without cleavage

(C) The twist value rarely changes in naturally occurring DNA.

(D) a and b.

(E) a, b, and c.

23. The role of GTP in self-splicing is

(A) to provide energy.

(B) as a cofactor.

(C) as a necessary base for RNA editing

(D) a and b.

(E) a, b, and c.

24. In preparation for attachment to the tRNA, amino acids are activated by

(A) methylation

(B) adenylation

(C) dimethylation

(D) all of the above.

(E) none of the above

25. A key reaction in gene repression is the deacetylation of this (these) amino acids in histones

(A) serine (B) threonine (C) arginine (D) lysine (E) All of the above

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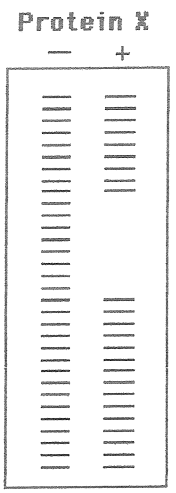
B: 簡答題:

1. The DNA molecule below is believed to contain a binding site for protein X. It is labeled at the 5′ end of the top strand (*), then subjected to a footprinting experiment. In the idealized gel below, there is a band for every base of the labeled strand. On the DNA sequence, point out the binding site for protein X.

*(5′)GGATTCTAATAAAGTAACGCGTTACGACTTGG

CCTAAGATTATTTCATTGCGCAATGCTGAACC



2. The kinetics of an enzyme are measured as a function of substrate concentration in the presence and in the absence of 2 mM inhibitor (I).

[S]	Velocity (μmole/minute)	
(μM)	No inhibitor	Inhibitor
3	10.4	4.1
5	14.5	6.4
10	22.5	11.3
30	33.8	22.6
90	40.5	33.8

a) What are the values of V_{max} and K_m in the absence of inhibitor? In its presence?

b) What type of inhibition is it ?

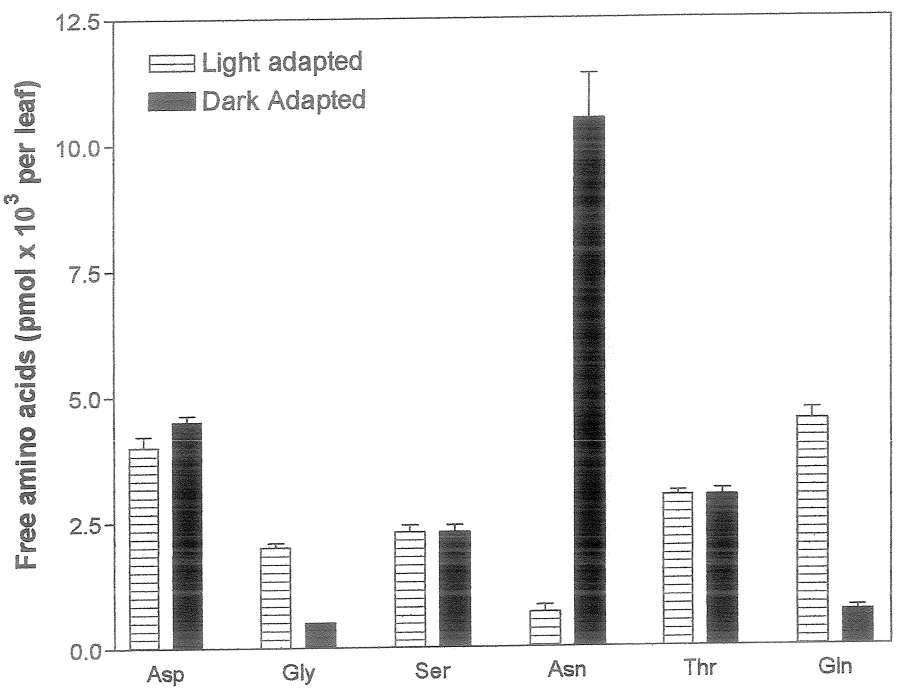
c) What is the binding constant of this inhibitor ?

d) If [S] = 10 μM and [I] = 2 mM, what fraction of the enzyme molecules have a bound substrate? A bound inhibitor?

e) If [S] = 20 μM, what fraction for the enzyme molecules have a bound substrate in the presence and in the absence of 2 mM inhibitor? Compare this ratio with the ratio of the reaction velocities under the same conditions.

3. Write a balanced reaction scheme for the conversion of pyruvate into α-ketoglutarate without depleting any of the citric acid components. You need to show cofactors and identify the required enzymes of each reaction.

4. Following graph shows the concentration of several free amino acids in light- and dark-adapted plants.



(i) Of the amino acids shown, which **are** most affected by light-dark adaptation ?

(ii) Suggest a plausible biochemical explanation for the difference observed in (i).

5. Write the reactions for the synthesis of TMP from dUMP that is coupled to the conversion of serine into glycine.