

國立成功大學

111學年度碩士班招生考試試題

編 號：262

系 所：生物化學暨分子生物學研究所

科 目：生物化學

日 期：0220

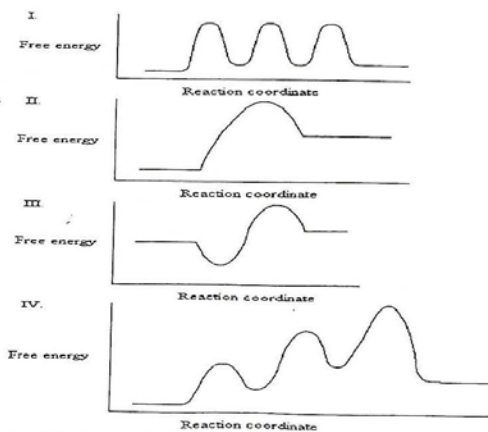
節 次：第 1 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

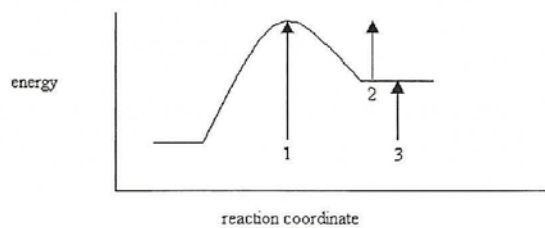
一、選擇題（共5分，每題1分）

- Replacement of the amino acid _____ at or near an active site of an enzyme is more likely to change enzyme activity than the replacement of _____ at or near the active site.
 - histidine; leucine
 - leucine; histidine
 - leucine; isoleucine
 - histidine; aspartate
 - serine; histidine
- Histidine is an ideal amino acid at neutral pH values at the active site of many enzymes because
 - it is hydrophobic.
 - it engages in electron transfer.
 - it is not ionizable.
 - its R group has a pKa of about 6 to 7 in most proteins.
 - its R group is structurally rigid.
- The graphs below all represent the same chemical reaction, but each employing a different catalyst. Which enzyme uses the most efficient mechanism of catalysis?



- A) See Graph I.
- B) See Graph II.
- C) See Graph III.
- D) See Graph IV
- E) See Graph I and IV.

4. On the energy diagram below, which arrow(s) represent the activation energy for the forward and reverse reactions?



- A) Arrow 1 is the activation energy for both the forward and reverse reactions.
 - B) Arrow 1 is the activation energy for the forward reaction and arrow 2 is the activation energy for the reverse reaction.
 - C) Arrow 1 is the activation energy for the forward reaction and arrow 3 is the activation energy for the reverse reaction.
 - D) Arrow 3 is the activation energy for the forward reaction and arrow 2 is the activation energy for the reverse reaction.
 - E) Arrow 2 is the activation energy for both the forward and reverse reactions.
5. Aspartate and lysine are in the active site of an enzyme. They are both known to participate directly in catalysis. The pKa's of the residues are found to be 3.2 and 9.6, respectively for aspartate and lysine. The optimum pH for the enzyme is 6.4. Which forms of these two residues will predominate when the enzyme is most active?
- A) Aspartate is protonated; lysine is deprotonated.
 - B) Both residues are protonated.
 - C) Aspartate is deprotonated; lysine is protonated.
 - D) Both residues are deprotonated.
 - E) All of the above are correct

二、選擇題（共20分，每題2分）

6. Which of the following description about myoglobin (Mb)/hemoglobin (Hb) are not true?
1. A porphyrin is a conjugated tetrapyrrole ring system.
 2. Hb has a lower affinity with oxygen when forming a carbamic acid.
 3. Myoglobin or hemoglobin without heme is called a holoprotein; with heme it is called an apoprotein.
 4. The H^+ released contributes to the Bohr effect.
 5. Binding of a Mb to iron porphyrin is a posttranslational modification (PTM)
 6. In heme, Fe^{2+} is bound to protoporphyrin XI.
- A) 5, 6
B) 3, 6
C) 2, 3, 5
D) 1, 3, 6
E) 3, 4, 5
7. Which of the following events did not increase oxygen-binding affinity of Hb?
1. The Fe^{3+} in Hb is reduced to Fe^{2+} at high oxygen pressure.
 2. Hb is in its T state.
 3. His 143 in Hb is changed into Ser 143.
 4. You are running at a mountain with a very high altitude.
 5. Hb is traveling in tissues/organs other than the lungs.
- A) 2, 3, 4
B) 1, 3, 5
C) 1, 2, 3
D) 1, 4, 5
E) 2, 4, 5
8. Which of the following statements about thin filament are *false*?
1. ADP-binding facilitates the formation of F-actin.
 2. ATP-bound actin is near to pointed end.
 3. Binding of calcium to troponin initiate muscle contraction.
 4. Myosin head binding sites in thin filament are masked when troponin is bound by Ca^{+2} .

5. The barbed end of F-actin is also called plus end and pointed end called minus end.
6. Exchanges of ADP to ATP bound G-actin leads to polymerization and the formation of F-actin.

- A) 1, 2, 6
- B) 2, 4, 6
- C) 1, 3, 5
- D) 1, 2, 3
- E) 3, 4, 5

9. Which of the following statements about muscle contraction are *false*?

1. The power stroke during myosin head conformational change is the main step to drive the swinging crossbridge model of muscle contraction.
2. ATP-binding in myosin head drives the binding between actin and myosin head.
3. Calcium-binding in the troponin C subunit is the main event to expose myosin head binding sites in F-actin.
4. ATP-binding in F-actin exposes its myosin head binding sites.
5. After releasing of ADP and Pi from myosin heads, muscle stops its contraction and returns to its rest state.
6. Tropomyosin blocks the binding between myosin and F-actin.

- A) 1, 3, 6
- B) 2, 3, 4
- C) 1, 5, 6
- D) 2, 4, 5
- E) 4, 5, 6

10. Which of the following protein interactions is enhanced upon binding of two receptors to the S domain of heparin sulfate?

1. FGF and FGFR dimer
2. Thrombin and Factor Xa
3. Antithrombin and Factor Xa
4. Thrombin and lipoprotein lipases
5. Antithrombin and thrombin
6. FGF dimer and FGFR

- A) 1, 2, 5
- B) 2, 3, 4
- C) 1, 3, 6
- D) 1, 3, 5
- E) 2, 5, 6

11. Which of the following is true about the nature of glycoconjugates?

1. The glycosaminoglycan chains of proteoglycans are monotonous than the oligosaccharide portions of aggrecan within cartilage; they are rich in information and forming highly specific sites for recognition.
2. The informational carbohydrate is often covalently joined to a protein to form a glycoconjugate, which is the biologically active molecule.
3. The glycosaminoglycan moiety commonly forms the greater fraction (by mass) of the proteoglycan molecule, dominates the structure, and is often the main site of biological activity.
4. Selectins mediate leukocyte rolling along endothelia via integrins
5. Selectins play important roles in the recognitions and adhesions between host cells and virus or bacteria.
6. Lectins, found in all organisms, are proteins that strongly bind carbohydrates with high specificity.

- A) 1, 2, 5
- B) 3, 4, 6
- C) 2, 3, 6
- D) 1, 2, 3, 5
- E) 1, 2, 3, 6

12. Which of the following is true about the nature of G protein-coupled receptor (GPCR)-mediated PKA functions?

1. The GTPases coupled with GPCR belong to large G-proteins.
2. G-proteins mediate signal transduction from GPCRs to other target proteins.
3. cAMP is a secondary messenger mediates the extracellular ligand-regulated adenylyl cyclase activity.
4. Binding between Catalytic subunit and cAMP triggers the GPCR-promoted PKA activity.
5. Each PKA molecule can bind four cAMP after GPCR-activated adenylyl cyclase activity.

- A) 3, 4, 5
- B) 1, 2, 5
- C) 2, 3, 4
- D) 1, 2, 3
- E) 2, 4, 5

13. Which of the following statements are true about the nature of G protein-coupled receptor (GPCR)-mediated signaling pathways related to calcium as a secondary messenger?

1. Calcium, together with IP3 and diacylglycerol, can activate the PKC function.
2. GTP-bound Gq α is dissociated from G $\beta\gamma$ to activate phospholipase C (PLC), leading to IP3 generation.
3. Ca²⁺ is released from ER to cytosol upon opening of the PIP3-gated calcium channel to activate calmodulin.
4. PKC can be activated by binding to Ca²⁺, diacylglycerol, and IP3.
5. Calmodulin has four EF hands for the binding of 4 Ca²⁺ in response to the activated PLC activity.
6. A ligand-gated ion channel releases Ca²⁺, which acts as another secondary messenger by activating calcium-sensing proteins like protein kinase C or calmodulin.

- A) 2, 5, 6
- B) 3, 4, 5
- C) 1, 4, 6
- D) 1, 2, 5, 6
- E) 2, 3, 4, 5

14. Which of the following statements are true about the receptor tyrosine kinases?

1. All the receptors can form dimers after binding to their extracellular ligands.
2. Inability of β cells in pancreatic islets to make or sense insulin results in diabetes.
3. Binding of insulin to the insulin receptor initiates autophosphorylation of the tyrosine kinase in the cytoplasmic region of insulin receptor and a cascade of events that leads to increased glucose uptake and metabolism through glucose transporter 4 (GLUT4).
4. Indirect interaction of phosphorylated IRS with protein Ras initiates a series of protein phosphorylations through the raf-1/mek/SRF cascade.
5. A transcription factor (Elk1) becomes phosphorylated and stimulates the GLUT4 expression upon SRF coupling.
6. Insulin reaches target cells, such as liver, muscle, or fat tissue cells via bloodstream.

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- A) 2, 5, 6
- B) 3, 4, 5
- C) 1, 3, 6
- D) 1, 2, 3, 5
- E) 2, 3, 5, 6

15. Which of the following statements are not true about the receptor tyrosine kinases?

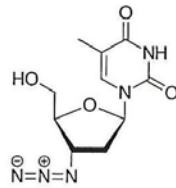
1. GSK, activated by phosphorylation, cannot activate glycogen synthase.
2. Synthesis of glycogen from glucose can be accelerated upon inactivation of GSK.
3. Endocytosis of GLUT4 occurs when we are starved.
4. Phosphorylation of PI3K by PDK is mainly responsible for phosphorylation of PIP2 to become PIP3.
5. PKB stimulates movement of GLUT4 from plasma membrane to internal vesicles for increased uptake of glucose.
6. v-Src has been identified from a sarcoma in chicken with a truncated C-terminal tail harboring a tyrosine residue, a phosphorylation of which exerts an autoinhibitory effect on c-Src activity.

- A) 2, 5, 6
- B) 3, 4, 5
- C) 1, 4, 5
- D) 1, 2, 3
- E) 4, 5, 6

三、簡答題與問答題（共 75 分，分數如題示）

16. Please state the concept of Sanger sequencing method. (2 pts)

17. AZT (3'-azido-2',3'-dideoxythymidine or Zidovudine; structure in the right) is a prodrug to treat human immunodeficiency virus (HIV) infection. Please explain (1) what is prodrug; and (2) what is the potential mechanism that AZT can inhibit viral propagation. (4 pts)



18. The biosynthesis of PRPP is the rate-limiting step in de novo biosynthesis of purine ring. Please describe how PRPP is synthesized, including the reactant(s), product(s), and enzyme(s) molecules. In addition, list two biomolecules that can inhibit this enzymatic reaction. (5 pts)
19. Please state the differences between cofactors and coenzymes. And, based on that, is tetrahydrofolate considered a cofactor or a coenzyme? Explain your reason. (6 pts)
20. Please describe in sufficient detail of how muscle cells detoxify and excrete the excess ammonia from amino acid degradation. (8 pts)
21. Please describe in detail about the pathway that fructose utilizes to enter the glycolysis in liver. (10%)
22. Please describe in detail about the *De novo* synthesis of glycogen. (10%)
23. Please describe in detail about the only reaction that takes place in the inner membrane of mitochondria in the citric acid cycle. (10%)
24. Please describe in detail about the function of cytochrome *bc1* complex in ATP synthesis. (10%)
25. Please describe in detail about the catabolism of propionyl-CoA from β oxidation of odd-numbered fatty acids. (10%)