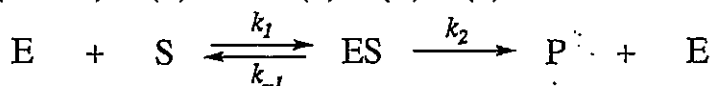


※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、選擇題：(單選，每題 2 分，共 40 分)

- The imidazole side chain of the histidine in enzyme does not usually function as (A) a general acid catalyst (B) a general base catalyst (C) a metal chelator (D) a transition-state stabilizer (E) a Schiff-base contributor.
- Which of the following enzymes will most likely and rapidly cut a peptide with a Glu-Ser-Val-Asp-Lys sequence next to Val? (A) trypsin (B) chymotrypsin (C) elastase (D) trypsinogen (E) none of above.
- Which of the following statements about enzyme catalysis is not true? (A) the transition state is stabilized due to the specificity of the active site for the substrate (B) serine proteases use electrostatic interactions to catalyze peptide bond cleavages (C) zymogens are not properly shaped forms of enzymes (D) lysozyme requires a deprotonated Glu in the active site for catalytic transformation (E) none of above.
- In steady-state kinetics, the Michaelis constant (K_M) can approximate the dissociation constant (K_S) for enzyme (E)-substrate (S) binding if (A) the enzyme-substrate complex (ES) remains constant in concentration (B) ES breakdown is faster than ES formation (C) chemical conversion is much slower than ES dissociation (D) substrate binding is much faster than chemical conversion (E) none of above since K_M can not approach closely to K_S .
- Which of the following is not true? (A) An enzyme inhibitor can be considered to be a lead compound when its inhibition constant (K_I) is in the order of 10^{-8} M (B) Irreversible enzyme inhibitors inhibit competitively (C) An enzyme is close to maximum efficiency when k_{cat}/K_M is near $10^8 \text{ M}^{-1}\text{s}^{-1}$ (D) Parallel lines on a Lineweaver-Burk plot suggest decrease in V_{max} (E) none of above. (V_{max} : maximum velocity; k_{cat} : turnover number; K_M : Michaelis constant)
- For the following enzymatic conversion of S to P, the catalytic efficiency of an enzyme can never exceed (A) $(k_{-1} + k_2)/k_1$ (B) $k_{-1} + k_2$ (C) k_1 (D) k_2 (E) k_{-1} .



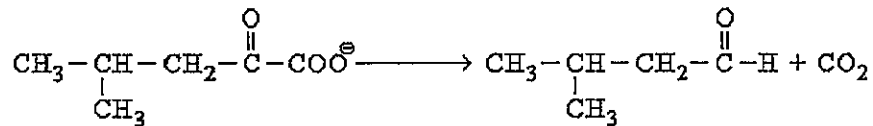
(E: Enzyme; S: Substrate; P: Product; k_1 , k_{-1} , k_2 : Rate Constants; ES: Enzyme-Substrate Complex)

- Which of the following is not true? (A) Mixed-type inhibitors can bind to enzyme-substrate complex (B) Catalytic activity of an enzyme can be controlled by modulating its expression level (C) Allosteric activators stabilize enzyme conformations with higher substrate affinity (D) Phase 2 clinical trials usually use single blind test (E) none of above.
- Which of the following enzymes is inhibited by penicillin to display antibiotic activity? (A) ribosome (B) lysozyme (C) transpeptidase (D) β -lactamase (E) protease.
- An enzyme inhibitor binds to a site other than the active site either before or after the substrate. The inhibitor displays a type of (A) uncompetitive inhibition (B) noncompetitive inhibition (C) competitive inhibition (D) irreversible inhibition (E) feedback inhibition.
- When NADH is oxidized, the UV absorbance at 340 nm (A) decreases (B) increases (C) stays the same (D) decreases, then increases (E) increases, then decreases.

11. Which of the following statements is true? (A) Acyl-group-transfer reactions often involve TPP (B) Coenzyme A contains the vitamin pantothenate (C) Lipoamide is involved in decarboxylation of metabolites (D) Pyridoxal phosphate is another name for vitamin B1 (E) none of above.
12. Which of the following statements is true? (A) Enzymes with vitamin B₆ catalyze various reactions involving amino acids (B) Transaminases are PLP-dependent enzymes that remove the beta-amino group from amino acids (C) The degradation of aspartic acid to oxaloacetic acid is catalyzed by an enzyme with thiamine (D) Vitamin C is a vitamin and a coenzyme (E) Folate participates in the conversion of homocysteine to methionine
13. Which of the following amino acids can construct a covalent bond to the pyridoxal phosphate coenzyme? (A) Cysteine (B) Aspartate (C) Serine (D) Lysine (E) All of the above.
14. Biotin, lipoic acid and pyridoxal phosphate link to the enzyme by attaching to (A) Asn (B) Cys (C) Gln (D) Ser (E) Lys.
15. Which of the following statements is not true? (A) Vitamin D helps control the Ca²⁺ utilization (B) Another name for α -tocopherol is vitamin E (C) Vitamin K is important in the scavenging of oxygen and free radicals (D) Ubiquinone is the strongest oxidizing agent (E) Plastoquinone is important in photosynthetic electron transport.
16. Which of the following statements is false? (A) A chaperonin helps fold some proteins in their lowest energy state (B) Chaperonins require ATP hydrolysis (C) The observation of motif provides the best prediction of the protein's function (D) Proteins with the same function from different species are likely to be more similar in sequence than in structure (E) Many crystallized enzyme proteins remain catalytically active.
17. To accelerate elution of a protein from a hydrophobic interaction chromatography column, which of the following is usually not an appropriate treatment made to the elution process? (A) to add detergents (B) to change the elution pH (C) to change the ion concentration of elution (D) to add organic solvent (E) none of above.
18. As a form of ion exchange chromatography, a carboxymethyl column is used to separate Arg, Val and Glu at pH 6.0. The elution order is (A) Glu>Val>Arg (B) Val>Glu>Arg (C) Glu>Arg>Val (D) Arg>Val>Glu (E) Val>Arg>Glu. (>: eluted out earlier than)
19. Which of the following statements is correct? (A) A genomic library is built from mRNA by reverse transcription (B) Small circular DNA molecules used to carry foreign DNA fragments are called clones (C) Alterations in genetic information cannot be caused by transposition of genes (D) Most of the proteins found in humans are unique to vertebrates (E) Nearly 50% of the human genome contains repetitive DNA sequences.
20. Which of the following statements is false? (A) HMG-CoA reductase catalyzes the key regulatory step of cholesterol synthesis (B) Acetyl-CoA carboxylase catalyzes the first committed step in fatty acid oxidation (C) The condensing enzyme (KS) of fatty acid synthase carries out covalent catalysis using a Cys residue in the active site (D) Fatty acid synthesis occurs in the cytosol (E) Malonyl-CoA is the source of the two carbon fragments in fatty acids biosynthesis.

二、簡答題：(共 60 分)

1. How to describe "substrate specificity" in a mathematical term of steady-state kinetics? Provide and explain an example of the relaxed substrate specificity in enzyme catalysis. (5%)
2. Explain the induced fit model of enzyme catalysis and compare it with the lock-and-key model. Give and explain an excellent example of enzyme to demonstrate the induced fit model. (5%)
3. Explain and give an example of the affinity labeling techniques in studying enzyme mechanism. Also, illustrate an analytical method to confirm and characterize the labeling of the enzyme. (5%)
4. Many kinases require magnesium ions in the active site for their phosphorylation activities. Give and explain three major functional roles of magnesium ions in kinase reactions in terms of enzyme mechanism and structure. (5%)
5. Describe the reaction and catalytic mechanism of alcohol dehydrogenase by electron flows with curved arrows and functional group transformations. The mechanism must include the core structure of the coenzyme. (5%)
6. Use serine protease as an example to explain the proximity effect taking place in enzyme catalysis. (5%)
7. Derive a rate equation for competitive inhibition, namely V_0 as a function of V_{max} , $[S]$, K_M , $[I]$ and K_I . Use the following terms and definition for deriving the equation: K_I =inhibition constant; E_T =total enzyme concentration; $[S]$ =substrate concentration; V_{max} =maximum velocity; K_M =Michaelis constant; $[I]$ =inhibitor concentration; $[ES]$ =concentration of enzyme-substrate complex; V_0 =initial rate. (5%)
8. Write out the catalytic mechanism for the following enzymatic reaction by electron flows with curved arrows, where the core structure of the required coenzyme must be shown within the mechanism. (5%)



9. Describe definition, analytic methods and applications of "Metabolomics" in modern science and technology. (5%)
10. Explain and compare between "primary metabolism" and "secondary metabolism". For each case of metabolism, give and explain briefly an example of its end products. (5%)
11. Draw each of the structures of aspartic acid that predominate at pH 1, 3, and 7. (5%)
12. Provide at least three major advantages and two major disadvantages in using *Escherichia coli* as a heterologous host to express functional proteins, as compared to using insect or mammalian cells. (5%)