國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、乙組、醫學生物科技學程

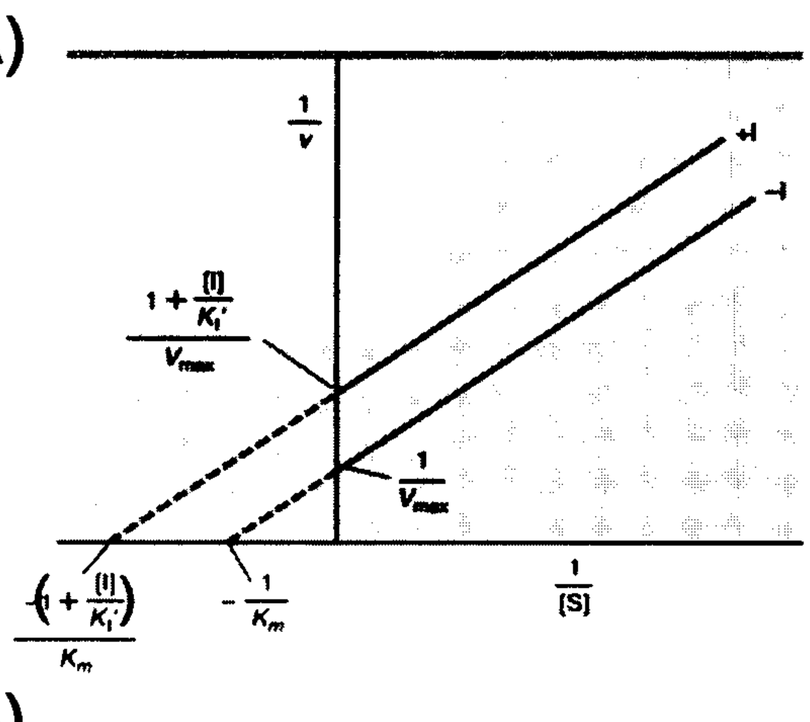
考試科目（代碼）：生物化學(0401、0501、0701)

　　*請在【答案卡】作答

Part 1 單選題 (每題一分，共四十分，答錯不倒扣。請在【答案卡】作答)

1. Which one of the following is the mechanism that Viagra inhibits PhosphoDiEsterase 5 (PDE5)?

(A)



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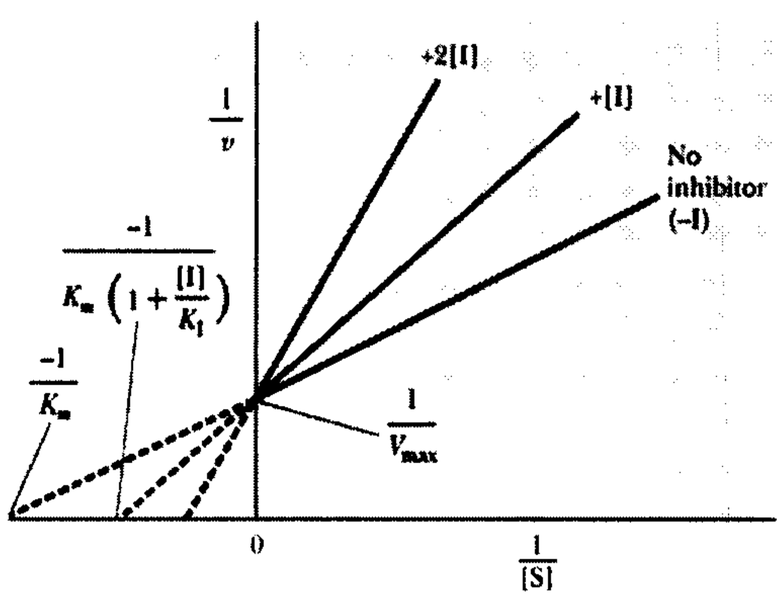

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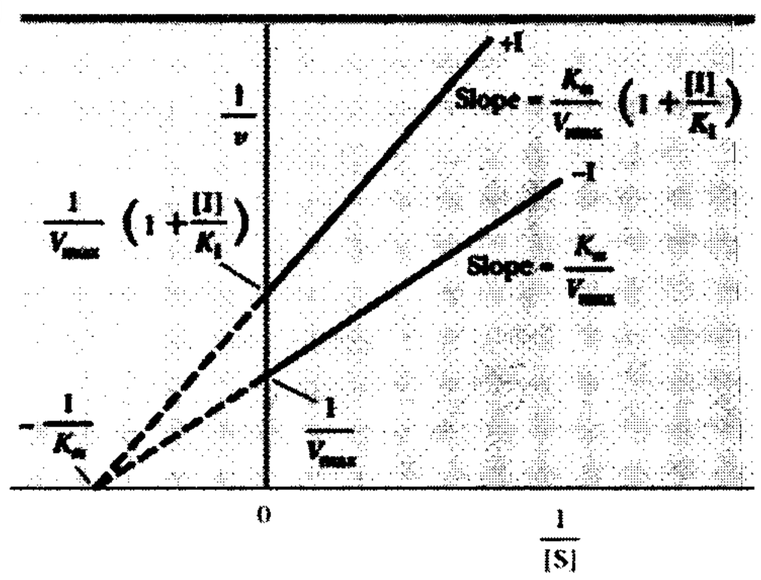

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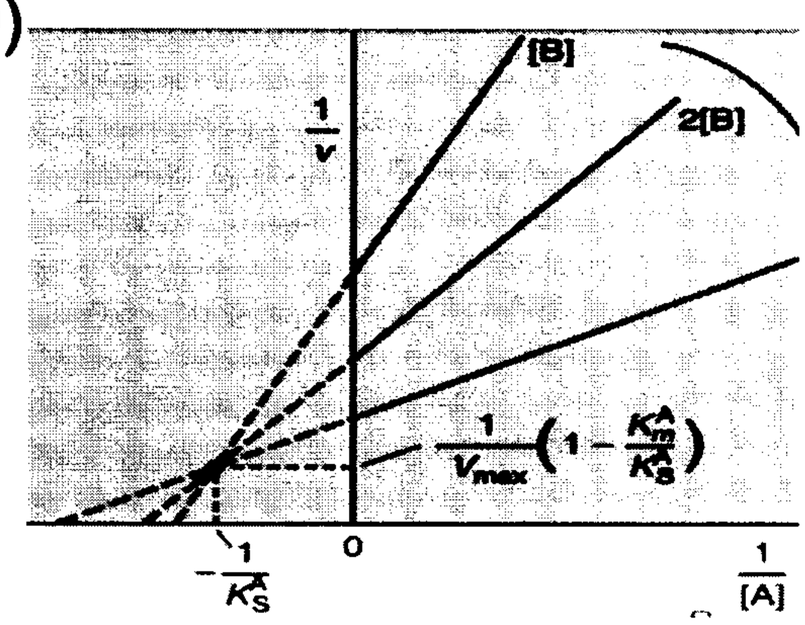
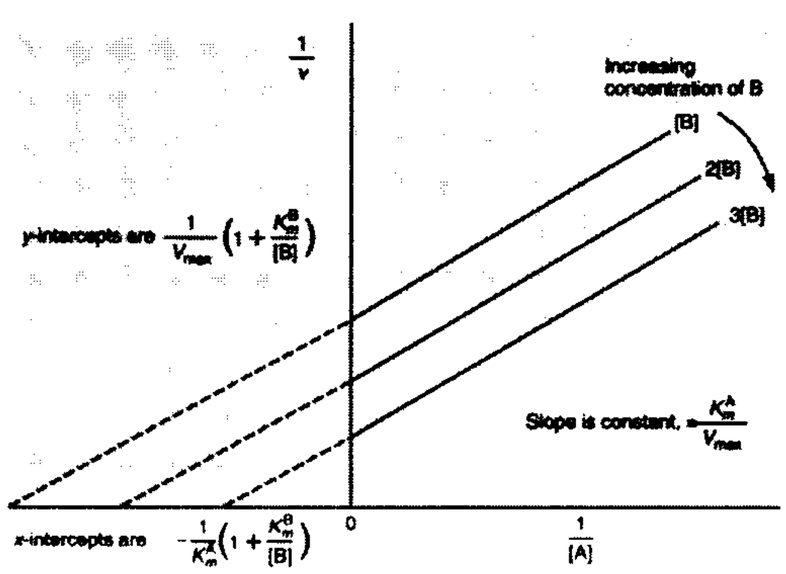
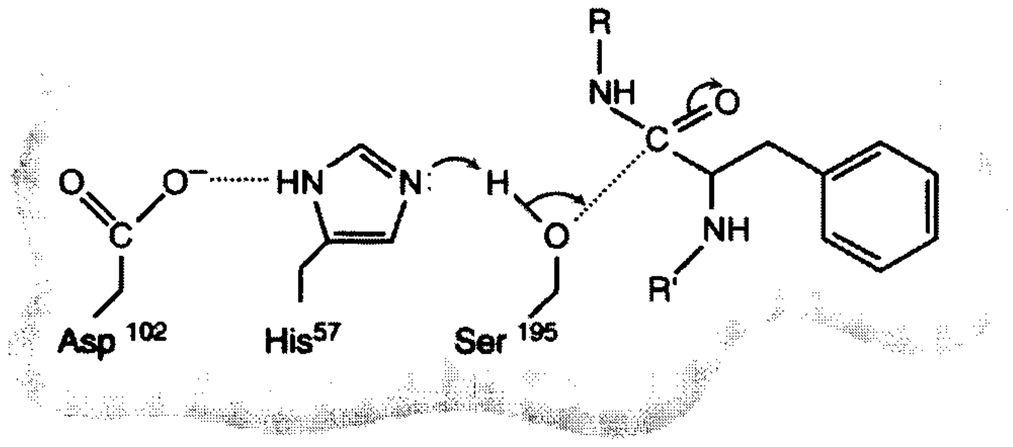


(E)

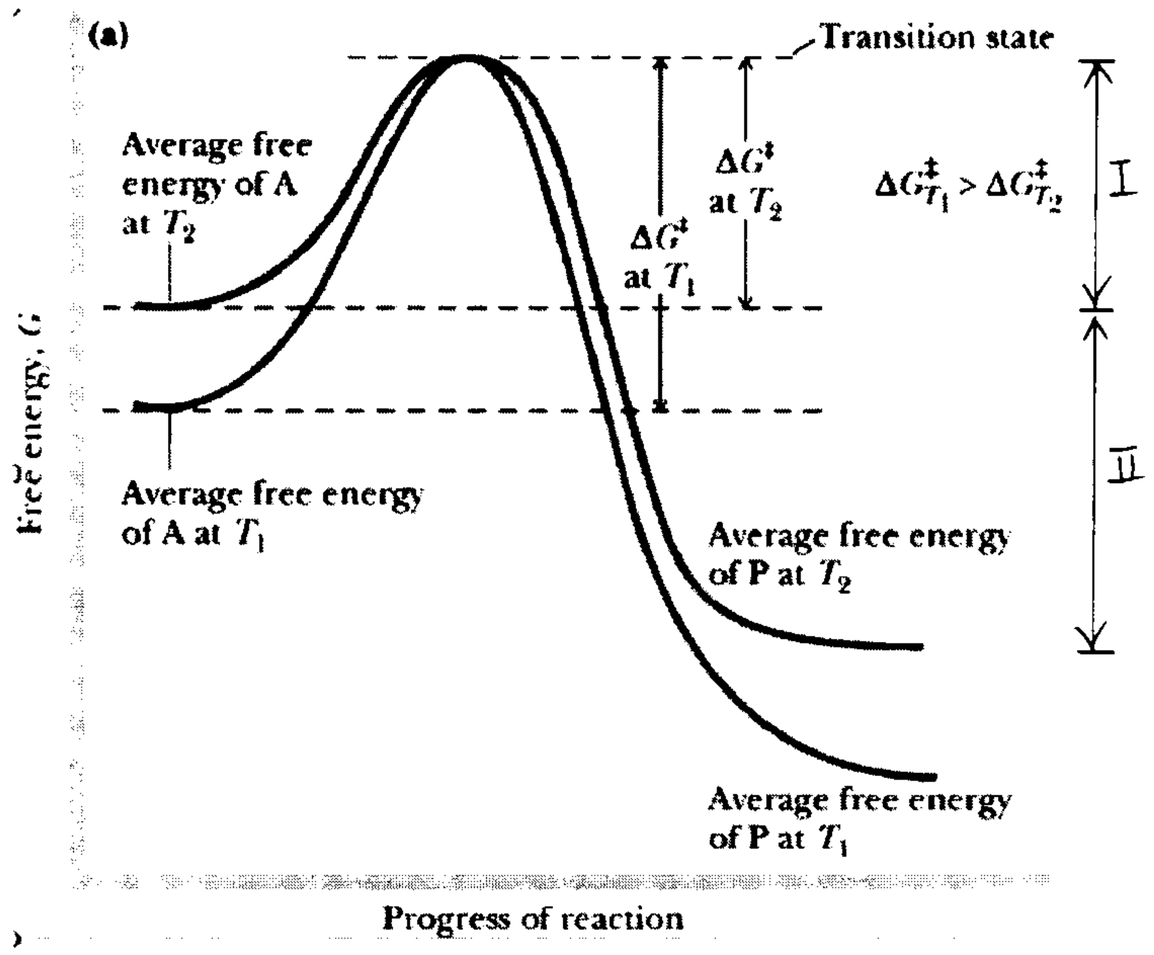


2. Enzyme is a (A) substrate analog (B) substrate stabilizer (C) transition state analog (D) transition state stabilizer (E) product stabilizer　(pick the best description)

3. For this enzyme reaction, it is a ? (A) Ping-Pong Reaction (B) Single-displacement reaction (C) Aspartic protease mediated reaction (D) reaction without water involvement (E) trypsin reaction.



4. Which statement below is inaccurate? (A) II is thermodynamics property and I is kinetics relevant (B) Both raising temperature and adding enzyme could lower the kinetic barrier (C) I is thermodynamics property and II is kinetics relevant (D) As long as II is large enough, the reaction can be completed at reasonable time frames (E) The probability for crossing barrier I is proportional to $e^{-\Delta G^{\ddagger}/kT}$.



5. Which of the following is incorrect to describe myoglobin (Mb) and hemoglobin (Hb)? (A)The R-form and T-form of the Hb differ at their salt bridges, H-bonds and covalent linkages between subunits (B) Oxygen binding curve of Hb becomes closer to that of Mb in the absence of CO2 and BPG. (C) Oxygen binds to a ferrous ion of the heme in both proteins. (D) At low pH values, the population of R-form is less than the T-from of Hb. (E) Hb can carry CO2 but at different site from the one that binds CO and O2.

6. Many adults show symptoms like diarrhea, abdominal bloating and general discomfort which can be relieved by eliminating milk from the diet. This is most likely due to lack of (A) amylase, (B) lactase, (C) galactosidase, (D) maltase, (E) sucrose.

7. The enzyme complex responsible for the photooxidation of water in photosystem II contains (A) Fe, (B) Cu, (C) Mg, (D) Mn, (E) Zn.

8. The enzyme that catalyzes the interconversion of aldoses and ketoses is a (A) isomerase, (B) epimerase, (C) aldolase, (D) mutase, (E) kinase.

9. The coenzymes of the pyruvate dehydrogenase complex do not include (A) thiamine pyrophosphate, (B) NADH, (C) coenzyme A, (D) lipoic acid, (E) iron-sulfur cluster.

10. F1F0ATP synthase works as a molecular motor. Which subunit of this complex functions as the central shaft? (A) α, (B) β, (C) γ, (D) δ, (E) ε.

11. Which of the following is the major advantage of a multi-enzyme complex?
(A) it's large size enables it to span an entire membrane (B) the product of one enzyme is passed directly to the next enzyme without the possibility of diffusion (C) multi-enzyme complexes are much less likely to be inhibite (D) all of the above (E) none of the above

12. What are the final products of aerobic catabolism? (A) pyruvate and H_2O, (B) acetyl-CoA and CO_2, (C) CO_2 and H_2O, (D) pyruvate and acetyl-CoA, (E) ammonia and O_2.

13. Dehydrogenases are enzymes that: (A) move hydrogens within the molecule, (B) add hydrogens across double bonds, (C) transfer hydrogens between substrates (D) transfer hydride ions to NAD^+ (or $NADP^+$) and release a proton, (E) all are true.

14. When dietary carbohydrate consumption exceeds the energy needs of the individual, excess carbohydrate is converted to _____ and _____ for energy storage. (A) Amino acids; glucose, (B) Fructose; triacylglycerols, (C) Triacylglycerols; glycogen, (D) Glycogen; protein, (E) None of the above.

15. Which of the following is a result of a high fat, high protein, low carbohydrate diet? (A) The bloodstream has a healthy level of ketone bodies, (B) Glycogen stores are close to maximum capacity, (C) The brain operates most efficiently on this type of diet, (D) Ketone body production generally exceeds rate of elimination, (E) None of the above.

16. Which vitamin is essential to vision? (A) vitamin A, (B) vitamin C, (C) vitamin D_2, (D) vitamin B_{12}, (E) vitamin B_1.

17. Grapefruit juice at pH 3.2 contains about _____ times as much H^+ as orange juice at pH 4.2. (A) 0.9, (B)$10^{-7.5}$, (C) 10^{-2}, (D)10, (E) 101.

18. What ionic forms are present at pH 7.0? The pK_as of phosphoric acid are 2.1, 7.2, 12.4. (A) HPO_4^{-2}, (B) $H_2PO_4^-$, (C) HPO_4^{-2} and PO_4^{-3}, (D) $H_2PO_4^-$ and HPO_4^{-2}, (E) All are correct.

19. Calorimetry measures _____ by a biochemical process. (A) Heat absorbed or given off, $\triangle H$, (B) Pressure change inside calorimeter created, (C) Water pressure created, (D) Entropy change, $\triangle S$, (E) Volume change, $\triangle V$, created.

20. A widely used "consensus value" for $\triangle G^{o'}$ of ATP hydrolysis in biological systems is _____ kJ/mol. (A) -21, (B) -30.5, (C) -7, (D) 3, (E) 21.

21. The amino and carboxyl groups of amino acids react in a head-to-tail fashion, eliminating water, and forming a covalent _____ linkage typically referred to as a _____ bond.
(A) ester, aromatic (B) anhydride, phosphoanhydride (C) amide, peptide (D) dehydration, hydrogen (E) none of the above

22. All of the statements about the classification of these amino acids are correct EXCEPT: (A) Aspartic acid and asparagine are acidic amino acids. (B) Alanine and valine are neutral, nonpolar amino acids. (C) Serine and glutamine are polar, uncharged amino acids. (D) Lysine and arginine are basic amino acids. (E) Tyrosine and phenylalanine are aromatic amino acids.

23. Which of the following amino acids absorbs light most strongly between 250 and 300 nm? (A) His, (B) Phe, (C) Trp, (D) Tyr, (E) None of the above absorb light in this range.

24. The formation of a disulfide bond would be an example of what level of protein structure? (A) Primary, (B) Secondary, (C) Tertiary, (D) quaternary, (E) Both c and d are correct.

25. After treating a protein with trypsin, which of the following techniques could be used to determine its identity by peptide mass fingerprinting? (A) NMR, (B) MALDI-TOF mass spectrometer, (C) HPLC, (D) Gel electrophoresis, (E) None of the above.

26. Alpha helices are stabilized primarily by: (A) Hydrogen bonds between the main chain peptide bond component atoms. (B) Electrostatic interactions between R-groups. (C) Hydrophobic interactions between the alpha-carbons of the main chain. (D) Hydrogen bonding between the R-groups. (E) Hydrophobic interactions between R-groups and the solvent water.

27. Tertiary structure is defined as: (A) the sequence of amino acids. (B) The folding of a single polypeptide chain in three-dimensional space. (C) Hydrogen bonding interactions between adjacent amino acid residues into helical or pleated segments. (D) The way in which separate folded monomeric protein subunits associate to form oligomeric proteins. (E) All are true.

28. The endoplasmic reticulum bound enzyme that hydrolyzes glucose-6-phosphate to glucose in liver is: (A) glucokinase, (B) glucose oxidase, (C) hexokinase, (D) phosphoglucomutase, (E) glucose-6-phosphatase.

29. Insulin in the bloodstream is a response to increased blood glucose, and: (A) stimulates gluconeogenesis. (B) inhibits glycolysis. (C) stimulates glycogen synthesis in muscle and liver. (D) stimulates glycogen breakdown in liver. (E) inhibits phosphoprotein phosphatase-1.

30. Which of the following can be used as a substrate for gluconeogenesis in the liver? (A) Alanine, (B) Glutamic acid, (C) Glycerol, (D) Succinate, (E) All of the above

31. For the complete oxidation of a saturated fatty acid with 16 carbons, how many times must the beta-oxidation cycle be repeated? (A) 4, (B) 7, (C) 8, (D) 6, (E) 16.

32. What are the β-oxidation products of oleic acid ($18:1^{\Delta 9}$) and how many ATP equivalents are required for activation? (A) 8 acetyl CoA, 8 NADH, 7 $FADH_2$, 1 ATP equivalents (B) 9 acetyl CoA, 8 NADH, 7 $FADH_2$, 2 ATP equivalents (C) 8 acetyl CoA, 7 NADH, 7 $FADH_2$, 1 ATP equivalents (D) 8 acetyl CoA, 7 NADH, 6 $FADH_2$, 2 ATP equivalents (E) 9 acetyl CoA, 9 NADH, 8 $FADH_2$, 1 ATP equivalents

33. The brain normally uses _____ as its source of metabolic energy, but during starvation _____ may be the major source of energy. (A) glucose; ketone bodies (B) ketone bodies; fatty acids (C) fatty acids; amino acids (D) amino acids; glucose (E) all are true

34. Dietary lipids are "packaged" in the intestine into _____ for transport in the blood stream. (A) Chylomicrons, (B) HDL, (C) IDL, (D) VLDL, (E) LDL.

35. *E. coli* does NOT have any _____ fatty acids, plants can introduce double bonds into fatty acids between $\triangle^9$ and the _____-end of the chain, while mammals can only introduce double bonds between $\triangle^9$ and the _____-end of the chain. (A) Saturated; carboxyl; methyl (B) Mono-unsaturated; carboxyl; methyl (C) Polyunsaturated; carboxyl; methyl (D) Polyunsaturated; methyl; carboxyl (E) Saturated; methyl; carboxyl

36. In the transamination of amino acids all of the following statements are true EXCEPT? : (A) pyridoxal phosphate is a coenzyme, (B) the reaction is tightly controlled by allosteric effectors, (C) the amino acid acceptor is typically an α-keto acids, (D) ammonia is neither consumed nor produced, (E) the reactions do not need ATP to catalyze.

37. The Lesch-Nyhan syndrome is due to a severe deficiency of ?: (A) PRPP, (B) ribonucleotide reductase, (C) xanthine oxidase, (D) HGPRT, (E) purine nucleoside phosphorylase.

38. Steps in the synthesis of dTMP include all of the following EXCEPT? (A) dUDP is formed from UDP, (B) dTMP is formed by methylation of dUMP, (C) a methylene group is transferred from N^5,N^{10}-methylene-THF and reduced to a methyl group, (D) N^5,N^{10}-methylene-THF is oxidized to DHF, (E) thymidine undergoes phosphorolysis.

39. Which of the following metabolic pathways is correctly matched with the key enzyme that regulates that pathway? (A) pentose pathways---glucokinase, (B) glycolysis---fructose 1,6-bisphosphatase, (C) gluconeogenesis --- phosphofructokinase, (D) fatty acid synthesis---acetyl CoA carboxylase, (E) TCA cycle---glucose 6-phosphate dehydrogenase.

40. All are true for the energy charge (EC) of a cell EXCEPT? (A) It is an index of adenylate phosphoric anhydrides, (B) EC has a range of 0 to 1.0, (C) It is a ratio of adenylate phosphoric anhydride bonds to total adenylate concentration, (D) It is 1.0 when all of the adenylate is ATP, (E) It is rapidly changed by adenylate kinase.

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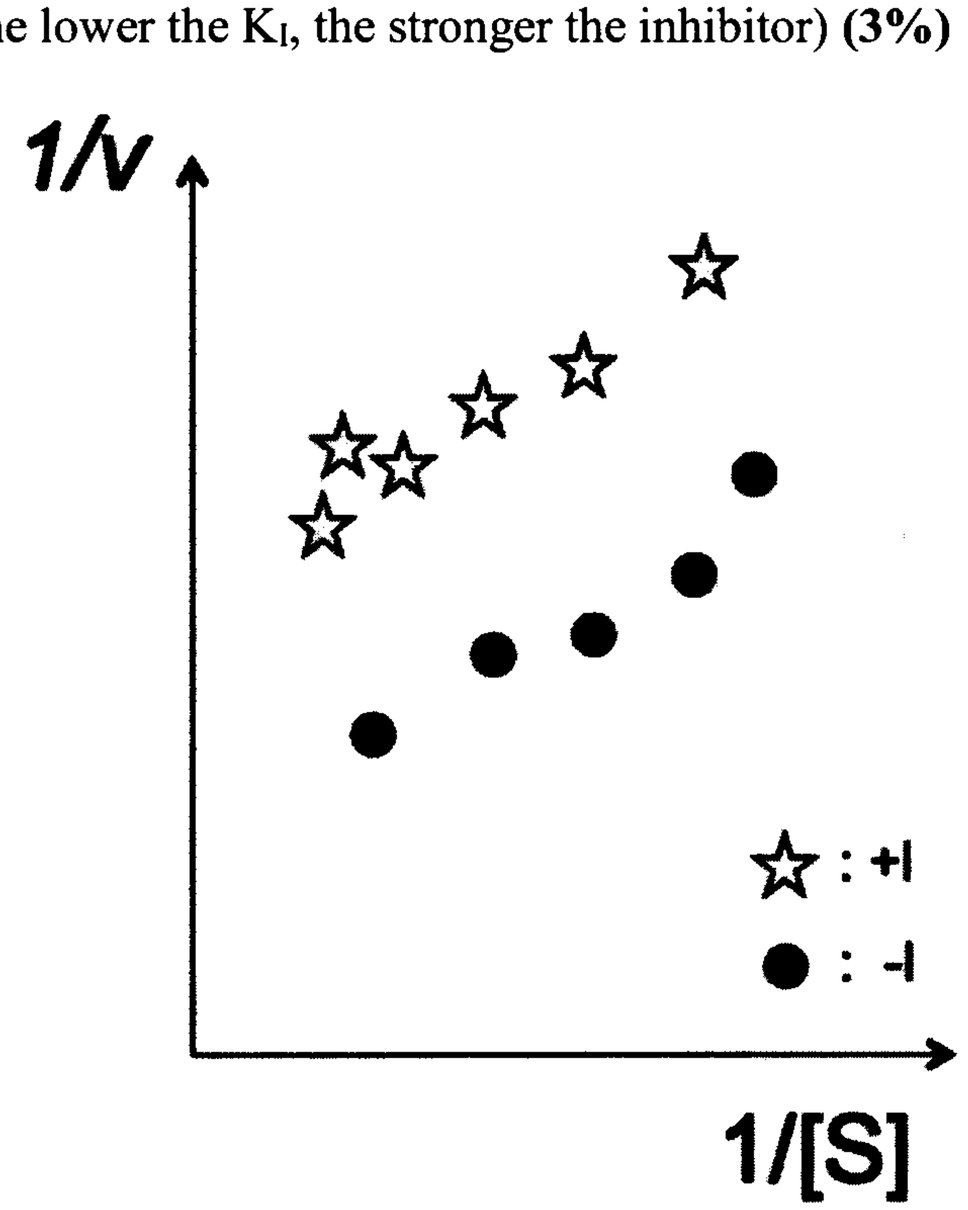
Part 2 問答題 (每題十分，共六十分。請在【答案卷】務必依序作答)

1. Write FOUR approaches how enzymes' activity can be regulated in response to organism's physiological needs and give examples. **(10%)**

2. The double reciprocal (Lineweaver Burk) plot drawn for an enzyme kinetics study, with or without inhibitor, is shown as below. **(a)** How does inhibitor bind enzyme? (do they compete the same site with the substrate, or substrate and inhibitor bind different sites, or inhibitor binds the enzyme only when substrate binds the enzyme) **(4%) (b)** which of the following is its "apparent K_m", K_m', under different [I] concentration ? $K_m' = K_m(1+[I]/K_I)$, or $K_m' = K_m$, or $K_m' = K_m/(1+[I]/K_I)$ **(3%) (c)** Please describe how you can do experiments to determine the potency of the inhibitor, K_I (the lower the K_I, the stronger the inhibitor) **(3%)**



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3. Write down the sequence of the electron transport components from plastocyanin to ferredoxin. (Hint: electron transport of photosystem I.) **(10%)**

4. Write the balanced equations for all the irreversible reactions of glycolysis.**(10%)**

5. What is peptide mass fingerprinting in mass spectrometry analysis? How can it be used for protein identification in proteomics? **(10 %)**

6. Glucose-6-phosphate is an important metabolic intermediate in liver. What are the metabolic roles / fates of Glucose-6-phosphate? **(10 %)**