

※ 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：(14分，每題1分)

1. Which is not true for a true catalyst?
 - (a). It is not "used up"
 - (b). It usually acts by forming a transient complex
 - (c). It increases the rate of a reaction by increase the energy level of the substrate
 - (d). It does not change the position of equilibrium
 - (e). RNA can catalyze the hydrolysis of peptide bonds

2. Myoglobins (Mb) and humoglobins (Hb) contain _____ α helices and _____ β -strands.
 - (a). 9; 0
 - (b). 6; 2
 - (c). 10; 2
 - (d). 7; 0
 - (e). 8; 0

3. How do Mb and Hb bind to oxygen?
 - (a). to use ferric iron-containing prothetic heme structure
 - (b). to use ferrous iron-containing prothetic heme structure
 - (c). to use ferric iron-containing Hb-free heme structure
 - (d). to use ferrous iron-containing tight (T) state Mb and Hb
 - (e). to use ferric iron-containing R state Mb and Hb

4. Which of the following receptors does not belong to seven transmembrane receptors (7 TM)?
 - (a). angiotensin II receptor
 - (b). adenylate cyclase
 - (c). rhodopsin
 - (d). G protein coupled receptor
 - (e). β 2-adrenergic receptor

5. Hemoglobins are examples of:
 - (a). highly regulated proteins simultaneously performing multiple physiological functions
 - (b). multiple different protein subunits in a complex network spontaneously associating into a specific molecular arrangement

(背面仍有題目，請繼續作答)

- (c). specific recognition of molecular and individual binding capabilities
(d). multidomain architecture
(e). similarities in their catalytic mechanism and three-dimensional structure
6. A prosthetic group of a protein is a non-protein structure that is:
- (a). a ligand of the protein.
(b). a part of the secondary structure of the protein.
(c). a substrate of the protein.
(d). permanently associated with the protein.
(e). transiently bound to the protein.
7. In an experiment completed in biochemistry lab, you found that a $4.5 \mu\text{M}$ solution of enzyme acetyl cholinesterase catalyzed the breakdown of 26 mM acetylcholine in 0.8 min of reaction time. What is the turn over number for acetyl cholinesterase in seconds⁻¹?
- (a). 7222
(b). 1204
(c). 120.4
(d). 7.222
(e). 72.22
8. How could the epinephrine stimulatory signaling pathway be stopped?
- (a). Dissociation of epinephrine from adenylate cyclase
(b). GDP-bound $G\alpha_S$ switched to GTP-bound $G\alpha_S$
(c). ATP switched to cAMP
(d). Phosphorylation of β_2 -adrenergic receptor by the receptor kinase
(e). β -arrestin attached to the dephosphorylated β_2 -adrenergic receptor
9. In the EGF/EGFR signaling pathway, what type of domain does polyprolin-rich polypeptide bind?
- (a). SH3
(b). SH2
(c). PHD
(d). PBD
(e). EF hand
10. Which of the following is *not* correct concerning 2,3-bisphosphoglycerate (BPG)?
- (a). It binds at a distance from the heme groups of hemoglobin.
(b). It binds with lower affinity to fetal hemoglobin than to adult hemoglobin.

- (c). It impedes the oxygen release from hemoglobin into tissues.
(d). It is an allosteric modulator.
(e). It is normally found associated with the hemoglobin extracted from red blood cells.
11. The amino acid substitution of Val for Glu in hemoglobin S results in aggregation of the protein because of _____ interactions between molecules.
- (a). covalent
(b). disulfide
(c). hydrogen bonding
(d). hydrophobic
(e). ionic
12. Which of the following interactions is not affected when hemoglobins bind to oxygens in the lungs?
- (a). $\alpha 1/\beta 2$ subunits
(b). $\alpha 2/\beta 1$ subunits
(c). $\alpha 1/\beta 1$ subunits
(d). $\alpha 1/\alpha 2$ subunits
(e). $\beta 1/\beta 2$ subunits
13. Which of the following glycoproteins contain variable number of tandem repeats (VNTR)?
- (a). glycosyltransferase
(b). erythropoietin
(c). phosphotransferase
(d). aggrecan
(e). mucin
14. Which of the following amino acids contain a side chain that most directly interferes the binding of O_2 to the 6th bond of Fe^{+3} in the heme compound within Hb?
- (a). proximal histidine
(b). distal histidine
(c). histidine within HC3 of Hb
(d). the 6th glutamate of Hb
(e). the 94th aspartate of Hb

(背面仍有題目，請繼續作答)

二、選擇題：（76分，每題2分）

15. For competitive inhibition, the K_m is higher in the presence of the inhibitor, why?
- Because the inhibitor binds substrate so that the enzyme no longer recognizes it
 - Because the inhibitor binds to the enzyme to change its conformation so that the binding affinity between the enzyme and the substrate is reduced
 - The K_m is the $[S]$ required to reach 1/2 of the maximum rate for the enzyme. Therefore the enzyme must work faster to process both the substrate and interfering inhibitor
 - The K_m is the $[S]$ required to reach 1/2 of the maximum rate for the enzyme. Therefore much more substrate will be needed to compete with the inhibitor to reach 1/2 of the V_{max}
 - The K_m is the $[S]$ required to reach 1/2 of the maximum rate for the enzyme. Therefore much more reaction time will be needed for enzyme work to reach 1/2 of the V_{max}
16. In a laboratory experiment you completed a study of enzyme kinetics. The following data were collected:

Substrate concentration [S] (μmolar)	50	120	300	500	800	1300	1800	2500
Velocity of enzymatic reaction ($\mu\text{molar}/\text{min}$)	30	87	110	130	170	208	215	210

Estimate the K_m for this substrate:enzyme combination without graphing the data.

- 260
 - 860
 - 460
 - 1060
 - 1720
17. When add an inhibitor with fixed concentration to the enzymatic reaction of [Q16], the velocity ($\mu\text{molar}/\text{min}$) of the reaction became: 46, 85, 99, 110, 120, 135, 148, 150. What is the function of this inhibitor?
- Irreversible inhibition
 - Competitive inhibition
 - Noncompetitive inhibition
 - Uncompetitive inhibition
 - Non-classical inhibition

18. When add an inhibitor with fixed concentration to the enzymatic reaction of [Q16], the velocity (umolar/min) of the reaction became: 27, 60, 77, 90, 115, 137, 209, 212. What change is not true for the inhibition?
- No change of V_{max}
 - Slope of the LB equation increased
 - No change of K_m
 - The inhibitor binds to the same binding site as that of substrate in the enzyme:substrate complexes
 - Increase of $-1/K_m$
19. In hemoglobin, the transition from R state to T state (high to low oxygen binding affinity) is not triggered by:
- the ion-pair between Asp94 and His-146 forms
 - pH in the blood is lower than 7.4
 - the pKa of His-146 is decreased
 - CO₂ binding
 - H+Hb.
20. When you are in a high mountain, why some people feel severe headache and short breath?
- allosteric cooperativity of Hb is decreased
 - pH within tissues is decreased
 - BPG is overproduced
 - oxygen concentration within tissues is increased
 - BPG concentration remains unchanged
21. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:
- lysine, serine, or threonine.
 - aspartate, serine or threonine.
 - asparagine, serine, or threonine.
 - aspartate or glutamate.
 - glutamine or arginine.
22. Which of the following statements concerning the structure of the repeating basic unit of amylose and cellulose is correct?
- For the structure of amylose, the repeating unit is α -D-glucose linked to α -D-glucose.
 - For the structure of cellulose, the repeating unit is α -D-glucose linked to β -D-glucose.
 - The glycosidic bond in amylose is ($\beta 1 \rightarrow 4$).
 - The glycosidic bond in cellulose is ($\alpha 1 \rightarrow 4$).
 - None of the above

(背面仍有題目，請繼續作答)

23. If $\Delta E'^{\circ}$ for an oxidation-reduction reaction is positive,
- (a). the $\Delta G'^{\circ}$ will be zero.
 - (b). the $\Delta G'^{\circ}$ will be positive.
 - (c). the $\Delta G'^{\circ}$ will be negative.
 - (d). the $\Delta G'^{\circ}$ is not related to $\Delta E'^{\circ}$.
 - (e). None of the above.
24. Which of the following statements concerning the relationship between $\Delta G'^{\circ}$ and K_{eq}' is correct?
- (a). When $\Delta G'^{\circ} > 0$, the term $-RT \ln K_{eq}'$ has a positive value and $K_{eq}' > 1$.
 - (b). When $\Delta G'^{\circ} < 0$, the term $-RT \ln K_{eq}'$ has a negative value and $K_{eq}' > 1$.
 - (c). When $\Delta G'^{\circ} = 1.0 \text{ kJ/mol}$, $K_{eq}' = 1$.
 - (d). K_{eq}' and $\Delta G'^{\circ}$ mean the same thing.
 - (e). None of the above.
25. The energy yield in molecules of ATP per glucose monomer converted to lactate from glycogen via glycogen breakdown and glycolysis is
- (a). 0 ATP.
 - (b). 1 ATP.
 - (c). 2 ATP.
 - (d). 3 ATP.
 - (e). 4 ATP.
26. The first reaction in glycolysis that results in the formation of an energy-rich compound is catalyzed by:
- (a). hexokinase.
 - (b). glyceraldehyde 3-phosphate dehydrogenase.
 - (c). phosphofructokinase-1.
 - (d). phosphoglycerate kinase.
 - (e). triose phosphate isomerase.
27. An enzyme used in glycolysis but not in gluconeogenesis is:
- (a). 3-phosphoglycerate kinase.
 - (b). glucose 6-phosphatase.
 - (c). aldolase.
 - (d). phosphofructokinase-1.
 - (e). enolase.

28. Which of the following statements concerning the pentose phosphate pathway is correct?
- (a). It generates CO_2 from C-1 of glucose.
 - (b). It requires the participation of molecular oxygen.
 - (c). It is not prominent in lactating mammary glands.
 - (d). It is principally directed toward the generation of NADP^+ .
 - (e). None of the above.
29. Glycogenin:
- (a). catalyzes the conversion of glycogen into glucose.
 - (b). is the enzyme that transfers a glucose residue from UDP-glucose to the hydroxyl group of a tyrosine residue on glycogenin molecule.
 - (c). is responsible for forming branches in glycogen.
 - (d). is the regulatory enzyme of glycogen synthesis.
 - (e). none of the above.
30. In the citric acid cycle, all of the following enzymes require NAD^+ as a coenzyme *except* the reaction catalyzed by:
- (a). isocitrate dehydrogenase.
 - (b). malate dehydrogenase.
 - (c). α -ketoglutarate dehydrogenase.
 - (d). succinate dehydrogenase.
 - (e). none of the above.
31. All of the following cofactors are required in the oxidative decarboxylation reaction of α -ketoglutarate *except*
- (a). thiamine pyrophosphate.
 - (b). coenzyme A.
 - (c). lipoic acid.
 - (d). NAD^+ .
 - (e). FAD.
32. Which one of the following statements concerning cytochrome *c* is *incorrect*?
- (a). In the electron transport chain, cytochrome *c* accepts electrons from Complex II and transfers them to Complex III.
 - (b). In the electron transport chain, cytochrome *c* is the only water soluble carrier.
 - (c). In apoptotic cell death, the permeability of the outer mitochondrial membrane increases dramatically allowing the escape of cytochrome *c* into the cytoplasm where it activates caspase 9.
 - (d). Cytochrome *c* operates in the space between the outer and inner mitochondrial membranes.
 - (e). None of the above.

(背面仍有題目，請繼續作答)

33. An infant is deficient in argininosuccinate synthetase and arginine is given to supply a protein restriction diet. Which molecule would carry nitrogen out of the body?
- (a). ornithine
 - (b). citrulline
 - (c). argininosuccinate
 - (d). aspartate
 - (e). hippurate
34. Pyridoxal phosphate enzymes catalyze amino acid substrate transformation. What is the function of the coenzyme in catalyzing the reaction?
- (a). It functions as a nucleophile.
 - (b). It functions as a general acid.
 - (c). It functions as a general base.
 - (d). It functions as an electron sink.
 - (e). It function as an electron donor.
35. During prolonged exercise and fasting, muscle uses branched chain amino acids as fuel. The nitrogen removed from the amino acids has to be transferred from the muscle to the liver. Which is the major form of the nitrogen carrier?
- (a). Glutamine
 - (b). Glutamate
 - (c). Arginine
 - (d). Aspartic acid
 - (e). Alanine
36. Which enzyme requires cofactor 5'-deoxyadenosylcobalamin?
- (a). Phenylalanine hydroxylase
 - (b). Cystathionine β -synthetase
 - (c). Methylmalonyl CoA mutase
 - (d). Carbamoyl phosphate synthetase
 - (e). Tyrosine 3-monooxygenase
37. A two-year-old child was under weight with slow physiological development. A urine sample treated with ferric chloride gave a green color characteristic of the presence of phenylpyruvate. Which enzyme might be deficient in this child?
- (a). Tyrosinase
 - (b). Phenylalanine hydroxylase
 - (c). Tyrosine aminotransferase
 - (d). *p*-Hydroxyphenylpyruvate dioxygenase
 - (e). Phenylalanine aminotransferase

38. Which amino acids are exclusive ketogenic?
- (a). Lysine and leucine
 - (b). Phenylalanine and tyrosine
 - (c). Isoleucine and leucine
 - (d). Histidine and tryptophan
 - (e). Isoleucine and methionine
39. The major degradation end product of histidine to get into citric acid cycle is
- (a). pyruvate
 - (b). oxaloacetate
 - (c). fumarate
 - (d). succinyl Co-A
 - (e). α -ketoglutarate
40. which cofactor is most active in the biological methyl group transfer ?
- (a). S-adenosylmethionine
 - (b). N5-methyltetrahydrofolate
 - (c). Biotin
 - (d). Methylcobalamin
 - (e). Tetrahydrobiopterin
41. Which of the following is *not* required in the synthesis of fatty acids?
- (a). Acetyl-CoA
 - (b). Biotin
 - (c). HCO_3^- (CO_2)
 - (d). Malonyl-CoA
 - (e). NADH
42. Which of the following statements concerning the β oxidation of fatty acids is true?
- (a). About 1,200 ATP molecules are ultimately produced per 20-carbon fatty acid oxidized.
 - (b). One FADH_2 and two NADH are produced for each acetyl-CoA.
 - (c). The free fatty acid must be carboxylated in the β position by a biotin-dependent reaction before the process of β oxidation commences.
 - (d). The free fatty acid must be converted to a thioester before the process of β oxidation commences.
 - (e). Two NADH are produced for each acetyl-CoA.

(背面仍有題目，請繼續作答)

43. Which of the following is *not* true of the fatty acid synthase and the fatty acid β -oxidation systems?
- A derivative of the vitamin pantothenic acid is involved.
 - Acyl-CoA derivatives are intermediates.
 - Double bonds are oxidized or reduced by pyridine nucleotide coenzymes.
 - The processes occur in different cellular compartments.
 - The processes occur in the mitochondrial matrix.
44. Which of the following is (are) true of the β oxidation of long-chain fatty acids?
- The enzyme complex that catalyzes the reaction contains biotin.
 - FADH_2 serves as an electron carrier.
 - NADH serves as an electron carrier.
 - Oxidation of an 18-carbon fatty acid produces six molecules of propionyl-CoA.
 - Oxidation of a 15-carbon fatty acid produces at least one propionyl-CoA.
- 1, 2, and 3
 - 1, 2, and 5
 - 2, 3, and 4
 - 2, 3, and 5
 - 3 and 5 only
45. Which of these statements about the regulation of cholesterol synthesis is *not* true?
- Cholesterol acquired in the diet has essentially no effect on the synthesis of cholesterol in the liver.
 - Failure to regulate cholesterol synthesis predisposes humans to atherosclerosis.
 - High intracellular cholesterol stimulates formation of cholesterol esters.
 - Insulin stimulates HMG-CoA reductase.
 - Some metabolite or derivative of cholesterol inhibits HMG-CoA reductase.
46. Fatty acids are activated to acyl-CoAs and the acyl group is further transferred to carnitine because:
- acyl-carnitines readily cross the mitochondrial inner membrane, but acyl-CoAs do not.
 - acyl-CoAs easily cross the mitochondrial membrane, but the fatty acids themselves will not.
 - carnitine is required to oxidize NAD^+ to NADH.
 - fatty acids cannot be oxidized by FAD unless they are in the acyl-carnitine form.
 - None of the above is true.

47. If malonyl-CoA is synthesized from $^{14}\text{CO}_2$ and unlabeled acetyl-CoA, and the labeled malonate is then used for fatty acid synthesis, the final product (fatty acid) will have radioactive carbon in:
- (a). every C.
 - (b). every even-numbered C-atom.
 - (c). every odd-numbered C-atom.
 - (d). no part of the molecule.
 - (e). only the omega-carbon atom (farthest carbon from C-1).
48. The role of hormone-sensitive triacylglycerol lipase is to:
- (a). hydrolyze lipids stored in the liver.
 - (b). hydrolyze membrane phospholipids in hormone-producing cells.
 - (c). hydrolyze triacylglycerols stored in adipose tissue.
 - (d). synthesize lipids in adipose tissue.
 - (e). synthesize triacylglycerols in the liver.
49. The enzyme system for adding double bonds to saturated fatty acids requires all of the following *except*:
- (a). a mixed-function oxidase.
 - (b). ATP.
 - (c). cytochrome *b5*.
 - (d). molecular oxygen (O_2).
 - (e). NADPH.
50. The carbon atoms from a fatty acid with an odd number of carbons will enter the citric acid cycle as acetyl-CoA and:
- (a). butyrate.
 - (b). citrate.
 - (c). malate.
 - (d). succinyl-CoA.
 - (e). α -ketoglutarate.
51. The acetyl-CoA derived from glyoxysomal β -oxidation is converted to carbohydrate via
- (a). The glyoxylate cycle
 - (b). The citric acid cycle
 - (c). Gluconeogenesis
 - (d). Both A and B are correct
 - (e). Both A and C are correct

(背面仍有題目，請繼續作答)

52. Which of the following types of fatty acid oxidation produces a dicarboxylic acid?

- (a). Alpha
- (b). Beta
- (c). Delta
- (d). Omega
- (e). A and D

三、簡答題（10分）

53. Allopurinol has been widely used to treat gouty arthritis, please describe the possible biochemical, pathological mechanisms for gouty arthritis in detail and the mode of function about allopurinol. (6%)
54. Please describe the molecular and biochemical mechanisms about severe combined immunodeficiency and the possible treatment of this disease. (4%)