

碩士班入學考試生物化學試題

I. 單選題(55%)，每題一分

- 下列分子那一個不是 gluconeogenesis 的主要 precursors ? (1) propionate (2) glycerol (3) fatty acid (4) lactate .
- 下列那一個 enzyme 不出現在 gluconeogenesis 的 pathway 中 ? (1) pyruvate carboxylase (2) hexokinase (3) fructose-1,6-bisphosphatase (4) phosphoglucose isomerase .
- 下列分子那一個直接參與 glycogen biosynthesis ? (1) UDP-glucose (2) CDP-glucose (3) ADP-glucose (4) GDP-glucose .
- Glycogen 中分支的部位是那一種 linkage ? (1) $\alpha(1 \rightarrow 4)$ (2) $\alpha(1 \rightarrow 6)$ (3) $\beta(1 \rightarrow 4)$ (4) $\beta(1 \rightarrow 6)$.
- 在 erythrocyte surface 上決定血型的 antigen 是一種 (1) phospholipid (2) carbohydrate (3) cholesterol (4) glycoprotein .
- 光合作用的 light reaction 在 chloroplast 的那一個部位進行 ? (1) inner membrane (2) thylakoid membrane (3) stroma (4) coupling factor .
- 光合作用所釋放出來的 O_2 是來自於 (1) H_2O (2) CO_2 (3) $[CH_2O]$ (4) HSO_3^- .
- 光合作用中的 reaction center 是什麼分子組成的 ? (1) protein (2) plastoquinone (3) pheophytin (4) chlorophyll .
- 葉綠素分子最會吸收下列那一個波長的光 (1) 320 nm (2) 540 nm (3) 680 nm (4) 820 nm .
- 光合作用的 electron transport system 中，要產生一分子的 O_2 至少需要幾個 photon ? (1) 2 (2) 4 (3) 8 (4) 12 .
- 光合作用中分解 H_2O 的機構中含有 (1) Fe (2) Cu (3) Mg (4) Mn .
- Calvin cycle 中第一個接受 CO_2 的分子是 (1) ribose-1,5-bisphosphate (2) ribulose-1,5-bisphosphate (3) glyceraldehyde-3-phosphate (4) ribose-5-phosphate .
- C_4 plants 具有濃縮 (1) CO_2 (2) O_2 (3) sucrose (4) H_2O 的能力 .
- 下列分子何者不是 lipid 的一種 (1) cholesterol (2) phosphatidylcholine (3) estrogens (4) vitamin C .
- 從 liver 運送 cholesterol 到各 tissues 的 lipoprotein 是 (1) very low-density (2) low density (3) intermediate-density (4) high-density .
- 能攜帶 fatty acid 從 cytosol 進入 mitochondria 的分子是 (1) coenzyme A (2) carnitine (3) acetate (4) biotin .
- Fatty acid oxidation 時，一般每次切下幾個碳 ? (1) 1 (2) 2 (3) 3 (4) 4 .
- Ketogenesis 在細胞的何處進行 ? (1) cytosol (2) peroxisome (3) lysosome (4) mitochondria .

19. 從 phosphatidylserine 上脫去一個 CO_2 後會產生 (1) phosphatidylethanolamine (2) phosphatidylcholin (3) phosphatidylinositol (4) phosphatidylglycerol.
20. Bile acids 的 precursor 是一種 (1) phospholipid (2) eicosanoid (3) steroid (4) sphingolipid.
21. 下列那一個分子不參與 redox reaction? (1) ATP (2) quinone (3) NADP^+ (4) Fe-S.
22. 在一個 redox reaction 中, 如 standard redox potential change 是 0.1 V, 則該 reaction 之 standard free energy change 應是 (1) 4.3 (2) 9.6 (3) 12.3 (4) 16.5 kJ/mole.
23. 在 electron transport system 中下列那一個分子不會擔任 mobile carrier? (1) chlorophyll (2) quinone (3) cytochrome (4) plastocyanin.
24. 加入 uncoupler 到 mitochondria 或 chloroplast, 下列那一種過程不會被抑制? (1) ATP synthesis (2) H^+ gradient formation (3) electron transport (4) membrane potential development.
25. Amylose 被水解後不會產生 (1) glucose (2) maltose (3) maltotriose (4) dextrin.
26. 許多人喝牛奶感到不適是因為缺乏 (1) amylase (2) lactase (3) galactosidase (4) maltase.
27. A 5-carbon ketose 具有幾個 stereoisomers? (1) 4 (2) 8 (3) 16 (4) 32.
28. 下列那一個分子是 ketose? (1) fructose (2) glucose (3) galactose (4) mannose.
29. pK_a of Tris(hydroxymethyl)aminomethane 是 (1) 6.2 (2) 7.6 (3) 8.3 (4) 9.2.
30. 通常在動物細胞中的離子濃度是 (1) Na^+ 低 K^+ 高 (2) Na^+ 高 K^+ 低 (3) Na^+ 和 K^+ 都高 (4) Na^+ 和 K^+ 都低.
31. Chloroplast 的 cytochrome bf complex 中所含 cyt b: cyt f 的比例是 (1) 2:2 (2) 1:2 (3) 1:1 (4) 2:1.
32. 在 retina 中的 rod cells 含能感光的分子 retinal. Retinal 在黑暗中以什麼形態存在? (1) 7-cis (2) 11-cis (3) all-trans (4) 13-cis.
33. 在 fatty acid biosynthesis 中會用到 (1) NADPH (2) FADH_2 (3) NADH (4) FMNH₂.
34. 光合作用的 electron transport system 中電子傳遞最慢的步驟是 (1) pheophytin \rightarrow Q_A (2) plastocyanin \rightarrow P700 (3) plastoquinone \rightarrow cytochrome f (4) ferredoxin \rightarrow NADP^+ .
35. Electron spin resonance 很少會用來探測 (1) electron transport (2) protein synthesis (3) membrane fluidity (4) enzymatic reaction.

36. Which of the following amino acids is *not* aromatic?

- (1) W
- (2) F
- (3) T
- (4) N
- (5) none of the above

37. If a solution of R, I and D at pH 7 were loaded on a strong cation exchange column and eluted from the column with an increasing salt (NaCl) gradient, what would be the order in which these amino acids would elute from the column? The amino acids are listed in the order in which they elute from the column.

- (1) R, I, D
- (2) R, I, D
- (3) D, I, R
- (4) D, R, I
- (5) R, D, I

38. Repeating structural motifs, which make up such secondary structures as an α -helix, are formed predominantly as a result of

- (1) intramolecular hydrogen bonding
- (2) electrostatic interactions
- (3) hydrophobic interactions
- (4) intermolecular hydrogen bonding
- (5) all of the above interactions

39. The information needed for the structure of a protein is contained in its

- (1) amino acid composition
- (2) primary structure
- (3) quaternary structure
- (4) tertiary structure
- (5) secondary structure

40. Which of the following statements concerning the Edman degradation method are not true?

- (1) Phenyl isothiocyanate is coupled to the amino-terminal residue.
- (2) Under mildly acidic conditions, the modified peptide is cleaved into a cyclic derivative of the terminal amino acids and a short-ended peptide.

- (3) Once a PTH amino acid is separated from the original peptide, the released PTH-amino acid can be identified by high-pressure liquid chromatography and the *N*-terminal residue of the degraded peptide is blocked.
- (4) If a protein has a blocked amino-terminal residue, it cannot react with phenyl isothiocyanate.

41. Which of the following statement about the peptide bond is true?

- (1) The peptide bond is planar because of the partial double bond character of the bond between the carboxyl carbon and the nitrogen.
- (2) There is relative freedom of the rotation of the bond between the carboxyl carbon and the nitrogen.
- (3) The hydrogen that is bonded to the nitrogen atom is cis to the oxygen of the carboxyl.
- (4) There is no freedom of rotation around the bond between the α -carbon and the carboxyl carbon.

42. The thermodynamics of folding of a soluble protein indicates that the single largest contribution to the stability of a folded protein is

- (1) internal interactions from intramolecular side group interactions
- (2) conformational entropy
- (3) hydrophobic effect
- (4) None of the above

43. A Ramachandran plot shows

- (1) the amino acid residues that have the greatest degree of rotational freedom
- (2) the sterically allowed rotational angles between any specific R groups in a peptide and the peptide backbone
- (3) the sterically limited rotational angles (domains which phi and psi are allowed in the peptide backbone
- (4) the angles that are allowed about the bonds connecting the amide nitrogen
- (5) none of the above statements are correct

44. Which of the following groups of amino acid residues can be phosphorylated?

- (1) H, W, and S
- (2) S, Y and T
- (3) D, E, and C
- (4) V, A, and G
- (5) None of the above

45. Quaternary structure is associated with which of the following?

- (1) the overall shape of a polypeptide chain
- (2) the sum of the secondary and tertiary interactions
- (3) simple proteins with only one subunit
- (4) proteins such as myoglobin that contains a heme group
- (5) the relative orientation of one polypeptide to another polypeptide in a multisubunit protein

46. Which of the following features is not a property of the transmembrane integral protein bacteriorhodopsin?

- (1) it has a channel made up of seven α -helices which cross the membrane
- (2) it is a globular integral protein
- (3) it carries out a light-driven proton transport
- (4) it has a single β -sheet which spans the length of the plasma membrane
- (5) it is not soluble in water

47. Hydrophobicity plot for anion channel of the erythrocyte membrane is utilized to reveal

- (1) amino acid residues that may be highly modified
- (2) amino acid residues that may be directly involved in facilitated transport
- (3) stretches of amino acid residues that make up hydrophobic regions and may be directly associated with the lipid bilayer
- (4) amino acids that are hyper-reactive due to their location.
- (5) none of the above are correct

48. In the list below, which amino acid is the most effective group in bringing about general acid-base catalysis in enzymes?

- (1) asparagine
- (2) serine
- (3) histidine
- (4) lysine
- (5) tryptophan

49. Which of the following statement is characteristic of a transition state analog?

- (1) it has the same three-dimensional arrangement of atoms as the product
- (2) it reacts faster than does the putative substrate
- (3) it binds more strongly to the active site than does the putative substrate
- (4) it has the same three-dimensional arrangement of atoms as the substrate.

(5) it is not stable upon interaction with the active site

50. Which of the following statements is not a feature of k_{cat}/K_m ?

- (1) it provides an excellent parameter for comparison of the catalytic efficiency of enzymes
- (2) it reflects the feature of the enzyme when substrate concentration is at saturation
- (3) its upper limit for the k_{cat}/K_m value is fixed by the diffusion-controlled limit for reactions, which is 10^8 to $10^9 \text{ M}^{-1}\text{s}^{-1}$
- (4) it corresponds to a second-order rate constant

51. The hydrogen bonding interactions in a Watson-Crick AT base pair involve which of the following units in the adenine base?

- (1) N-1 and the amino group on C-6
- (2) N-1 and N-3
- (3) N-7 and amino group on C-6
- (4) N-7 and C-7
- (5) N-9 and N-3

52. Which of the following components of DNA is responsible for the absorbance band at 250-270 nm?

- (1) bases, pentoses
- (2) bases
- (3) bases and pentoses
- (4) bases and phosphate
- (5) bases, pentoses, and phosphate all contribute

53. The human genome has 3×10^9 bp of DNA. If it were one continuous molecule and extended such that each nucleotide was arranged according to the model proposed by Watson and Crick, what would be the end-to-end distance?

- (1) 1 meter
- (2) 1 centimeter
- (3) 10 meters
- (4) 10 centimeter
- (5) 10^{10} nm

54. The dominant conformation of DNA found in the cell is the B form of DNA. Which of the following characteristics is associated with the B form of DNA?

- (1) the sugars are located in the interior of the double helix
- (2) the distance between base pairs along the axis of the helix is 0.68 nm
- (3) the major and minor grooves are readily apparent
- (4) the planes of the bases make about a 20 degree angle with the helical axis

55. The atoms or groups in guanine exposed in the major groove are

- (1) C-8, N-7, and the amino group on C-6
- (2) N-3 and the amino group on C-2
- (3) C-8, N-7, C-5, and the carbonyl group at C-6
- (4) C-4, C-5 and the amino group on C-6

II. (10%) Suppose you are trying to purify and characterize the properties of a recombinant human hemoglobin produced by *Escherichia coli*.

1. Please describe all the known properties of human hemoglobin including the molecular weight, pK values, absorption coefficients, spectroscopic characteristics and other biochemical properties. How can you find all these properties if you do not know those properties?
2. Describe the approach to purify the recombinant hemoglobin protein produced by *Escherichia coli*. You have to include (i) the principle of your purification method and (ii) your experimental procedures step by step. Please also describe the way to identify this protein.

III. (15%) Isotope Labeling Experiments:

1. Assume the citric acid cycle were completely block by fluorocitrate. In each case draw the structure of citric acid that would accumulate showing the position of the label. All of the citric acid must come from the substrate.
 - a. Pyruvate + $^{14}\text{CO}_2$
 - b. Pyruvate-2- ^{14}C + CO_2
 - c. α -Ketoglutarate-2- ^{14}C
2. Draw the structures of ATP and CTP, numbering the atoms in the bases, and indicate the principal positions in each which would become isotopically labeled by incubation of cells with the followings.
 - a. ^{15}N -Aspartate
 - b. ^{14}C -Aspartate (uniformly labeled)
 - c. ^{14}C -Glycine (uniformly labeled)

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生命科學系

分生組甲, 生醫組甲乙

八十七學年度 生物技術所 系(所) 甲、乙 組碩士班研究生入學考試

科目 生物化學 科號 0801,1001 1101,1201 1301 共 8 頁第 8 頁 *請在試卷【答案卷】內作答

IV (10%) Taking into account reducing equivalents ($1 \text{ NADH} = 3 \text{ ATP}$; $1 \text{ FADH}_2 = 2 \text{ ATP}$), what would be the net high energy phosphate change (gain or loss of ATP) to a cell for the following: Show calculation summaries for full credits.

- The complete oxidation of one mole of glycerol
- The conversion of two moles of acetyl-CoA into one mole of succinate.

V. (10%) Many cell signalings (e.g. from binding of glucagon to activation of phosphorylase in liver cells) are transduced by pathways involved PKA.

- What is PKA? Please give the full name (correct spelling required) and briefly explain.
- Please the complete signaling pathway from binding of glucagon to activation of phosphorylase in liver cells (please put down ALL intermediate steps).