國 立 清 華 大 學 命 題 紙

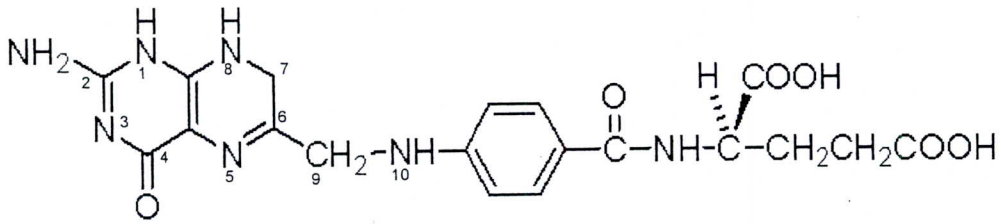
99 學年度生命科學院甲、乙組及醫學生物科技學程碩士班入學考試

科目 生物化學 科目代碼 0201、0301、0501 共 5 頁第 1 頁 *請在【答案卡】內作答

Part I 單選題 (每題一分，共五十分，答錯不倒扣。請在【答案卡】作答)

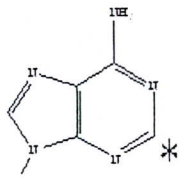
1. Dipolar interaction plays important roles in biological system. The relationship of interaction energy ΔE versus distance (r) between two permanent dipoles is described by (A) r^{-1}, (B) r^{-2}, (C) r^{-3}, (D) r^{-6}, (E) r^{-12}.
2. Ninhydrin reaction is used to detect (A) proteins at 280 nm, (B) amino acids at 280 nm, (C) amino acids at 570 nm, (D) nucleic acids at 260 nm, (E) amino acids at 260 nm.
3. Amino acid sequence is: (A) primary structure, (B) secondary structure, (C) tertiary structure, (D) quaternary structure, (E) regular structure.
4. Secondary and higher orders of structure are determined by all EXCEPT: (A) hydrophobic interactions, (B) ionic bonds, (C) van der Waals forces, (D) hydrogen bonds, (E) peptide bonds.
5. 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.
6. Protein isolation and purification include all of the techniques EXCEPT: (A) gas-liquid chromatography, (B) ion exchange chromatography, (C) electrophoresis, (D) solubility, (E) affinity chromatography.
7. Insulin is a polypeptide hormone that contains two short polypeptide chains linked by two interstrand disulfide bonds. The most logical order of events to perform in order to sequence this protein would be:
   a. The peptides are reduced with mercaptoethanol.
   b. The peptides are sequenced using Edman chemistry.
   c. The peptides are separated by chromatography techniques.
   d. The peptides are alkylated with iodoacetamide.
   (A) c, a, d, b, (B) c, b, a, d, (C) a, b, c, d, (D) a, c, d, b, (E) a, d, c, b.
8. _____ is specific in hydrolyzing only peptide bonds in which the carboxyl function is contributed by an arginine or a lysine residue. (A) chymotrypsin, (B) carboxypeptidase, (C) trypsin, (D) CNBr, (E) None of the above.
9. The "N" represents the amide nitrogen, "Cα " is the α-carbon, and "CO" is the carbonyl carbon of amino acids in a peptide, the peptide backbone of a protein consists of the repeated sequence: (A)-Cα-N-CO-, (B)-N-CO-Cα-, (C)-N-Cα-CO-, (D)-CO-Cα-N-, (E) None of the above.
10. All of the statements about homologous proteins such as hemoglobin from different organisms are correct EXCEPT: (A) have nearly identical lengths, (B) share a significant degree of sequence similarity, (C) perform the same function in different organisms, (D) have sequence identity in direct correlation to the relatedness of the species from which they were derived, (E) share little sequence homology with other proteins with similar function.
11. Edman degradation will: (A) determine the C-terminal amino acid by using a carboxypeptidase, (B) cleave the protein into a multitude of smaller peptides, (C) compare overlapping sets of peptide fragments, (D) determine the N-terminal amino acid, (E) generate two different, but overlapping sets of peptide fragments.
12. A protein's particular conformations are all EXCEPT: (A) the overall three-dimentional architecture of the protein, (B) achieved by breaking and reforming covalent bonds, (C) Achieved by rotations about each single bond along the peptide backbone, (D) the result of amino acid side-chain interactions, (E) None, all are true.
13. Xylose is a (A) triose, (B) tetrose, (C) pentose, (D) hexose, (E) heptose.

14. In cellulose the glucose units are linked by (A) α(1→4), (B) β(1→4), (C) α(1→6), (D) β(1→6), (E) α(1→3) glycosidic bonds.
15. Bacteriorhodopsin is a light-driven (A) Na^+, (B) K^+, (C) Cl^-, (D) Ca^{2+}, (E) H^+ pump.
16. When tetrahydrofolate (THF, see the chemical structure below) is bio-transformed to dihydrofolate (DHF), which atom releases electron(s)? (A) N5 one electron, (B)C6 one electron, (C) C7 two electrons, (D) N8 one electron, (E) None of the above.



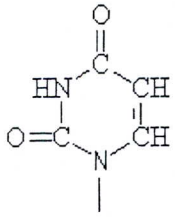
17. Cytochrome c oxidase is NOT inhibited by (A) cyanide, (B) sulfide, (C) azide, (D) carbon monoxide, (E) rotenone.
18. The active site of oxygen-evolving complex of photosystem II contains a metal cluster that consists of (A) one, (B) two, (C) three, (D) four, (E) five manganese ions.
19. In higher plants, rubisco is a heteromultimeric complex consisting of (A) 8 large and 8 small, (B) 6 large and 6 small, (C) 4 large and 4 small, (D) 2 large and 2 small, (E) 2 large and 4 small subunits.
20. NADPH generally can be obtained from (A) glycolysis, (B) citric acid cycle, (C) pentose phosphate pathway, (D) fatty acid oxidation, (E) oxidative phosphorylation.
21. The activated form of bicarbonate requires (A) ATP, (B) Biotin, (C) Protein kinase, (D) ATP and biotin, (E) ATP and protein kinase.
22. Carbons in glucose molecule can appear in membrane via (A) dihydroxyacetone, (B) acetyl-CoA, (C) phosphatidic acid, (D) dihydroxyacetone and acetyl-CoA, (E) All of above.
23. When stearoyl-CoA (18:0) is bio-transformed to oleoyl-CoA (18:1), a double bond is generated. The reaction requires electron source(s) from (A) NADH, (B) NADPH, (C) stearoyl-CoA, (D) NADH and stearoyl-CoA, (E) NADPH and stearoyl-CoA.
24. Shikimate pathway is an important precursor in the synthesis of all of the following compounds EXCEPT? (A) tryptophan, (B) tyrosine, (C) phenylalanine, (D) vitamin K, (E) threonine.
25. All of the statements about Ribonucleotide Reductase are true EXCEPT? (A) the enzyme contains specificity domain, activity domain and substrate binding domain, (B) ATP can switch on the enzyme, (C) dTTP in specificity domain favors GDP in substrate binding domain, (D) dGTP in specificity domain favors CDP in substrate binding domain, (E) the enzyme obtains the reducing power from thioredoxin system.
26. Which amino acid is the "pure" ketogenic amino acid? (A) tyrosine, (B) histidine, (C) leucine, (D) cysteine, (E) isoleucine.
27. All of the carbons and nitrogens of ornithine come biosynthetically from? (A) proline, (B) glutamate, (C) aspartate, (D) valine, (E) tyrosine.
28. During strictly anaerobic exercise, muscle cells preferentially? (A) carboxylate pyruvate to oxaloacetate, (B) reduce pyruvate to lactate, (C) oxidize pyruvate to acetyl-CoA, (D) decarboxylate pyruvate to acetaldehyde (E) oxidize fatty acids to acetyl-CoA.

29. Heart muscle differs from skeletal muscle in the following ways EXCEPT? (A) heart has more phosphocreatine than skeletal muscle, (B) heart is completely aerobic, (C) heart prefers fatty acids as fuel, (D) heart has limited quantities of glycogen, (E) all are true.
30. Adipocytes lack the enzyme _____ so that the futile cycle of triacylglycerol hydrolysis and synthesis is prevented. (A) DHAP reductase, (B) glycerol kinase, (C) glucose-6-phosphate dehydrogenase, (D) acetyl-CoA carboxylase, (E) carnitine acyl transferase.
31. All are uses of glucose-6-phosphate in liver EXCEPT? (A) catabolized to acetyl-CoA for fatty acid biosynthesis, (B) generate NADPH and pentoses, (C) released as glucose to blood stream, (D) converted to glycogen, (E) all are true.
32. Which of the following comments regarding resveratrol is INCORRECT? (A) produced in plants, particularly in grape skins, in response to stress, (B) activates SIRT1 NAD^+-dependent deacetylase activity, (C) inhibits AMPK in the brain, (D) has many of the same effects as caloric restriction, (E) all of the above are correct.
33. Muscle contractions occur when a motor nerve impulse causes _____ released from specialized cellular compartments. These ions then bind to _____, a regulatory protein for initiating events that result in the sliding of ____ thick filaments along the ____ thin filaments. (A) Fe^{++}; myoglobin; actin; myosin, (B) Na^+; troponin C; IGG; actin, (C) Ca^{++}; troponin C; myosin; actin, (D) Ca^{++}; calmodulin; PKC; PLC, (E) K^+; Na^+/K^+ ATPase; subunit-α; subunit-β.
34. Which one is the major energy source for protein synthesis?
(A) ATP, (B) GTP, (C) CTP, (D) TTP, (E) UTP.
35. In the following figure, * denotes position (A) 2 , (B) 3, (C) 4, (D) 5, (E) 6.



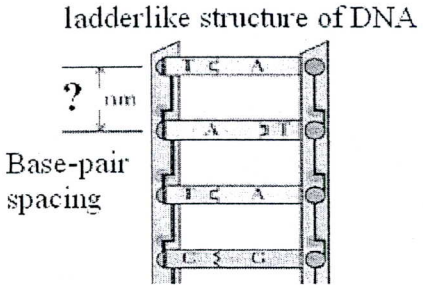
36. The higher the _____content of a DNA, the _____ the melting temperature, and the _____ the ionic strength, the _____ the melting temperature.
(A) G:C; higher; higher; lower, (B) G:C; lower; higher; lower, (C) G:C; higher; lower; lower, (D) A:T; higher; higher; lower, (E) A:T; lower; lower; higher.
37. Chromatin is about _____ DNA/____ protein by weight
(A) 80%, 20%, (B) 70%, 30%, (C) 60%, 40%, (D) 50%, 50%, (E)40%, 60%
38. Which kind of experimental procedure is used to probe RNA sequences?
(A) Eastern Blotting, (B) Southern Blotting, (C) Western Blotting, (D) Northern Blotting, (E) None of the above.
39. _____ received Nobel Prize in chemistry " for his invention of the polymerase chain reaction method " (A) Frederick Sanger, (B) Maurice Wilkins, (C) Kary Mullis, (D) Oswald Avery, (E) Michael Smith.

40. The following structure belongs to which moiety? (A) adenine, (B) uridine, (C) cytidine, (D) guanosine, (E) thymidine.



41. What would be the 9-residue primer used to amplify: 5'-ATCGACGTTACGCTACATAGCATAAGGCTT-3'
(A) 5'-TAGCTGCAA-3', (B) 5'-AAGCCTTAT-3', (C) 5'-UAGCUGCAA-3'
(D) 5'-AAGCCUUAU-3', (E) 5'-TGCGATGTA-3'.

42.



(A) 0.34, (B) 0.40, (C) 0.54, (D) 0.60, (E) 0.64.

43. Nucleosomes consist of ___ turns of DNA supercoiled about a histone "core" _____.
(A) four; pantamer, (B) two; octamer, (C) four; octamer, (D) two; pantamer, (E) None of the above.

44. Na^+, K^+-ATPase actively pumps (A) 3 K^+ into and 2 Na^+ out of, (B) 3 K^+ out of and 2 Na^+ into, (C) 2 K^+ out of and 3 Na^+ into, (D) 2 K^+ into and 3 Na^+ out of, (E) 2 K^+ out of and 2 Na^+ into the cell per ATP hydrolyzed.

45. The neurotransmitters norepinephine and epinephrine are synthesized from (A) glutamate, (B) tyrosine, (C) tryptophan, (D) phenylalanine, (E) cholesterol.

46. For one electron transfer in biological reactions, which should be considered as best cofactor(s)? (A) Cu ions, (B) Fe ions, (C) Co ions, (D) Cu and Fe ions, (E) Fe and Co ions.

47. All of the statements about AMP-activated protein kinase (AMPK) are true EXCEPT?
(A) AMPK is the cellular energy sensor, (B) when ATP is low, AMPK is allosterically activated, (C) AMPK can phosphorylate many targets controlling cellular energy production and consumption, (D) AMPK can induce insulin secretion, (E) AMPK can induce fatty acid uptake by heart.

48. The following descriptions of sirtuin 1 (SIRT1) are true EXCEPT?
(A) deletion of SIRT1 abolishes the ability of caloric restriction, (B) sirtuins are NAD+-dependent protein acetylases, (C) NAD+/NADH ratio controls sirtuin protein activity, (D) SIRT1 participates in the transcriptional regulation of adipogenesis through interaction with peroxisome proliferator-activator receptor-γ, (E) resveratrol is a potent activator of SIRT1 activity.

49. Our colorful world is a gift, most likely, of (A) chorismate, (B) glutamate, (C) histidine, (D) polysaccharide, (E) nucleotides.

50. Photosynthesis converts CO_2 and H_2O to glucose. The oxygen atoms in glucose are derived from (A) CO_2, (B) H_2O, (C) 2 from CO_2 and 2 from H_2O, (D) 3 from CO_2 and 3 from H_2O, (E) None of the above.

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Part II 問答題 (每題十分，共五十分。請在【答案卷】依序作答)

1. Proteins represent an extremely diverse set of biomolecules. Match the functional class of proteins with their appropriate function

Class		Function	
a	Enzymes	1	Proteins destined for an extracellular location
b	Regulatory proteins	2	Various venoms and toxins
c	Transport proteins	3	Spherical in shape and water soluble
d	Storage proteins	4	Associate with biological membranes
e	Contractile proteins	5	Biological catalysts
f	Structural proteins	6	Certain hormones
g	Glycoproteins	7	Move glucose across the cell membrane
h	Protective proteins	8	Source of amino acids for developing organisms
i	Globular Proteins	9	Structural components of motile cellular appendages
j	Membrane proteins	10	Certain extracellular, fibrous elements

Please draw and fill in the following table (from a to j) on your answer sheet. 1% x 10 = 10%.
請在【答案卷】作答

a	b	c	d	e
f	g	h	i	j

2. (A) How many ATP molecules would be generated if a 18-carbon fatty acid were metabolized solely by the citric acid cycle in the form of acetyl-CoA molecules?
   (B) Oxygen is the final electron acceptor in the electron transport chain of mitochondria. What advantage does oxygen have over other electron acceptors?
3. (A) Can NADH generate NADPH by biological reactions? Discuss your answer.
   (B) In biological reactions, a carboxylation reaction (add $-COO^-$) is frequently followed by a decarboxylation process (remove $-COO^-$). Please give an example of this paired process and explain why carboxylation and decarboxylation occur as paired reactions.
4. What reactions are the following cofactors involved? (A) pyridoxal phosphate (PLP) (B) thiamine pyrophosphate (TPP) (C) tetrahydrobiopterin (D) vitamin C (E) folate.
5. Fill in the name of each loop in the blanks of this yeast alanine tRNA. 請在【答案卷】作答.