國立中央大學101學年度碩士班考試入學試題卷

所別：生物醫學工程研究所碩士班 乙組(一般生)　科目：生物化學　共 7 頁 第 1 頁

本科考試可使用計算器，廠牌、功能不拘　＊請在試卷答案卷（卡）內作答

單選題 (共 50 題，每題 2 分)；請在答案卡內作答

1. (2%) Which of following action(s) will NOT denaturalize the double-helix DNA?
   I. Increase the temperature of a solution of DNA.
   II. Increase the ion concentration of a solution of DNA.
   III. Add formamide to a solution of DNA.
   IV. Add urea to a solution of DNA.
   V. Neutralize the pH of a solution of DNA.
   (A) I, II, III (B) II, IV, V (C) II, V (D) IV, V (E) II, III, V

2. (2%) Which of the following description(s) is correct regarding DNA replication?
   I. DNA is synthesized in the 5'→3' direction by DNA polymerases.
   II. Most cells have >1 types of DNA polymerases.
   III. The DNA polymerases unwind the strands of duplex DNA and initiate synthesis reaction.
   IV. At the replication fork, the lagging strand is elongated continuously.
   V. The *Okazaki* fragments are formed on the leading strand on every few hundred nucleotides.
   (A) I, II (B) I, II, III (C) I, III, IV (D) III, IV, V (E) I, II, III, V

3. (2%) Decoding of the nucleotide sequence in mRNA into the amino acid sequence of proteins depends on _____?
   (A) tRNAs
   (B) rRNAs
   (C) Aminoacyl-tRNA synthetases
   (D) tRNAs & Aminoacyl-tRNA synthetases
   (E) rRNAs & Aminoacyl-tRNA synthetases

4. (2%) At the *wobble* position, a given base "G (Guanine)" in tRNA can base-pair with _____in mRNA ?
   (A) C (B) C & U (C) C & A (D) C & G (E) C, A, & G

5. (2%) Which of the following amino acid replacement(s) is/are caused by a single base change?
   I. Phe → Leu
   II. Lys → Ala
   III. Pro → Ser
   IV. Ala → Thr
   V. Ile → Leu
   (A) I, II, III (B) II, IV, V (C) I, II, III, IV (D) III, IV, V (E) I, III, IV, V

6. (2%) What is the most common "secondary messenger" that was produced by cells to lead adaptive changes in the cellular interior?
   (A) 1, 2-Diacylglycerol
   (B) Calcium ion9
   (C) 3' ,5'-cyclic Adenosine monophosphate
   (D) Guanosine triphosphate
   (E) 3' ,5'-cyclic Guanosine monophosphate

注意：背面有試題

7. (2%) Which of following description is correct regarding the comparison of DNA replication and transcription?
   (A) DNA replication has higher reaction rate than transcription
   (B) Both reactions need primers
   (C) DNA transcription is processed using both strands as templates
   (D) DNA replication usually processes on portion of section
   (E) DNA transcription uses RNA polymerase as the catalyst, and it possesses capability of proofreading for the final product

8. (2%) Which of following is true regarding molecules transport across cell membrane?
   (A) Facilitated diffusion is driven by movement of a co-transported ion down its gradient
   (B) Solute transported by co-transport approach will not against its gradient
   (C) Passive diffusion is processed with ATP hydrolysis
   (D) Active transport does not require specific protein
   (E) Transports of CO_2/O_2, and hormones across cell membrane do not request specific protein

9. (2%) Given the following information:
   Glucose $\leftrightarrow$ 2 ethanol + $2CO_2$　　$\Delta G' = -55{,}000$ cal/mole
   Glucose + $6O_2 \leftrightarrow 6CO_2 + 6H_2O$　　$\Delta G' = -686{,}000$ cal/mole
   Calculate the number of moles of ATP that could be synthesized from ADP + P_i upon complete oxidation of one mole of ethanol to $2CO_2 + 3H_2O$. Assume an efficiency of energy conservation of 44% under standard conditions.
   (A) 17 (B) 18 (C) 19 (D) 20 (E) 21 (moles ATP/mole ethanol)

10. (2%) The carbon skeletons of amino acids enter the citric acid cycle through five intermediates, which does not include_____.
    (A) Acetyl-CoA (B) α-ketoglutarate (C) Tetrahydrofolate (D) Succinyl-CoA (E) Oxaloacetate

11. (2%) What is the catalysis enzyme in the reaction of AMP + ATP $\leftrightarrow$ 2ADP?
    (A) Nucleoside diphosphate kinase
    (B) Inorganic pyrophosphatase
    (C) Phenylalanine hydroxylase
    (D) Adenylate kinase
    (E) HMG-CoA reductase

12. (2%) Which of the following description is true regarding physiological metabolism?
    (A) The activation groups in catabolism are –SH group in different enzymes
    (B) Anabolism is endergonic reaction, such as gluconeogenesis and synthesis of amino acids
    (C) Catabolism uses NADPH as reducing agent
    (D) Anabolism uses NAD^+ or FAD as electrons receptor
    (E) All of the above

13. (2%) In a condensed chromatin fiber, the octameric histone core is composed of four types of histone proteins except_____.
    (A) H1 (B) H2A (C) H2B (D) H3 (E) H4

注意：背面有試題

14. (2%) Given a scenario that *E. coli* cells are growing in a medium containing lactose but no glucose. What shall we do in order to increase the expression of the *lac* operon?
(A) Add high concentration of glucose
(B) Make mutation to prevent dissociation of the *lac* repressor from the operator
(C) Make mutation to completely inactivate β-galactosidase
(D) Make mutation to completely inactivate galactoside permease
(E) None of the above

15. (2%) Which of following description is true regarding DNA repair through recombination process?
(A) Error-prone repair of double-strand breaks in DNA is accomplished by homologous recombination
(B) Repair of double-strand breaks by homologous recombination may lose several base pairs
(C) Repair of double-strand breaks by homologous recombination needs DNA-dependent protein kinase and KU-based heterodimer
(D) Both error-free and error-prone repair mechanism have risk of cancer
(E) None of the above

16. (2%) Which of following is NOT correct regarding the description of calmodulin?
(A) Calmodulins can be regulated by cAMP phosphodiesterase
(B) Calmodulins are bound in the neck region of light chains of myosin I & II
(C) Calmodulin is a molecule with MW of 17,000 and has four high-affinity Ca^{2+}-binding site
(D) The structure and functions of calmodulin are very similar with troponin C
(E) When intracellular [Ca^{2+}] increases, calmodulin binds with Ca^{2+} to activate the calmodulin kinase

17. (2%) In the GTPase superfamily, what is different between Ras protein and $G_{\alpha s}$ protein?
(A) Ras binds with GDP only and $G_{\alpha s}$ binds with GTP only
(B) Ras is activated by GDP and $G_{\alpha s}$ is activated by GTP
(C) Ras is a small, monomeric protein, and $G_{\alpha s}$ is heterotrimeric
(D) Ras activates upstream enzyme and $G_{\alpha s}$ activates downstream enzyme
(E) Ras increase adenylyl cyclase and $G_{\alpha s}$ inhibits it

18. (2%) A marine microorganism contains an enzyme that hydrolyzes glucose-6-sulfate. The assay is based on the rate of glucose formation. The enzyme in a cell-free extract has kinetic constants of K_m = 6.7×10^{-4} M and V_{max} = 300 nmoles×liter^{-1}×min^{-1}. Galactose-6-sulfate is a competitive inhibitor in the reaction. At 10^{-5} M of galactose-6-sulfate and 2×10^{-5} M of glucose-6-sulfate, v = 1.5 nmoles×liter^{-1}×min^{-1}. What is K_i for galactose-6-sulfate?
(A) 1.86 (B) 25.63 (C) 4.65 (D) 2.02 (E) 8.5 μM

19. (2%) Which of following is a reverse transcriptase?
(A) Aminoacyl-tRNA synthetases
(B) HMG-CoA reductase
(C) RNA-dependent RNA polymerase
(D) DNA polymerase II
(E) Telomerase

注意：背面有試題

20. (2%) _____is a type of enzyme used to catalyze reaction of forming double bonds by removal of groups.
(A) Oxidoreductases (B) Transferases (C) Lyases (D) Ligases (E) Hydrolases

21. (2%) Which of following restriction enzyme(s) cleave(s) both DNA strands at the same point within the restriction site, generating fragments with "blunt" ends for each?
I. BamHI
II. *Hin*dIII
III. *Pst*I
IV. *Sma*I
V. *Alu*I
(A) I, II, III (B) II, IV, V (C) I, II, III, IV (D) IV, V (E) I, III, IV

For question # 22 & 23
I. Ubiquinone (Coenzyme Q/CoQ)
II. NADH-CoQ reductase
III. Succinate-CoQ reductase
IV. $CoQH_2$-cytochrome *c* reductase
V. Cytochrome *c* oxidase

22. (2%) The major components of the mitochondrial respiratory chain are four inner membrane multi-protein complexes. Which of above is NOT the one of them?
(A) I (B) II (C) III (D) IV (E) V

23. (2%) Which of above is used to transfer electrons to O_2 to form H_2O in the mitochondrial respiratory chain?
(A) I (B) II (C) III (D) IV (E) V

24. (2%) Given a serial reaction that RCOOH → RCHO → RCH_2OH → RCH_3. Which of following is an adequate description for the above reaction?
(A) Saponification (B) Hydrogenation (C) Reduction (D) Oxidation (E) Esterification

25. (2%) An early step in the catabolism of amino acids is the separation of the amino group from the carbon skeleton. Generally, the amino group is transferred to α-ketoglutarate to form glutamate in the presence of co-enzyme _____.
(A) Pyruvate kinase (B) Pyridoxal phosphate (C) Peroxidase (D) Arginase (E) Cytochrome oxidase

26. (2%) Which of the following is an amino acid not found in proteins?
(A) Isoleucine (B) Asparagine (C) Proline (D) Ornithine (E) Histidine

27. (2%) Which of the following acid contains hydrophobic side chain?
(A) Serine (B) Glycine (C) Lysine (D) Histidine (E) Tryptophan

28. (2%) What is the net charge on the peptide Arg-Lys-His-Glu at pH 7?
(A) +2 (B) +1 (C) 0 (D) -1 (E) -2

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29. (2%) Repeating structural motif, which make up secondary structures, such as α-helices, are predominantly formed as a result of
(A) Electrostatic interactions
(B) Hydrophobic interactions
(C) Intramolecular hydrogen bonding
(D) Van der Waals interactions
(E) π-cation interactions

30. (2%) The tertiary structure of a protein is usually a result of which of the following interactions?
(A) Electrostatic interactions
(B) Hydrophobic interactions
(C) Intramolecular hydrogen bonding
(D) Van der Waals interactions
(E) All of the above

31. (2%) Polylysine is a random coil when the pH is less than 11, but it forms an α-helix if the pH is raised above 12. This happens because
(A) The ε-NH_2 group is protonated into ε-NH_3^+ at pH 12 and the charges stabilize the α-helix structure.
(B) The pKa of ε-NH_2 group is 12 and the partially protonated amino groups stabilize the α-helix structure.
(C) The ε-NH_3^+ groups are titrated to produce neutral NH_2 groups, which eliminate electrostatic repulsions between R groups.
(D) The high concentration of OH^- at pH 12 reduces the effective positive charges on the ε-NH_3^+ groups and results in less electrostatic repulsion between R groups.
(E) The ε-NH_2 becomes negatively charged ε-NH^- which stabilizes the α-helix structure.

32. (2%) In sick-cell anemia
(A) The four subunits of hemoglobin dissociate from on another
(B) The iron is in the Fe(III) form rather than the normal Fe(II)
(C) The heme group is lost from all subunits
(D) Hemoglobin molecules aggregate with each other
(E) Hemoglobin has higher affinity toward oxygen.

33. (2%) The protein collagen
(A) Contain no glycine
(B) Is a prime example of a globular protein
(C) Contain hydroxyproline
(D) Has a α-helical structure
(E) All of above descriptions are correct.

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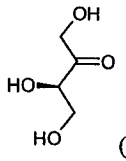
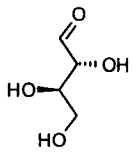
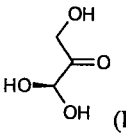
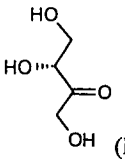
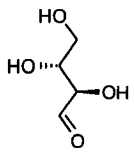
34. (2%) The fundamental difference between competitive and non-competitive inhibition is
(A) The degree of cooperativity of the reaction
(B) The size of the active site of the enzyme
(C) The binding sites of substrate and inhibitor
(D) The affinity of inhibitor toward the binding site
(E) The type of enzyme it inhibits

35. (2%) Zymogens are a feature of what type of enzymatic control?
(A) Genetic control
(B) Covalent modification
(C) Allosteric regulation
(D) Compartmentalization
(E) Both (B) and (C)

36. (2%) Which of the following is not a carbohydrate?

(A) 
(B) 
(C) 
(D) 
(E) 

37. (2%) Which of the following carbohydrates is a non-reducing sugar?
(A) Glucose (B) Fructose (C) Lactose (D) Sucrose (E) Ribose

38. (2%) The preferred energy source of the brain is
(A) Glucose (B) Fructose (C) Lactose (D) Sucrose (E) Maltose

39. (2%) Carbohydrate is thought to enhance the stability of protein molecules by
(A) Changing the proteins shape to better resist denaturation
(B) Using hydrogen bonding to increase the stability of the protein
(C) Protecting protein against oxidation
(D) Protecting the underlying protein from the action of proteolytic enzymes
(E) Attaching protein to cell surface

40. (2%) In glycoprotein the carbohydrate is most often linked to threonine, asparagine, or
(A) Serine (B) lysine (C) Valine (D) Aspartic acid (E) Tyrosine

41. (2%) Blood typing depends on
(A) The protein coat on the surface of the red blood cell
(B) The oligosaccharide coat on the surface of the red blood cell
(C) The overall shape of the red blood cell
(D) The iron content of the red blood cell
(E) The phosphorylation of the membrane protein of the red blood cell

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42. (2%) The binding of insulin to receptors on the surface of muscle cells stimulates which of the following processes?
(A) Release of ATP
(B) Release of glucagon
(C) Glycogenesis
(D) Formation of cyclic AMP
(E) Glycogenlysis

43. (2%) Which of the following molecules is not amphipathic?
(A) Cholesterol (B) Oleic acid (C) Phosphatidylcholine (D) Glucose (E) Glycine

44. (2%) Facilitated diffusion requires
(A) A channel through which the transported substance can pass
(B) A receptor protein
(C) An ATPase
(D) A carrier protein to which the transported substance binds
(E) Another substance transports in opposite direction

45. (2%) The role of very low density lipoproteins is
(A) Scavenging the cholesterol from cell membrane
(B) Transporting of lipids from liver to tissue
(C) Transporting of cholesterol esters to the liver
(D) All of the above are correct
(E) All of the above are not correct

46. (2%) In muscle cells local depolarization caused by acetylcholine binding leads to the opening of ___ channels.
(A) Cl^- (B) K^+ (C) Glucose permease (D) Ca^{2+} (E) Na^+

47. (2%) Trypsin cleaves polypeptides at the carboxyl end of
(A) Phenylalanine (B) Lysine (C) Arginine (D) Tryptophan (E) Both B and C are correct.

48. (2%) Chymotrypsin cleaves polypeptides at the carboxyl end of
(A) Phenylalanine (B) Lysine (C) Arginine (D) Tyrosine (E) Both A and D

49. (2%) The pKa1, pKa2 and pKa3 of cysteine are 1.71, 5.71, and 8.33, respectively. The isoelectric point of cysteine is
(A) 1.71 (B) 3.71 (C) 5.71 (D) 6.62 (E) 8.33

50. (2%) Peptide poisons act by
(A) Causing damage to cell membranes
(B) Inhibition of function at nerve cell synapses
(C) Inhibit DNA replication
(D) Inhibit mRNA expression
(E) All of the above