

參
考
用

I. 單選題 (共 70 分)

- (2%) Which of following condition(s) will denature proteins?
 - Heating.
 - Extreme pH
 - Addition of alcohol
 - Addition of guanidine hydrochloride
 - Addition of detergents.(A) I, II, III, V (B) II, III, IV, V (C) I, II, IV, V (D) I, III, V (E) All of the above
- (2%) Which of the following description(s) is/are correct regarding DNA structure?
 - DNA specimens isolated from different tissues of the same species have different base composition.
 - In all cellular DNAs, the number of adenosine residues is equal to the number of thymidine residues.
 - In all cellular DNAs, the sum of the purine residues equals the sum of the pyrimidine residues (i.e., $A+G = T+C$).
 - Separation of paired DNA strands is more difficult the higher the ratio of AT to GC base pairs.
 - Adjacent nucleotides in the same DNA strand are linked by hydrogen bonds.(A) I (B) II, III (C) I, III, IV (D) III, IV, V (E) I, II, III, V
- (2%) At the *wobble* position, a given base "U (Uracil)" in mRNA can base-pair with _____ in tRNA?
(A) A (B) A & G (C) I & A (D) I & G (E) I, A, & G
- (2%) During the translation process, the binding of each incoming aminoacyl-tRNA and the movement of the ribosome along the mRNA are facilitated by the hydrolysis of _____ as each residue is added to the growing polypeptide?
(A) ATP (B) ADP (C) GTP (D) GDP (E) AMP
- (2%) Which of following description is NOT correct regarding the protein folding?
 - Protein folding requires molecular chaperones including Hsp70 and chaperonins.
 - Disulfide bond formation and the *cis-trans* isomerization of Pro peptide bonds are catalyzed by "Protein disulfide isomerase" and "Peptide prolyl *cis-trans* isomerase".
 - Hsp70 proteins bind to regions of unfolded polypeptides that are rich in hydrophilic residues, preventing inappropriate aggregation.
 - Protein misfolding may cause diseases, such as amyloidoses.
 - In chaperonin system, unfolded protein initially binds to the GroEL pocket, and then binded with GroES after ATP hydrolysis.
- (2%) In the pathway of amino acid catabolism, which amino acids are exclusively ketogenic?
 - Lysine and Leucine
 - Leucine and Tryptophan
 - Tyrosine and Threonine
 - Leucine and Threonine
 - Lysine and Phenylalanine

注
意：背面有試題

參
考
用

7. (2%) Which of the following represent stop codons that can mark the carboxyl terminus of polypeptide chains in almost all cells?
- UAA
 - UGA
 - AUG
 - UGG
 - CAG
 - UAG
- (A) I, III, V (B) III, IV, VI (C) I, II, VI (D) II, IV, VI (E) I, IV, V
8. (2%) Please order the following procedures for the cholesterol biosynthesis.
- Formation of four-ring steroid nucleus.
 - Formation of squalene.
 - Synthesis of mevalonate.
 - Production of two activated isoprenes.
- (A) III→II→IV→I (B) II→IV→I→III (C) II→III→I→IV (D) III→IV→II→I (E) I→II→IV→III
9. (2%) Which of the following description is correct regarding carbohydrates?
- The sizes of different carbohydrates can be ordered by oligosaccharides > polysaccharides > monosaccharides.
 - All the monosaccharides including 『dihydroxyacetone』 and 『glyceraldehyde』 contain one or more isomeric forms.
 - The hydrogen atom of one monosaccharide can be added to anomeric carbon of a 2nd monosaccharide to form an acetal.
 - Glycosaminoglycans, the type of heteropolysaccharide, are a family of linear polymers composed of repeating disaccharide units.
 - None of the above.
10. (2%) Given the light used by a plant for photosynthesis is about 720 nm wavelength. Please calculate the energy per *Einstein* of the light?
- (Hint: Planck's constant = 6.626×10^{-34} J • s. An *Einstein* of light is Avogadro's number of photons)
- (A) 166 (B) 185 (C) 210 (D) 254 (E) 273 kJ/Einstein
11. (2%) For a weak acid with a $pK_a = 6.0$, what is the ratio of conjugate base to acid at a pH of 5.0?
- (A) 0.05 (B) 0.1 (C) 0.2 (D) 0.3 (E) None of the above
12. (2%) _____ is the type of enzyme used to transfer electrons (hydride ions or H atoms).
- (A) Oxidoreductases (B) Transferases (C) Lyases (D) Ligases (E) Hydrolases
13. (2%) What is the net yield of ATP per molecule of glucose converted to pyruvate?
- (A) -2 (B) -1 (C) 0 (D) +1 (E) +2
14. (2%) The simplest lipids constructed from fatty acids are the
- (A) Triacylglycerols (B) Glycerophospholipids (C) Galactolipids (D) Sulfolipids (E) Sphingolipids

注
意：背面有試題

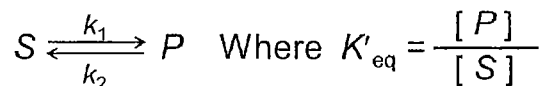
參考用

15. (2%) Which of the following description is correct regarding the correlation between the 『metabolic effect』 and 『response of the target enzyme』?
- (A) When the glycolysis in liver ↓, PFK-1 ↑.
 (B) When the gluconeogenesis in liver ↑, the pyruvate kinase ↑.
 (C) When the fatty acid mobilization in adipose tissue ↑, the hormone-sensitive lipase ↑.
 (D) When the ketogenesis ↑, the acetyl-CoA carboxylase ↑.
 (E) None of the above.
16. (2%) Mixtures of amino acids can be analyzed by first separating through ion-exchange chromatography. Please determine the order of elution from the cation-exchange column by a pH 7.0 buffer?
- I. Arginine
 II. Glutamate
 III. Serine
 IV. Alanine
 (A) I→III→II→IV (B) IV→III→I→II (C) III→II→I→IV (D) II→III→IV→I (E) IV→I→II→III
17. (2%) Pepsin cleaves polypeptides at specific cleavage points excluding
 (A) Lysine (B) Phenylalanine (C) Tyrosine (D) Tryptophan (E) Leucine
18. (2%) The chloroplast membranes are rich in two kinds of lipids; sulfolipids and _____.
 (A) Glycerophospholipids (B) Archaeal lipids (C) Galactolipids (D) Sphingolipids (E) Triacylglycerols
19. (2%) Which of the following molecules is NOT amphipathic?
 (A) Cholesterol (B) Sucrose (C) Phosphatidylcholine (D) Oleic acid (E) Plasmalogen

For question # 20 & 21:

Given 6×10^{-4} M substrate concentration ($K_m = 10^{-3}$ M), 2.5×10^{-4} M noncompetitive inhibitor concentration ($K_i = 3 \times 10^{-5}$ M), and the $V_{max} = 515$ nmol/L/min, please calculate:

20. (2%) The velocity of the enzyme-catalyzed reaction?
 (A) 62.5 (B) 50.5 (C) 33.2 (D) 20.7 (E) 45.8 nmol/L/min
21. (2%) The degree of inhibition of the enzyme-catalyzed reaction?
 (A) 42.6% (B) 65.8% (C) 75.6% (D) 53.4% (E) 89.3%
22. (2%) Which of the following effects would be brought about by any enzyme catalyzing a simple reaction?



- I. Decreased K'_{eq}
 II. Increased k_1
 III. Increased K'_{eq}
 IV. Decreased activation energy; ΔG^\ddagger
 V. Increased k_2
 (A) II, IV, V (B) II, III, IV (C) I, II, V (D) II, IV (E) I, II, IV

注意：背面有試題

參考用

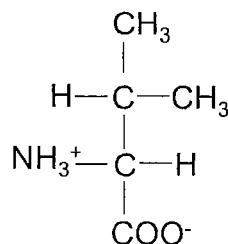
For question # 23 - 25:

- I. Lysine
- II. Leucine
- III. Histidine
- IV. Proline
- V. Arginine
- VI. Valine

23. (2%) Which of the following amino acids possess positively charged R group?
 (A) I, II, IV (B) III, VI (C) I, V, VI (D) I, III, V (E) II, IV, V
24. (2%) Which of the following group represents hydrophobic amino acids?
 (A) I, II (B) II, VI (C) III, VI (D) I, VI (E) V, VI
25. (2%) How many amino acid(s) contain polar, uncharged R group?
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

For question # 26 & 27:

Given the structure of an amino acid 『X』 is:



26. (2%) How many chiral center(s) does it have?
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
27. (2%) How many optical isomer(s) does it have?
 (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
28. (2%) Which type of ATPase on the plasma membrane can produce gradients of protons across some intracellular membranes, including plant vacuolar membrane?
 (A) N^+K^+ -ATPase (B) SERCA pumps (C) P-type ATPase (D) F-type ATPase (E) V-type ATPase
29. (2%) Which of the following description about the catalytic reaction is correct? (E: enzyme; S: substrate)
 (A) Reversible inhibition must be the type of competitive inhibition.
 (B) Uncompetitive inhibitors bind only to the ES complexes at a place distinct from the active site.
 (C) Competitive inhibitors compete with the enzymes by binding to the active sites on the substrates.
 (D) The activity of enzyme is quite stable and may not be affected by environmental pH.
 (E) None of the above.
30. (2%) DNA molecules can present three usual structure conformations, namely A, B, and Z-forms, which of the following is correct regarding the order of the base-pair number per helical turn in three forms?
 (A) $Z > A > B$ (B) $A > B > Z$ (C) $Z > B > A$ (D) $B > A > Z$ (E) $A > Z > B$

注意：背面有試題

參考用

31. (2%) Which of the following description regarding DNA replication is correct?
 (A) Replication begins at random places and unwinds the parental DNA strands using DNA polymerase.
 (B) The leading strand of DNA is synthesized from 5' to 3', and the lagging strand is from 3' to 5'.
 (C) DNA replication follows the semiconservative mechanism.
 (D) Like RNA polymerase, DNA polymerase can initiate chain synthesis alone.
 (E) The Okazaki fragments will finally associate together through a specific enzyme called helicase.
32. (2%) Which of the following enzyme can recognize DNA lesions (e.g., bases mismatch) in a cell?
 (A) AP endonucleases (B) DNA photolyases (C) DNA ligases (D) DNA polymerases (E) DNA glycosylases
33. (2%) In the amino acid catabolism, the carbon skeletons of amino acids enter the citric acid cycle through five intermediates exclude:
 (A) Acetoacetyl-CoA (B) Acetyl-CoA (C) Oxaloacetate (D) Fumarate (E) Succinyl-CoA
34. (2%) What is the approximate molecular weight of a protein with 743 amino acid residues in a single polypeptide chain?
 (A) 46,000 (B) 100,000 (C) 230,000 (D) 68,000 (E) 84,000
35. (2%) The simplest way to produce glucose 6-phosphate would be:
 Reaction 1: $\text{Glucose} + \text{P}_i \rightarrow \text{Glucose 6-phosphate}$ (ΔG_1 ; this reaction does NOT occur spontaneously)
 Reaction 2: $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$ (ΔG_2)
 Reaction 3: $\text{Glucose} + \text{ATP} \rightarrow \text{Glucose 6-phosphate} + \text{ADP}$ (ΔG_3 ; the sum of Reaction 1 & 2)
 Which of the following description is correct regarding the ΔG_1 , ΔG_2 , and ΔG_3 that represent free-energy change in each reaction?
 (A) The Reaction 1 is exergonic, so ΔG_1 is negative.
 (B) The Reaction 2 is endergonic, so ΔG_2 is positive.
 (C) The Reaction 3 is exergonic, so ΔG_1 is positive.
 (D) ATP breakdown in cells is exergonic, so ΔG_2 is negative.
 (E) None of the above.

II. 計算題 (共 30 分)

1. The conversion of glucose to lactic acid has a $\Delta G'$ of -52,000 cal/mole. In an anaerobic cell, this conversion is coupled to the synthesis of 2 moles of ATP per mole of glucose.
 (a) Please calculate the $\Delta G'$ of the overall coupled reaction. (5%)
 (Hint: $\text{ADP} + \text{P}_i \rightarrow \text{ATP}$, $\Delta G' = 7700$ cal/mole).
 (b) Please calculate the efficiency of energy conservation in the anaerobic cell. (2%)
 (c) At the efficiency obtained from (b), how many moles of ATP per mole of glucose could be obtained in an aerobic organism in which glucose is completely oxidized to CO_2 and H_2O ? (8%)
 (Hint: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$, $\Delta G' = -686,000$ cal/mole).
 (d) Please calculate the $\Delta G'$ for the overall oxidation coupled to ATP synthesis in (c). (5%)
2. Please calculate the concentration ratio of sodium acetate to acetic acid ($\text{pK}_a = 4.76$) that are constituents of 0.2 M acetate buffer at $\text{pH} = 5.0$. (10%)

