

※請在答案卡內作答

I. 單選題 (每題 2.5 分，共 100 分)

- A buffer contains 0.01 mole of lactic acid ($pK_a = 3.86$) and 0.05 mole of sodium lactate per liter. What is the pH of the buffer?
(A) 3.5 (B) 4.6 (C) 7.4 (D) 9.6 (E) 12.97
- Which of the following statements about protein-ligand binding is correct?
(A) The larger the K_a (association constant), the lower the affinity.
(B) The larger the K_a , the faster is the binding.
(C) The K_a is equal to the concentration of ligand when half of the binding sites are occupied.
(D) The K_a is independent of conditions such as salt concentration and pH.
(E) The larger the K_a , the smaller the K_d (dissociation constant).
- Which of the following description is correct regarding carbohydrates?
(A) The sizes of different carbohydrates can be ordered by oligosaccharides > polysaccharides > monosaccharides.
(B) All the monosaccharides including 『dihydroxyacetone』 and 『glyceraldehyde』 contain one or more isomeric forms.
(C) Glycosaminoglycans, the type of heteropolysaccharide, are a family of linear polymers composed of repeating disaccharide units.
(D) The hydrogen atom of one monosaccharide can be added to anomeric carbon of a 2nd monosaccharide to form an acetal.
(E) None of the above.
- At the anticodon *wobble* position, a given base “I (*Inosine*)”, a deaminated product of adenine, in tRNA can base-pair with _____ in mRNA?
(A) C, A, & U (B) A & G (C) C & A (D) C & U (E) A & U
- Given the following information:
Glucose \leftrightarrow 2 ethanol + 2CO₂ $\Delta G' = -55,000$ cal/mole
Glucose + 6O₂ \leftrightarrow 6CO₂ + 6H₂O $\Delta G' = -686,000$ 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 2CO₂ + 3H₂O. Assume an efficiency of energy conservation of 44% under standard conditions.
(A) 15 (B) 16 (C) 17 (D) 18 (E) 19 (moles ATP/mole ethanol)

注意：背面有試題

※請在答案卡內作答

6. An allosteric interaction between a ligand and a protein is one in which:
- (A) two different ligands can bind to the same binding site.
 - (B) the binding of a molecule to a binding site affects the binding properties of another site on the protein.
 - (C) the binding of the ligand to the protein is covalent.
 - (D) multiple molecules of the same ligand can bind to the same binding site.
 - (E) the binding of a molecule to a binding site affects the binding of an additional molecule to the same site.
7. Which of the following cell process is NOT energized by Adenosine triphosphate (ATP) molecules?
- (A) Translocation of RNA polymerase
 - (B) Translocation of DNA polymerase
 - (C) Rotation of viral capsid motor leading to DNA packaging
 - (D) Transport of chromosomes during mitosis
 - (E) Movement of Ribosome along mRNA molecules during translation
8. 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) 0.01 (B) 0.05 (C) 0.1 (D) 0.2 (E) 0.4
9. Please order the following procedures for the cholesterol biosynthesis in animals.
- I. Activation of isoprene units
 - II. Formation of four rings of the steroid nucleus
 - III. Condensation of acetate units to form mevalonate
 - IV. Formation the 30-carbon linear squalene
- (A) III \rightarrow I \rightarrow IV \rightarrow II
 - (B) III \rightarrow II \rightarrow IV \rightarrow I
 - (C) II \rightarrow III \rightarrow I \rightarrow IV
 - (D) I \rightarrow II \rightarrow III \rightarrow IV
 - (E) IV \rightarrow II \rightarrow I \rightarrow III
10. Which of following description regarding the DNA replication is correct?
- (A) DNA replication occurs with very high fidelity and at a designated time in the cell cycle.
 - (B) DNA replication is carried out in three phases: initiation, elongation, and termination.
 - (C) The DNA replication starts at a single origin in bacteria and usually proceeds bi-directionally.
 - (D) DNA is synthesized in the 5' \rightarrow 3' direction by DNA polymerases.
 - (E) All of the above.

注意：背面有試題

※請在答案卡內作答

11. Please calculate the K_i for a noncompetitive inhibitor if 2×10^{-4} M [I] yields 75% inhibition of an enzyme-catalyzed reaction?
(A) 1.86×10^{-5} M (B) 3.46×10^{-5} M (C) 6.66×10^{-5} M (D) 8.17×10^{-5} M (E) 9.45×10^{-5} M
12. 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 -NH₂ group is protonated into ϵ -NH₃⁺ at pH 12 and the charges stabilize the α -helix structure.
(B) The pKa of ϵ -NH₂ group is 12 and the partially protonated amino groups stabilize the α -helix structure.
(C) The high concentration of OH⁻ at pH 12 reduces the effective positive charges on the ϵ -NH₃⁺ groups and results in less electrostatic repulsion between R groups.
(D) The ϵ -NH₃⁺ groups are titrated to produce neutral NH₂ groups, which eliminate electrostatic repulsions between R groups.
(E) The ϵ -NH₂ becomes negatively charged ϵ -NH⁻ which stabilize the α -helix structure.
13. A monoclonal antibody differs from a polyclonal antibody in that monoclonal antibodies:
(A) are produced by cells from the same organism that produced the antigen.
(B) have only a single polypeptide chain that can recognize an antigen.
(C) are labeled with chemicals that can be visualized.
(D) are synthesized by a population of identical, or "cloned," cells.
(E) are synthesized only in living organisms.
14. The activity of chymotrypsin will be tremendously affected by change of ?
(A) Ser¹⁹⁵ and Leu¹⁶
(B) His⁵⁷ and C-terminal
(C) Ile¹⁶ and Glu¹⁹⁴
(D) Ile¹⁶, Arg¹⁹⁴, & Gly¹⁹³
(E) Asp¹⁰², His⁵⁷, & Ser¹⁹⁵
15. What is the catalysis enzyme in the reaction of AMP + ATP \leftrightarrow 2ADP?
(A) Nucleoside diphosphate kinase
(B) Adenylate kinase
(C) Inorganic pyrophosphatase
(D) Phenylalanine hydroxylase
(E) HMG-CoA reductase

注意：背面有試題

※請在答案卡內作答

16. Which of the following description about the catalytic reaction is correct? (E: enzyme; S: substrate)
- (A) Uncompetitive inhibitors bind only to the ES complexes at a place distinct from the active site.
 - (B) Reversible inhibition must be the type of competitive inhibition.
 - (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.
17. Which of the following codons may serve as the start codon / initiator?
- I. UUG
 - II. AUG
 - III. GUG
 - IV. UAA
 - V. UGA
 - VI. CUG
- (A) I, III, V (B) III, IV, VI (C) II, IV, VI (D) I, IV, V (E) II, III, VI
18. Thr and/or Leu residues tend to disrupt an α helix when they occur next to each other in a protein because:
- (A) of electrostatic repulsion between the Thr and/or Leu side chains.
 - (B) of steric hindrance between the bulky Thr and/or Leu side chains.
 - (C) both amino acids are highly hydrophobic.
 - (D) the R group of neither amino acid can form a hydrogen bond.
 - (E) of the possible covalent interactions between the Thr and/or Leu side chains.
19. Which of the following description about ATP reaction is NOT correct?
- (A) The exergonic conversion of ATP to ADP or to AMP is coupled to many endergonic reactions and processes.
 - (B) To maintain its high group transfer potential, ATP concentration must be held far above the equilibrium concentration by energy-yielding reactions of catabolism.
 - (C) Hydrolysis of ATP provides energy for bioprocess including translocation of RNA polymerase and ribosome movement.
 - (D) ATP provides the energy for anabolic reactions, including the synthesis of information macromolecules, transfer of molecules across membranes against concentration and/or electrical potential gradients.
 - (E) ATP is the chemical link between catabolism and anabolism.

注意：背面有試題

※請在答案卡內作答

20. 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) Guanosine triphosphate
(D) 3', 5'-cyclic Guanosine monophosphate
(E) 3', 5'-cyclic Adenosine monophosphate
21. The Southern blotting method is normally used for detection of
- (A) proteins (B) DNA (C) RNA (D) lipids (E) carbohydrates.
22. The mRNA must contain the following to allow for initiation of protein synthesis in *E. coli*.
- (A) A purine rich sequence to bind to the ribosome.
(B) A pyrimidine rich sequence to bind to the ribosome.
(C) A Shine-Delgarno sequence.
(D) A purine rich sequence to bind to the ribosome and a Shine-Delgarno sequence
(E). A pyrimidine rich sequence to bind to the ribosome and a Shine-Delgarno sequence.
23. Which of the following details the progression of structural levels from DNA to chromosome in eukaryotic DNA?
- (A) A-DNA → 30-nm fiber → nucleosome → loop → chromosome
(B) A-DNA → nucleosome → loop → 30-nm fiber → chromosome
(C) B-DNA → nucleosome → 30-nm fiber → loop → chromosome
(D) B-DNA → nucleosome → loop → 30-nm fiber → chromosome
(E) Z-DNA → 30-nm fiber → nucleosome → loop → chromosome
24. Which of the following tRNA binding sites is correctly defined?
- (A) A site: accepts incoming aminoacyl-tRNA
(B) E site: entrance site for initial tRNA binding
(C) P site: site occupied by the tRNA that accepts the growing peptide chain
(D) T site: site that is briefly occupied while the tRNA is passed from the A site to P site
(E) all of the above

注意：背面有試題

※請在答案卡內作答

25. Which of the following is responsible for RNA splicing?
- (A) rRNA
 - (B) miRNA
 - (C) tRNA
 - (D) siRNA
 - (E) snRNA
26. What is the region immediately adjacent to the starting site for RNA polymerization called?
- (A) promoter
 - (B) enhancer
 - (C) initiator
 - (D) consensus sequence
 - (E) TF binding site
27. What is the purpose of DNA helicase?
- (A) removal of negative supercoiling to allow for replication
 - (B) removal of positive supercoiling to allow for replication
 - (C) separation of double stranded DNA into single stranded DNA in front of DNA polymerase
 - (D) conversion of single stranded DNA to double stranded DNA behind DNA polymerase
 - (E) none of the above
28. What metabolite is used in unusually high amounts by cancerous tumors and is thus often used as a means to visualize cancerous tissue?
- (A) lactate
 - (B) glutamine
 - (C) glucose
 - (D) ketone bodies
 - (E) very long chain fatty acids
29. O-linked oligosaccharides are commonly attached to the oxygen of _____.
- (A) ribose
 - (B) tyrosine
 - (C) lysine
 - (D) threonine
 - (E) galactose

注意：背面有試題

※請在答案卡內作答

30. As temperatures grow colder with the onset of winter, animals will adapt by changing the fatty acid composition of cell membranes. What characteristics of fatty acids will be seen?
- (A) longer chains with greater unsaturation
 - (B) longer chains with greater saturation
 - (C) shorter chains with greater unsaturation
 - (D) shorter chains with greater saturation
 - (E) chain length and saturation do not change in a cell membrane
31. If the Asp in the chymotrypsin active site was mutated to another amino acid, which of the following would be considered an invisible mutation in that it is least likely to impact the function of the enzyme?
- (A) Asp → Asn
 - (B) Asp → Glu
 - (C) Asp → His
 - (D) Asp → Ser
 - (E) Asp → Lys
32. Which of the lipoproteins is responsible for removing cholesterol from cells?
- (A) chylomicron
 - (B) VLDL
 - (C) LDL
 - (D) HDL
 - (E) VHDL
33. How does insulin cause an increase in the rate of glucose transport into cells?
- (A) binds to the glucose transporter causing a conformational change resulting in greater transport velocity
 - (B) activates Na/K ATPase to increase glucose active transport
 - (C) recruits glucose transporters from intracellular vesicles to the cell membrane
 - (D) activates an insulin-dependent porin that allows for rapid glucose transport
 - (E) inhibits an insulin-dependent porin that allows for rapid glucose transport

注意：背面有試題

※請在答案卡內作答

34. Which of the following best explains the chain of events that occurs when glucagon binds to its receptor?
- (A) activation of protein kinase A, activation of G protein, activation of adenylate cyclase, production of cAMP
 - (B) activation of adenylate cyclase, production of cAMP, activation of protein kinase A, activation of G protein
 - (C) production of cAMP, activation of adenylate cyclase, activation of protein kinase A, activation of G protein
 - (D) activation of G protein, activation of protein kinase A, activation of adenylate cyclase, production of cAMP
 - (E) activation of G protein, activation of adenylate cyclase, production of cAMP, activation of protein kinase A
35. In which order are the following energy sources (either directly or through gluconeogenesis) depleted during starvation?
- (A) Dietary; adipose tissue; proteins; liver glycogen.
 - (B) Adipose tissue; dietary; liver glycogen; proteins.
 - (C) Dietary; liver glycogen; adipose tissue; proteins.
 - (D) Liver glycogen; dietary; adipose tissue; proteins.
 - (E) Proteins; liver glycogen; dietary; adipose tissue.
36. EcoRI recognizes the sequence 5'-G↓AATTC-3' (the arrow indicates the point of cleavage). Treatment of the following oligonucleotide with EcoRI would produce two oligonucleotides with sizes of _____ nucleotides containing _____ ends.
- 5'-AAGTCGATACAGAATTCGTACCTAG-3'
- (A) 12 and 13; blunt
 - (B) 12 and 8; blunt
 - (C) 11 and 8; sticky
 - (D) 12 and 13; sticky
 - (E) 9 and 13; sticky

注意：背面有試題

※請在答案卡內作答

37. What reagents are required to perform PCR?
- (A) DNA fragment, primers flanking the region of interest, dNTPs, DNA polymerase
 - (B) DNA fragment, primers flanking the region of interest, dNTPs, ddNTPs, DNA polymerase
 - (C) DNA fragment, one primer, dNTPs, DNA Polymerase, DNA ligase
 - (D) DNA fragment, one primer, dNTPs, DNA Polymerase, DNA endonuclease
 - (E) DNA fragment, primers flanking the region of interest, dNTPs, DNA endonuclease
38. If the following mixture of proteins was applied to a size-exclusion chromatography column, what would be the order of elution? Proteins with molecular weights: myoglobin (17.7 kDa), hemoglobin (64.5 kDa), lysozyme (14.3 kDa) and triose phosphate isomerase (57.4 kDa)
- (A) lysozyme, myoglobin, triose phosphate isomerase, hemoglobin
 - (B) triose phosphate isomerase, hemoglobin, lysozyme, myoglobin
 - (C) hemoglobin, myoglobin, lysozyme, triose phosphate isomerase
 - (D) hemoglobin, triose phosphate isomerase, myoglobin, lysozyme
 - (E) cannot be determined
39. A sudden increase in the concentration of _____ causes the release of acetylcholine from the axon of a nerve cell.
- (A) Na^+
 - (B) K^+
 - (C) Ca^{2+}
 - (D) Cl^-
 - (E) H^+
40. Different enzymes that catalyze the same reaction are known as _____.
- (A) transferases
 - (B) isomerases
 - (C) allosteric enzymes
 - (D) holoenzymes
 - (E) isozymes