

國立成功大學

111學年度碩士班招生考試試題

編 號： 311

系 所： 細胞生物與解剖學研究所

科 目： 生物化學

日 期： 0220

節 次： 第 1 節

備 註： 不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。
此試題共 8 頁，單選題，共 40 題，每題 2.5 分。

1. Hydrogen bonds form only between atoms containing lone pair of electrons such as oxygen or nitrogen and a hydrogen atom bonded to
 - (A) sulfur
 - (B) carbon
 - (C) an electronegative atom
 - (D) an electropositive atom
2. Which weak acid will be 91% ionized at pH 4.86?
 - (A) pyruvic acid $pK_a = 2.50$
 - (B) acetoacetic acid $pK_a = 3.60$
 - (C) acetic acid $pK_a = 3.86$
 - (D) propionic acid $pK_a = 4.86$
3. Which of the following compounds is 'least' likely to be soluble in water?
 - (A) weakly polar compound
 - (B) strongly polar compound
 - (C) nonpolar compound
 - (D) weak electrolyte.
4. The transport system that maintains the Na^+ and K^+ gradients across the plasma membrane of cells:
 - (A) involves an enzyme that is an ATPase
 - (B) is a passive transport system
 - (C) hydrolyzes ATP independently of the movement of Na^+ and K^+
 - (D) does not have quaternary structure
5. Which of the following descriptions is appropriate for protein conformation?
 - (A) From the complete primary structure of a protein, it now is possible to calculate its three-dimensional conformation
 - (B) Organic solvents denature proteins primarily by preventing ionic interactions
 - (C) The thermodynamically most stable conformation of a protein is the structure of lowest free energy
 - (D) Quaternary structure refers to protein conformation in the fourth dimension, that is, as a function of time.
6. The peptide bond has a 'backbone' of atoms in which of the following sequences?
 - (A) C-C-N-C
 - (B) C-C-C-N
 - (C) N-C-C-C

(D) C-N-C-N.

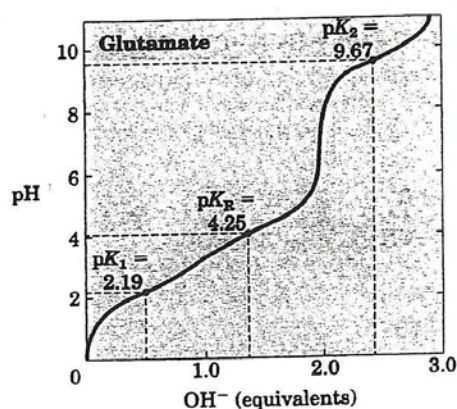
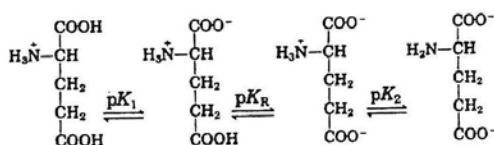
7. Which of the following proteins has quaternary structure?
- (A) hemoglobin
 - (B) ribonuclease
 - (C) chymotrypsin
 - (D) myoglobin.
8. The peptide bond is planar because:
- (A) The partial double bond character of C-N bond prevents its free rotation
 - (B) The partial charges on the CO and NH groups allow them to participate in hydrogen bond
 - (C) It is aromatic
 - (D) Steric hindrance between side chains of adjacent amino acid residues prevent free rotation around the C-N bond
9. SDS-PAGE (sodium dodecyl sulfate-polyacrylamide gel electrophoresis) is the most common method to estimate the molecular of a protein. The capability of this method to separate proteins according to their molecular weights rely on:
- (A) the charge-to-mass ratio of protein
 - (B) the shape of the protein
 - (C) the electric potential
 - (D) the frictions between proteins and gel matrix.
10. Sickle-cell anemia is a genetic disease in which an individual has inherited the allele for sickle-cell hemoglobin (termed hemoglobin S) from both parents. When hemoglobin S is deoxygenated, it becomes insoluble and forms polymers that aggregate into tubular fibers. The altered properties of hemoglobin S result from a single amino acid substitution, a Val instead of a Glu residue at position 6 in the twoβ chains. Please indicate what kind of interatomic attractions is responsible the property alteration observed in hemoglobin S:
- (A) Covalent bond
 - (B) Hydrogen bond
 - (C) Ionic interaction
 - (D) Hydrophobic interaction.
11. Which amino acid cannot play a role in general acid-base catalysis in enzyme reaction?
- (A) Lysine
 - (B) Serine
 - (C) Valine
 - (D) Histidine.

12. K_m and V_{max} are important parameters in enzyme kinetic study. How the two parameters will alter in an enzyme-catalyzed reaction when a competitive inhibitor of the enzyme is included in the reaction?
- (A) both K_m and V_{max} increase
 (B) both K_m and V_{max} decrease
 (C) K_m increases, but V_{max} do not change
 (D) K_m do not change, but V_{max} increases.

13. The characteristic pH at which the net charge of an amino acid is zero is called the isoelectric point or isoelectric pH (pI). The pI value of a given amino acid can be calculated from the titration curve. Following is the titration curve of glutamate.

Please indicate how to calculate the pI value of glutamat

- (A) $pI = (pK_1 + pK_2)/2$
 (B) $pI = (pK_1 + pK_R)/2$
 (C) $pI = (pK_R + pK_2)/2$
 (D) $pI = (pK_1 + pK_R + pK_2)/3$



14. Titin is a huge protein identified in muscle tissues. The amino acid sequence of human titin can be deduced from public data banks, and it contains 26,926 amino acid residues in a single polypeptide chain. What will be the possible molecular weight range of this protein:

- (A) 2,000,000 ~ 2,400,000
 (B) 2,400,000 ~ 2,800,000
 (C) 2,800,000 ~ 3,200,000
 (D) 3,200,000 ~ 3,600,000

15. Lectins are defined as

- (A) Nucleic acids binding lipids
 (B) Lipid binding proteins or glycoproteins
 (C) Carbohydrate binding proteins or glycoproteins
 (D) Glycoproteins binding lipids, which are playing important roles in life processes and can be used tools to study structural and functional roles of complex carbohydrates.

16. Active trisaccharide in blood group A determinant is

- (A) $\text{LFuc}\alpha 1 \rightarrow 2\text{Gal}\beta 1 \rightarrow 3 \text{ or } 4\text{GlcNAc}$
- (B) $\text{Gal}\alpha 1 \rightarrow 3\text{Gal}$
 $\uparrow \alpha 1,2$
 L-Fuc
- (C) $\text{NeuAc}\alpha 2 \rightarrow 6\text{GalNAc}$
 $\uparrow \beta 1,6$
 GlcNAc
- (D) $\text{GalNAc}\alpha 1 \rightarrow 3\text{Gal}$
 $\uparrow \alpha 1,2$
 L-Fuc

17. If an aerobic organism (e.g., the bacterium *E. coli*) were fed each of the following four compounds as a source of energy, the energy yield per mole from these molecules would be in the order:

- (A) glucose > alanine > palmitate (16:0)
 (B) palmitate > alanine > glucose
 (C) palmitate > glucose > alanine
 (D) glucose > palmitate > alanine.

18. Please indicate the cellular location of pyruvate carboxylase.

- (A) mitochondrial matrix
 (B) mitochondrial inner membrane
 (C) mitochondrial intermembrane space
 (D) cytoplasm.

19. What yield of ATP can be expected from complete oxidation of fructose-1,6-bisphosphate by the reactions of glycolysis, the citric acid cycle, and oxidative phosphorylation?

- (A) 36 ATP
 (B) 20 ATP
 (C) 10 ATP
 (D) 2.5 ATP

20. The synthesis of glycogen, starch, and sucrose all:

- (A) use glucose 1-phosphate as the only substrate
 (B) use a sugar nucleotide as substrate
 (C) take place in liver and muscle of mammals
 (D) involve addition of a sugar residue at the reducing end of the growing polymer.

21. _____ is found only in prokaryotic (Bacterial) cell wall.

- (A) Hyaluronic Acid: unbranched high molecular weight polysaccharide made up of alternating glucuronic acid and *N*-acetyl glucosamine units
 (B) Heparin: Heterogenous mixture of variably sulfated polysaccharide chains composed of repeating units of D-glucosamine and either L-iduronic or D-glucuronic acids

- (C) The polymer consists of alternating subunits of *N*-acetylglucosamine and *N*-acetylmuramic acid connected by β -1,4 linkages
- (D) Chitin : consists of *N*-acetylglucosamine residues in β -1,4 linkage.
22. Which of the following statements about the oxidative decarboxylation of pyruvate in aerobic conditions in animal cells is correct?
- (A) The methyl ($-\text{CH}_3$) group is eliminated as CO_2
- (B) The process occurs in the cytosolic compartment of the cell
- (C) One of the products of the reactions of the pyruvate dehydrogenase complex is a thioester of acetate
- (D) The pyruvate dehydrogenase complex uses all of the following as cofactors: NAD^+ , lipoic acid, pyridoxal phosphate (PLP), and FAD.
23. During seed germination, the glyoxylate pathway is important to plants because it enables them to:
- (A) obtain glyoxylate for pyrimidine synthesis
- (B) get rid of isocitrate formed from the aconitase reaction
- (C) form acetyl-CoA from malate
- (D) carry out the net synthesis of glucose from acetyl-CoA.
24. The citric acid cycle begins with the condensation of acetyl-CoA with oxaloacetate. Which of the following is not a possible sources for the acetyl-CoA?
- (A) The pyruvate dehydrogenase complex
- (B) oxidation of fatty acids
- (C) Degradation of certain amino acids
- (D) Glycolysis.
25. Which of these processes can move a solute against its concentration gradient?
- (A) passive transport
- (B) diffusion
- (C) facilitated diffusion
- (D) active transport.
26. Which of the following represents a similarity between RNA and DNA?
- (A) the presence of a double-stranded helix
- (B) repair systems that correct genetic code errors
- (C) nucleotides consisting of a phosphate, sugar, and nitrogen base
- (D) the presence of an OH group on the 3' carbon of the sugar.
27. A particular eukaryotic protein is 300 amino acids long. Which of the following could be the maximum number of nucleotides in the DNA that codes for the amino acids in this protein?

- (A) 100
- (B) 300
- (C) 900
- (D) 150.

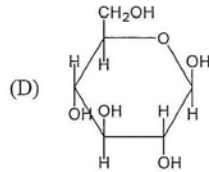
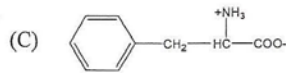
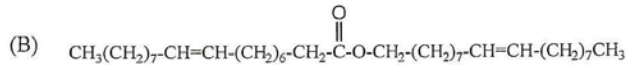
28. The genetic code is essentially the same for all organisms. From this, one can logically assume all of the following except:
- (A) A gene from an organism could theoretically be expressed by any other organism
 - (B) All organisms have a common ancestor
 - (C) DNA was the first genetic material
 - (D) Codons usually translate into the same amino acids.
29. Andy Will has cloned a gene that he believes is important in conferring resistance to insects in a certain plant. He now wants to determine where in the genome that gene is physically located. He would most likely use which technique?
- (A) RFLP analysis
 - (B) in situ hybridization
 - (C) in vivo mutagenesis
 - (D) DNA microarray assays.
30. The principal problem with inserting an unmodified mammalian gene into the bacterial chromosome, and then getting that gene expressed, is that
- (A) prokaryotes use a different genetic code from that of eukaryotes
 - (B) bacteria translate polycistronic messages only
 - (C) bacteria cannot remove eukaryotic introns
 - (D) bacterial RNA polymerase cannot make RNA complementary to mammalian DNA.
31. A gene that contains introns can be made shorter (but remain functional) for genetic engineering purposes by
- (A) using RNA polymerase to transcribe the gene
 - (B) using a restriction enzyme to cut the gene into shorter pieces
 - (C) using reverse transcriptase to reconstruct the gene from its mRNA
 - (D) using DNA ligase to put together fragments of the DNA that codes for a particular polypeptide.
32. Serpentine receptors:
- (A) have multiple membrane-spanning helical domains
 - (B) are present in the nucleus and affect gene expression.
 - (C) are mainly involved in the regulation of ion transport
 - (D) are present in prokaryotic cells but not in eukaryotic cells.

33. Which one of the following compounds is the precursor of membrane lipids, fats and waxes:

- (A) amino acids
- (B) adenine
- (C) palmitic acid
- (D) glucose.

34. Which one of the following compounds has the "amphipathic" property ?

- (A) $^+\text{NH}_3\text{-CH}_2\text{-COO}^-$



35. 2,3-bisphosphoglycerate (BPG) is highly abundant in erythrocytes and is used to regulate the binding ability of hemoglobin (Hb) to O₂. According to the definition on interaction between protein and ligand, which one of the following statements is correct?

- (A) Both BPG and O₂ are homotropic modulators for Hb
- (B) Both BPG and O₂ are heterotropic modulators for Hb
- (C) BPG is heterotropic modulators for Hb
- (D) O₂ are heterotropic modulators for Hb.

36. Which of the following statements is correct?

- (A) There is free rotation about a peptide bond.
- (B) Leu is more polar than Ala
- (C) At a pH greater than the pK_a of an ionizable group, more than half of such groups are dissociated.
- (D) Only at very low or very high pH does the nonionized form of an amino acid predominate.

37. Which of the following is true of sphingolipid synthesis?

- (A) All of the carbon atoms of palmitate and serine are incorporated into sphingosine
- (B) Phosphatidic acid is a key intermediate in the pathway
- (C) CDP-sphingosine is the activated intermediate
- (D) CO₂ is produced during the synthesis of ceramide from palmitate and serine.

38. Citrate synthase and the NAD⁺-specific isocitrate dehydrogenase are two key regulatory enzymes of the citric acid cycle. These enzymes are inhibited by:

- (A) AMP and/or NADH
- (B) ATP and/or NADH
- (C) ATP and/or NAD⁺
- (D) AMP and/or NAD⁺.

39. Sugars have large numbers of stereoisomers because they contain several asymmetric carbon atoms.

Glucose has:

- (A) 4 isomers
- (B) 5 isomers
- (C) 10 isomers
- (D) 16 isomers

40. Selectin is one of animal lectins involved in inflammation and binds to:

- (A) Galβ1→4GlcNAcβ1→
- (B) NeuAcα2→3Galβ1→4GlcNAcβ1→
- (C) Galβ1→4GlcNAcβ1→
 ↑α2,3 ↑α1,3
 NeuAc Fuc
- (D) Galβ1→3GlcNAcβ1
 ↑α1,3
 Fuc