

國 立 宜 蘭 大 學

1 0 5 學 年 度 研 究 所 碩 士 班 考 試 入 學

## 生物化學試題

( 生 物 技 術 與 動 物 科 學 系 生 物 技 術 碩 士 班 )

准考證號碼：

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### 《作答注意事項》

- 1.請先檢查准考證號碼、座位號碼及答案卷號碼是否相符。
- 2.考試時間：100 分鐘。
- 3.本試卷共有選擇題 50 題，一題 2 分，共計 100 分。
- 4.請將答案寫在答案卷上。
- 5.考試中禁止使用大哥大或其他通信設備。
- 6.考試後，請將試題卷及答案卷一併繳交。
- 7.本試卷採雙面影印，請勿漏答。
- 8.應試時不得使用電子計算機。

- ( ) 1. What happens to nonpolar molecules in water?  
**A) They dissolve independently.                      B) They precipitate.**  
**C) They aggregate together.                         D) All of the above.**
- ( ) 2. Why is the peptide bond planar?  
**A) Bulky side chains prevent free rotation around the bond.**  
**B) It contains partial double-bond character, preventing rotation.**  
**C) Hydrogen bonding between the NH and C=O groups limits movement.**
- ( ) 3. Which amino acids contain sulfur?  
**A) cysteine and lysine                                 B) arginine and methionine**  
**C) cysteine and methionine                         D) cysteine and isoleucine**
- ( ) 4. Which of the following four fatty acids has the highest melting point  
[1]  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$                       [2]  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$   
[3]  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$                       [4]  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{COOH}$   
**A) 1                      B) 2                      C) 3                      D) 4**
- ( ) 5. What factor(s) influence(s) the binding of oxygen to myoglobin?  
**A) The concentration of bicarbonate ion,  $\text{HCO}_3^-$**   
**B) The partial pressure of oxygen,  $p\text{O}_2$**   
**C) The concentration of hemoglobin present**  
**D) The concentration of 2,3-BPG**
- ( ) 6. Which of the following amino acids is unlikely to be found in an  $\alpha$ -helix due to its cyclic structure?  
**A) proline                      B) tryptophan                      C) phenylalanine                      D) lysine**
- ( ) 7. Which of the following inhibitors binds to the enzyme at a site other than the active site?  
**A) noncompetitive inhibitor                                 B) competitive inhibitor**  
**C) irreversible inhibitor                                         D) all of the above**  
**E) none of the above**
- ( ) 8. Zymogens are  
**A) allosteric enzymes that are always in the T state.**  
**B) allosteric enzymes that are always in the R state.**  
**C) inactive forms of enzymes which require phosphorylation by a kinase to become active.**  
**D) inactive precursors of enzymes which can be activated by the irreversible cleavage of covalent bonds.**
- ( ) 9. Which would be best to separate a protein that binds strongly to its substrate?  
**A) Gel filtration                      B) Cation or anion exchange                      C) Cation exchange**  
**D) Anion exchange                      E) Affinity chromatography**

- ( )10. The difference between active transport and passive transport is that  
**A) concentration gradients are involved in one and not in the other**  
**B) glycolipids play a role in one and not in the other**  
**C) one requires expenditure of energy by the cell and the other does not**  
**D) ions are transported into and out of the cell by one process and not by the other**
- ( )11. Phosphorylation of enzymes  
**A) has no effect on their catalytic activity.**  
**B) is not easily characterized.**  
**C) usually takes place on serine, threonine, and tyrosine residues.**  
**D) does not require ATP.**
- ( )12. In allosteric interactions  
**A) proteins that consist of a single polypeptide chain form aggregates.**  
**B) disulfide bonds are broken.**  
**C) metal ions always bind to the protein.**  
**D) changes that take place in one site of a protein cause drastic changes at a distant site**
- ( )13. What conclusion can be drawn concerning an inhibitor if the  $V_{max}$  is the same in the presence and absence of the inhibitor?  
**A) The inhibitor binds to the substrate.**  
**B) The  $K_M$  is smaller in the presence of inhibitor.**  
**C) The inhibitor can be overcome with sufficiently high concentrations of substrate.**  
**D) The inhibitor reacts with a critical residue of the enzyme.**  
**E) The inhibitor binds to the same active site as the substrate.**
- ( )14. The oxidative reactions of the pentose phosphate pathway  
**A) require biotin**                      **B) produce NADPH rather than NADH**  
**C) require coenzyme A**              **D) require thiamine pyrophosphate**
- ( )15. Which of the following modifications is likely to happen to the mRNA in a eukaryotic cell?  
**A) removal of intervening sequences (introns)**  
**B) addition of a poly-A tail to the 3' end**  
**C) capping of the 5' end**  
**D) All of the above occur in eukaryotic cells.**
- ( )16. Which of the following is correct concerning fetal hemoglobin?  
**A) Fetal hemoglobin is composed of two  $\alpha$  and two  $\gamma$  subunits.**  
**B) Fetal hemoglobin binds 2,3-BPG more tightly than normal hemoglobin.**  
**C) Fetal hemoglobin binds oxygen less than HbA at all  $pO_2$ .**  
**D) Fetal hemoglobin does not exist in the T-form.**

- ( )17. Two-dimensional electrophoresis is a combination of what two techniques?  
**A) isoelectric focusing and affinity chromatography**  
**B) isoelectric focusing and SDS-PAGE**  
**C) ion-exchange chromatography and SDS-PAGE**  
**D) affinity chromatography and SDS-PAGE**  
**E) isoelectric focusing and ion-exchange chromatography**
- ( )18. Protein kinase A (PKA) is  
**A) activated by covalent binding of cyclic AMP.**  
**B) affected by cyclic AMP only under unusual circumstances.**  
**C) allosterically activated by cyclic AMP.**  
**D) competitively inhibited by cyclic AMP.**  
**E) noncompetitively inhibited by cyclic AMP**
- ( )19. Metabolic processes are regulated by  
**A) transcriptional regulation of the amount of enzyme.**  
**B) allosteric control of enzyme activity.**  
**C) accessibility of substrates by compartmentalization.**  
**D) A and B.**  
**E) A, B, and C.**
- ( )20. The standard free-energy changes for the reactions below are given.  
Phosphocreatine  $\rightarrow$  creatine +  $P_i$      $\Delta G'^{\circ} = -43.0$  kJ/mol  
ATP  $\rightarrow$  ADP +  $P_i$      $\Delta G'^{\circ} = -30.5$  kJ/mol  
What is the overall  $\Delta G'^{\circ}$  for the following reaction?  
Phosphocreatine + ADP  $\rightarrow$  creatine + ATP  
**A) -73.5 kJ/mol**                      **B) -12.5 kJ/mol**                      **C) +12.5 kJ/mol**  
**D) +73.5 kJ/mol**                      **E)  $\Delta G'^{\circ}$  cannot be calculated without  $K_{eq}'$ .**
- ( )21. The phenomenon of coupling always involves  
**A) oxidation and reduction reactions**  
**B) decarboxylation reactions**  
**C) esterification reactions**  
**D) reactions that produce energy and reactions that require energy**
- ( )22. Which of the following enzymes **does not** use  $NAD^+$  for oxidation?  
**A)  $\alpha$ -Ketoglutarate Dehydrogenase complex**  
**B) Isocitrate Dehydrogenase**                      **C) Succinate Dehydrogenase.**  
**D) Malate Dehydrogenase**                      **E) All of these enzymes use  $NAD^+$**
- ( )23. Enzymes with the following name types are used in isomerization reactions  
**A) Dehydrogenase**                      **B) Phosphatase**                      **C) Kinase**                      **D) Mutase**

- ( )24. Which of the following cannot cross the inner mitochondrial membrane?  
**A) malate    B) phosphoenolpyruvate    C) succinyl-CoA    D) oxaloacetate**
- ( )25. Which of the following is a mechanism by which enzyme catalytic activity is controlled?  
**A) Allosteric control    B) Feedback inhibition    C) Covalent modification  
D) A and C    E) A, B, and C**
- ( )26. Which of the following is an example of a mechanism by which a signaling process might be terminated?  
**A) Aggregation of all protein subunits    B) Change in temperature  
C) Protein dephosphorylation by phosphatases    D) None of the above**
- ( )27. In the reoxidation of QH<sub>2</sub> by purified ubiquinone-cytochrome c reductase (Complex III) from heart muscle, the overall stoichiometry of the reaction requires 2 mol of cytochrome c per mole of QH<sub>2</sub> because  
**A) cytochrome c is a one-electron acceptor, whereas QH<sub>2</sub> is a two-electron donor.  
B) cytochrome c is a two-electron acceptor, whereas QH<sub>2</sub> is a one-electron donor.  
C) cytochrome c is water soluble and operates between the inner and outer mitochondrial membranes  
D) heart muscle has a high rate of oxidative metabolism, and therefore requires twice as much cytochrome c as QH<sub>2</sub> for electron transfer to proceed normally.**
- ( )28. Which of the following techniques can be used to determine mass to charge ratio of a molecule?  
**A) Edman degradation    B) affinity chromatography    C) MALDI-TOF  
D) diagonal electrophoresis    E) SDS-PAGE**
- ( )29. What kind of reaction is used to release glucose units from glycogen?  
**A) hydrolysis    B) phosphorolysis    C) dehydration    D) oxidation**
- ( )30. The reactions of glycolysis occur in this eukaryotic cell compartment  
**A) Mitochondrion    B) Nucleus    C) Cytoplasm  
D) Both cytoplasm and mitochondria  
E) Glycolysis occurs in all these cell compartments**
- ( )31. A unique feature of the glyoxylate cycle is that it allows the organisms that possess this pathway to  
**A) convert acetyl-CoA to pyruvate    B) produce fats from carbohydrates  
C) produce carbohydrates from fats    D) do all of the above**

- ( )32. What is substrate level phosphorylation?  
**A) ATP and AMP synthesis from two molecules of ADP**  
**B) Phosphorylation of AMP by ATP**  
**C) Phosphorylation of ATP coupled to an ion gradient**  
**D) ATP synthesis when the phosphate donor is a substrate with high phosphoryl transfer potential**
- ( )33. The genetic code is said to be degenerate. This means that  
**A) each codon codes for more than one amino acid**  
**B) many of the amino acids are coded for by different codons**  
**C) the code is universally used by virtually all species**  
**D) each anticodon can interact with many different triplet sequences in the mRNA, which may differ in any or all of the three nucleotide**
- ( )34. High concentrations of fructose-2,6-bisphosphate  
**A) stimulate glycolysis and inhibit gluconeogenesis.**  
**B) inhibit glycolysis and stimulate gluconeogenesis.**  
**C) stimulate both glycolysis and gluconeogenesis.**  
**D) inhibit both glycolysis and gluconeogenesis.**
- ( )35. Chemiosmotic coupling involves this process  
**A) Using an electron gradient to synthesize ATP**  
**B) Using a proton gradient to synthesize ATP**  
**C) Using oxygen flow to synthesize ATP**  
**D) Using a proton gradient to make water from oxygen**  
**E) These are all chemiosmotic processes**
- ( )36. Which of the following monosaccharides is a ketose?  
**A) glucose      B) galactose      C) fructose      D) mannose**
- ( )37. Glycogen is  
**A) polysaccharide storage polymer found in plants**  
**B) a highly branched polysaccharide found in animals**  
**C) a linear polysaccharide**  
**D) a synthetic sugar substitute**
- ( )38. The "natural" function of restriction endonucleases is to  
**A) chromatin from histones**  
**B) help bacteriophages infect cells**  
**C) regulate gene expression from specific promoters**  
**D) protect bacterial cells from invasion by viruses (bacteriophages) remove**

- ( )39. The degree of membrane fluidity depends on  
**A) the percentage of lipids that contain choline**  
**B) the percentage of glycolipids**  
**C) the percentage of fatty acids**  
**D) the percentage of unsaturated fatty acids**
- ( )40. The 5' → 3' exonuclease activity of *E. coli* DNA polymerase I is involved in:  
**A) proofreading of the replication process.**  
**B) formation of a nick at the DNA replication origin.**  
**C) removal of RNA primers by nick translation.**  
**D) formation of Okazaki fragments.**
- ( )41. Two circular DNAs are isolated, both with 1000 bp. One is supercoiled; the other is not. The two DNAs are placed in an ultracentrifuge  
**A) The supercoiled DNA should sediment faster**  
**B) The nonsupercoiled DNA should sediment faster**  
**C) They should sediment at the same rate**  
**D) The information provided is not enough to determine which is faster**
- ( )42. What is the Bohr effect?  
**A) the ability of hemoglobin to retain oxygen when in competition with myoglobin**  
**B) the regulation of hemoglobin-binding by hydrogen ions and carbon dioxide**  
**C) the alteration of hemoglobin conformation during low oxygen stress**
- ( )43. The following vitamins and cofactors are all used in  $\beta$ -oxidation, except  
**A) Biotin    B) Niacin    C) Pantothenic acid    D) Riboflavin**
- ( )44. The promoter site is  
**A) the start site for transcription in DNA**  
**B) the binding site for regulatory proteins that stimulate transcription**  
**C) the general region of DNA downstream from the start site**  
**D) the site on DNA at which RNA polymerase binds to initiate transcription**
- ( )45. The PCR reaction mixture does *not* include  
**A) DNA containing the sequence to be amplified.    B) DNA ligase.**  
**C) heat-stable DNA polymerase.    D) oligonucleotide primer(s)**

According to the table below, answer these questions

Amino acid	-carboxyl group pK	- amino group pK	R-group pK
Ala	2.3	9.7	
Arg	2.2	9.0	12.5
Asn or Gln	2.1	9.0	
Asp or Glu	2.2	9.8	4.0
Cys	1.7	10.8	8.3
His	1.8	9.2	6.0
Ser	2.2	9.2	
Tyr	2.1	9.1	10.1

- ( ) 46. The pI of an amino acid is the pH at which it has a zero net charge. What is the increasing order of isoelectric points (low pH to high) for these three amino acids?  
**A) Ala, His, Asp      B) His, Ala, Asp      C) Asp, Ala, His**  
**D) Ala, Asp, His      E) Asp, His, Ala**
- ( ) 47. Calculate the pI of Asn  
**A) 2.5      B) 5.0      C) 5.5      C) 6.0      E) 10.7**
- ( ) 48. What is the order of the pIs in increasing order (from acid to base)?  
**A) Aspartic Acid, Cysteine, Asparagine, Alanine, and Arginine**  
**B) Aspartic Acid, Alanine, Asparagine, Cysteine, and Arginine**  
**C) Arginine, Alanine, Asparagine, Cysteine, and Aspartic Acid**  
**D) Alanine, Arginine, Asparagine, Cysteine, and Aspartic Acid**  
**E) Aspartic Acid, Cysteine, Arginine, Alanine, and Asparagine**
- ( ) 49. Calculate the pI of Cys?  
**A) 5.0    B) 1.7      C) 8.3      D) 9.6      E) 10.8**
- ( ) 50. The pI of the peptide Ala-Gln-Arg-Ser-His would be:  
**A) Strongly acid      B) Weakly acid (4-6)      C) About neutral (6-8)**  
**D) Weakly basic (8-10)      E) Strongly basic**