國立臺北科技大學

九十三學年度生物科技研究所入學考試

生物化學試題

填准考證號碼

注意事項：

1. 本試題分 Part I 及 Part II 兩部份，Part I 為選擇題，共 25 題，每題 2 分。Part II 為計算申論題，每題 10 分，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

Part I: 選擇題 共 50 分 (答對每題得 2 分，答錯每題倒扣 1 分)

1. Which one of the following is NOT an organelle in eukaryotic cells: (A) nucleus (B) mitochondria (C) ribosome (D) lysozyme.
2. Which one of the following is NOT attached to the central carbon atom (C_α) of an amino acid: (A) amino group (B) aromatic group (C) hydrogen atom (D) R group.
3. Which one of the following molecules is NOT a pyrimidine: (A) Adenine (B) Thymine (C) Cytosine (D) Uracil.
4. How many molecules of ATP can be produced by degradation of a molecule of glucose: (A) 2 (B) 26 (C) 36 (D) 38.
5. Which of the following statements is WRONG: (A) Virtually all living organisms use ATP for transferring free energy. (B) In the human body, about 2.3 kg of ATP is formed and consumed every day. (C) The full name of ATP is adenine triphosphate. (D) Hydrolysis of the linkage between the β and γ phosphate groups of ATP yields ADP and P_i.
6. Which of the following statements is CORRECT: (A) Enthalpy is a measure of the order in a system. (B) The entropy of a molecule depends mainly on translational and rotational freedom. (C) The change in the free energy of a ystem is defined as: $\Delta G = T\Delta S - \Delta H$, where T is the absolute temperature. (D) The standard free energy change is related to the equilibrium constant by: $\Delta G^o = RT\ln K_{eq}$.
7. Which one of the following amino acids is NOT an aromatic amino acid: (A) Thr (B) Tyr

(C) Phe (D) Trp.

8. Which of the following statements about peptide bond is WRONG: (A) It is a covalent bond. (B) It is usually longer than the common C-N bond. (C) It is a double bond. (D) All of the atoms directly connected to peptide bond lie in a planer configuration.
9. Which of the following statements about the hierarchy of globular protein structure is WRONG: (A) The primary structure of a protein is its amino acid sequence. (B) The most important force to determine the secondary structure of a protein is hydrogen bonding. (C) A functional unit of a tertiary structure is called a "domain". (D) Hairpin is formed by connecting two parallel β-strands.
10. Which of the following statements is WRONG: (A) The polypeptide chains of proteins are synthesized on ribosomes. (B) Hemoglobin is a trimer made of almost identical subunits. (C) The oxygen-binding curve for myoglobin is hyperbolic. (D) Gel electrophoresis separate proteins according to their size and charge.
11. Which one of the following sugars is NOT a six-carbon sugar: (A) D-Xylulose (B) D-Allose (C) D-Mannose (D) D-Galactose.
12. Which one of the following amino acids can NOT be glycosylated: (A) Ser (B) Thr (C) Asp (D) Asn.
13. Which of the following unsaturated fatty acids is the most commonly found fatty acid in mammals: (A) linoleic acid (B) pa;mitoleic acid (C) oleic acid (D) vaccenic acid.
14. What is the most commonly found structural element of the membrane-spanning regions of the integral membrane proteins: (A) α-helices (B) β-sheets (C) β-turns (D) random coils.
15. Which one of the following enzyme classes belongs to EC5: (A) oxidoreductase (B) isomerase (C) ligase (D) hydrolase.
16. What is the definition of "specificity constant" for an enzyme: (A) K_{cat} (B) K_M (C) K_{cat}/K_M (D) $K_{cat}K_M$.
17. Which one of the following inhibitors can bind to an enzyme whether or not the active site is occupied by the substrate: (A) competitive inhibitor (B) noncompetitive inhibitor (C) uncompetitive inhibitor (D) partial competitive inhibitor.
18. Which one of the following vitamins is NOT water soluble: (A) Vitamin D (B) Vitamin C (C) Biotin (D) Riboflavin.
19. Which one of the following enzymes is NOT involved in the glycolytic pathway: (A) hexokinase (B) aldolase (C) enolase (D) adenyl cyclase.
20. How many molecules of ATP are synthesized for each pair of electrons that pass down the electron-transport chain from NADH to O_2: (A) 2 (B) 2.5 (C) 36 (D) 38.
21. In plants, the photosynthesis takes place in the chloroplast thylakoid membrane, whereas in bacteria, they take place in the: (A) cytoplasm (B) cell wall (C) cell membrane (D) nucleus.
22. Which one of the following sources can NOT generate fatty acids: (A) TCA cycle (B) diet

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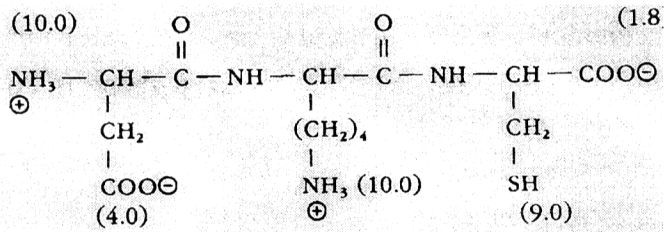
(C) adipocytes (D) *de novo* synthesis.

23. Which one of the following molecules is NOT a nucleotide-containing molecule: (A) NAD^+ (B) FAD (C) CoA (D) GMP.
24. Which one of the following pieces of DNA molecules has the highest melting temperature (T_m): (A) 5'-AAATTT-3' (B) 5'-ATCGAT-3' (C) 5'-CCCGGG-3' (D) 5'-CCATGG-3'.
25. Which of the following statements about DNA replication is WRONG: (A) DNA synthesis can occur only in the 5'→3' direction. (B) Okazaki fragments are synthesized in the leading strand. (C) Helicases are enzymes used to unwind the double-helical DNA. (D) Ligase is used to fill in the gaps and join the ends in the case of lagging strand synthesis.

Part II: 計算及問答題 50 分 (每題 10 分)

1. The hydrolysis of lactose (D-galactosyl-β(1,4)-D-glucose) to D-galactose and D-glucose occurs with a $\Delta G^{o'}$ of -4.0 kcal/mol. (a) Calculate K_{eq}' for the hydrolytic reaction. (b) What are the $\Delta G^{o'}$ and K_{eq}' for the synthesis of lactose from D-galactose and D-glucose?

2. For the tripeptide shown below, the numbers in parentheses are the pK_a values of the ionizable groups. (a) Estimate the net charge at pH 1 and pH 14. (b) Estimate the isoelectric point.



3. Assume that an enzyme-catalyzed reaction follows the scheme shown below: where $k_1 = 10^9\ M^{-1}S^{-1}$, $k_2 = 10^5\ S^{-1}$, $k_3 = 10^2\ S^{-1}$, $k_4 = 10^7\ M^{-1}S^{-1}$, and [ET] is 0.1 nM. Determine the value of each of the following. (a) K_M (b) V_{max} (c) turnover number (d) initial velocity when $[S]_o$ is 20 μM.

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \underset{k_4}{\overset{k_3}{\rightleftharpoons}} E + P$$

4. (a) Calculate the substrate concentration [S] in terms of K_M for a hyperbolically responding enzyme when the velocity is 10% V_{max} or 90% V_{max}. (b) What is the ratio of substrate concentrations that affect the nine-fold velocity change ($S_{0.9}/S_{0.1}$)? (c) How would the ($S_{0.9}/S_{0.1}$) ratio differ for an allosterically responding enzyme?

5. Please draw the glycolysis pathway, including all the enzymes required for each step in this metabolic pathway.