

※ 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。

Short Essay (12 questions, 100%)

1. What is protein phosphorylation / dephosphorylation? Give one example to explain how phosphorylation / dephosphorylation works in regulating protein functions. (8%)
2. The pentose phosphate pathway is a metabolic pathway parallel to glycolysis. Please explain the primary roles of the pentose phosphate pathway for biosynthesis. (8%)
3. Blood glucose is maintained in homeostasis. Please elaborate on the relationships among glycogen synthase (GS), glycogen phosphorylase (GP), insulin, and glucagon in regulating blood sugar levels. (8%)
4. Lysozyme is an antimicrobial enzyme produced by animals as a part of the innate immune system. Please explain where we can find the lysozyme and how it functions as a chemical defense. (8%)
5. Non-covalent interactions are critical in maintaining structure and providing function of large molecules, such as proteins and nucleic acids. Please name at least 4 types of non-covalent interactions related to structure and function of proteins and nucleic acids. (8%)
6. The globins are a group of heme-containing globular proteins. Please explain the differences between hemoglobin (Hb) and myoglobin (Mb), in molecular structures and physiological functions. (8%)
7. Metabolic wastes are substances that cannot be used by the organism. Please explain what nitrogenous wastes would be produced in humans. (8%)
8. NADH and NADPH are fundamental common mediators of various biological processes. Please explain the functions of NADH and NADPH, and also try to point out similarities and differences between each other. (8%)
9. Membrane transport can be separated into passive transport and active transport. Passive transport can be further separated into simple diffusion and facilitated diffusion. Active transport can be further separated into primary active transport and secondary active transport. Please explain differences among simple diffusion, facilitated diffusion, primary active transport, and secondary active transport. (8%)

10. The RNA world hypothesis suggests that RNA molecules are the primary living substance before the evolution of DNA and proteins on Earth. Please explain main reasons behind this hypothesis. (8%)

11. Gene expression analysis aims to study RNA expression levels of genes wherein a changing expression pattern implies a changing biological process. Please provide at least two approaches and techniques used for gene expression analysis. (10%)

12. In the samples of DNA isolated from two unidentified species of bacteria, X and Y, adenine makes up 32% and 17%, respectively, of the total bases. What relative proportions of adenine, guanine, thymine, and cytosine would you expect to find in the two DNA samples? Which species is more possible to be the thermophilic bacterium? What is the basis for your answer? (10%)