Biological Chemistry I

I-a Answer the following questions regarding protein analysis methods.

(1) Explain why, in Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDS-PAGE), larger molecules move more slowly than smaller molecules, whereas in gel filtration chromatography, smaller molecules move more slowly than larger molecules.

(2) Provide one experimental method for determining the type and number of metal ions bound to a protein molecule. Additionally, explain the principle behind this experimental method.

I-b Answer the following questions.

(1) Explain the structure of the cell membrane. Additionally, provide two representative examples of mechanisms for the transport of substances across the cell membrane.

(2) Explain the structure and role of mitochondria, and explain those of chloroplasts.

I-c Explain the principle of DNA amplification by the polymerase chain reaction (PCR) method.

I-d Provide one experimental method to investigate whether a protein specifically binds to DNA, and explain the principle behind it.

(The end)

Biological Chemistry II

II-a Answer the following questions.

(1) Provide the names of the four types of bases that are contained in DNA.

(2) Explain the structure of Watson-Crick base pairs in DNA.

(3) Name one method for determining the DNA base sequence and explain its principle.

II-b Answer the following questions.

(1) Explain what is meant by the isoelectric point (pI) of a protein.

(2) Ion exchange chromatography is widely used for protein purification. Explain the principle of ion exchange chromatography.

(3) Name a typical secondary structure of proteins and describe its structural features, considering the interactions that contribute to its stability.

(4) Write the structural formula for one of the two possible structures of a dipeptide composed of leucine and phenylalanine. Note that there is no need to consider optical isomers of amino acids.

II-c In the structural analysis of proteins, electromagnetic waves (such as X-rays, infrared, and microwaves) or particle beams (such as electron beams and neutron beams) are often employed. Provide one example of a structural analysis method using electromagnetic waves and one using particle beams, and compare their advantages and disadvantages.

(The end)