

Biological Chemistry I
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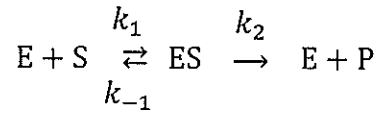
I Read the following sentences and answer the questions below.

An ultracentrifugal analysis revealed that protein X had a sedimentation coefficient similar to that of a protein with a molecular weight of 90,000. In polyacrylamide gel electrophoresis, protein X treated with sodium dodecyl sulfate migrated giving two bands corresponding to molecular weights of 60,000 and 30,000, whereas protein X treated with sodium dodecyl sulfate and 2-mercaptoethanol showed a single band corresponding to a molecular weight of 30,000. On the other hand, in a gel filtration chromatographic analysis, protein X exhibited an elution time similar to that of a protein with a molecular weight of 10,000.

- (1) Explain molecular properties of protein X based on the results of gel electrophoretic analyses.
- (2) Explain a possible cause for the discrepant results between the ultracentrifugal and gel filtration analyses.
- (3) Give another example of method to determine molecular weights of proteins and explain its principle.
- (4) Give two examples of non-covalent interactions that mediate protein complex formation and explain their properties.

## Biological Chemistry II

II Solve the problems from ( 1 ) to ( 4 ) for the following enzyme reaction (E, S, ES and P indicate the enzyme, substrate, enzyme-substrate complex, and product, respectively).



- ( 1 ) Under the steady-state assumption,  $d[ES]/dt = 0$ , derive the Michaelis-Menten equation expressing the reaction velocity,  $v$ , by using the substrate concentration,  $[S]$ , the maximal reaction velocity at saturating substrate concentration,  $V_{\max}$ , and the Michaelis constant,  $K_M = (k_2 + k_{-1})/k_1$ .
- ( 2 ) Draw the graph of the Michaelis-Menten equation with  $[S]$  and  $v$ .
- ( 3 ) Express the substrate concentration,  $[S]$ , using  $K_M$ , when  $v$  is the half of  $V_{\max}$ .
- ( 4 )  $k_2/K_M$  is a measure of enzyme's catalytic efficiency. Explain what determines the upper limit of the catalytic efficiency.