Assignment 3

Due on: 2020-10-18, 23:59:57

You are assigned to submit the following assignments:

1. In your studies of biochemistry, you have learned that the enzyme E is involved in catalyzing the reaction between substrates A and B to produce product C. The reaction mechanism involves two steps, as follows:

   a. Initial binding of substrates A and B to the active site of enzyme E.
   b. Formation of an enzyme-substrate complex (ES).
   c. Transition state complex (TS).
   d. Release of product C from the enzyme.

   The rate constant for the reaction is given by the expression:
   \[ k = \frac{[C]}{[A][B]} \]

   where [C], [A], and [B] represent the concentrations of product C, substrate A, and substrate B, respectively. The rate constant is measured at 25°C and the Arrhenius equation applies.

   a. Determine the Arrhenius equation for the reaction.

2. The rate-determining step in the reaction is the formation of the transition state complex (TS). Given the activation energy of the reaction is 20 kJ/mol, determine the Arrhenius equation for the reaction.

   \[ k = A \exp\left(-\frac{E_a}{RT}\right) \]

   where A is the frequency factor, E_a is the activation energy, R is the gas constant, and T is the temperature in Kelvin.

   a. Calculate the Arrhenius equation for the reaction.

3. The enzyme E is inhibited by a competitive inhibitor I. The inhibition constant (K_i) for the inhibitor is 0.1 M. Determine the inhibition constant (K_i) for the inhibitor.

   \[ K_i = \frac{[I]_0}{[C]} \]

   where [I]_0 is the concentration of the inhibitor at which half-maximal inhibition occurs.

   a. Calculate the inhibition constant (K_i) for the inhibitor.

4. The enzyme E is also inhibited by a non-competitive inhibitor J. The inhibition constant (K_i) for the inhibitor is 0.01 M. Determine the inhibition constant (K_i) for the inhibitor.

   \[ K_i = \frac{[J]}{[C]} \]

   where [J] is the concentration of the inhibitor.

   a. Calculate the inhibition constant (K_i) for the inhibitor.

5. The enzyme E is inhibited by a mixed inhibitor K. The inhibition constant (K_i) for the inhibitor is 0.001 M. Determine the inhibition constant (K_i) for the inhibitor.

   \[ K_i = \frac{[K]_0}{[C]} \]

   where [K]_0 is the concentration of the inhibitor at which half-maximal inhibition occurs.

   a. Calculate the inhibition constant (K_i) for the inhibitor.

6. The enzyme E is inhibited by a uncompetitive inhibitor L. The inhibition constant (K_i) for the inhibitor is 0.0001 M. Determine the inhibition constant (K_i) for the inhibitor.

   \[ K_i = \frac{[L]}{[C]} \]

   where [L] is the concentration of the inhibitor.

   a. Calculate the inhibition constant (K_i) for the inhibitor.