

Essay Questions: Chapter 5 – Enzymes

Mode of action

1. Describe the 'lock and key' hypothesis of an enzyme.

[6]

- Enzymes provide an alternative pathway of lower activation energy through the formation of enzyme-complex substrate.
- In the lock and key hypothesis of enzymes, the enzyme molecule acts as the lock and the substrate molecule acts as the key.
- The shape of the substrate molecule is complementary to the shape of the active site of the enzyme molecule.
- The substrate molecule fits / binds into the active site of the enzyme molecule to form an enzyme-substrate complex.
- The enzyme molecule catalyses (decomposes / hydrolyses) the reaction to form product molecules.
- The enzyme molecule remains chemically unchanged after the reaction and is able to catalyses more reactions.

Effect of temperature

2. Explain the effect of temperature on rate of enzyme reaction.

[4]

- At low temperatures, rate of enzyme reaction is low. Kinetic energy of substrate molecules is low. Effective collision of substrate molecules with enzyme molecules and fitting into active sites of enzyme molecules is very low. Rate of formation of enzyme-substrate complex is low. The enzyme is inactive.
- As temperature increases, rate of enzyme reaction increases. Kinetic energy of substrate molecules increases. Effective collision of substrate molecules with enzyme molecules and fitting into active sites of enzyme molecules increases. Rate of formation of enzyme-substrate complex increases. Enzyme is more active. As the temperature increases by 10°C, rate of enzyme reaction doubles.
- When temperature reaches the optimum temperature of the enzyme, rate of enzyme reaction is the highest. Kinetic energy of substrate molecules is the highest. Effective collision of substrate molecules with enzyme molecules and fitting into active sites of enzyme molecules is the highest. Rate of formation of enzyme-substrate complex is the highest. Enzyme is most active at this temperature.
- When temperature exceeds the optimum temperature, rate of enzyme reaction rapidly decreases. The chemical bonds that keep the enzyme protein in shape start to break, changing the three-dimensional shape of the active site. The shape of the substrate molecule and active site of enzyme are no longer complementary. The substrate molecule cannot fit into the active site to form enzyme-substrate complex. As temperature continues to increase, the enzyme is completely denatured.