Name _____ Period _____ Date _____

What are Enzymes?

Directions: Read the information provided. Use complete sentences to answer the accompanying questions.

Enzymes are biological molecules (typically proteins) that significantly speed up the rate of virtually all of the chemical reactions that take place within cells.

They are vital for life and serve a wide range of important functions in the body, such as aiding in digestion and metabolism.

Some enzymes help break large molecules into smaller pieces that are more easily absorbed by the body. Other enzymes help bind two molecules together to produce a new molecule. Enzymes are highly selective catalysts, meaning that each enzyme only speeds up a specific reaction.

1. What is an enzyme? (2 points)

2. Identify two reasons that enzymes are vital for life. (2 points)

3. Describe two ways that enzymes help maintain homeostasis (4 points).

The molecules that an enzyme works with are called substrates. The substrates bind to a region on the enzyme called the active site.

There are two theories explaining the enzyme-substrate interaction.

In the **lock-and-key model**, the active site of an enzyme is precisely shaped to hold specific substrates. In the **induced-fit model**, the active site and substrate don't fit perfectly together; instead, they both alter their shape to connect.

Whatever the case, the reactions that occur accelerate greatly — over a millionfold — once the substrates bind to the active site of the enzyme. The chemical reactions result in a new product or molecule that then separates from the enzyme, which goes on to catalyze other reactions.

Here's an example: When the salivary enzyme amylase binds to a starch, it catalyzes hydrolysis (the breakdown of a compound due to a reaction with water), resulting in maltose, or malt sugar.

4. What are substrates? (2 points)

5. Where does a substrate bind to an enzyme? (2 points)

6. Describe the lock and key model (2 points).

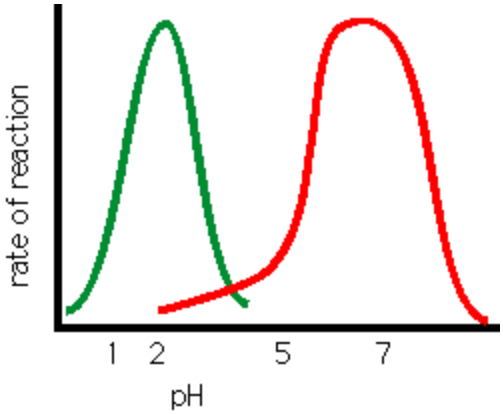
7. Describe the induced fit model (2 points).

8. What is hydrolysis? (2 points)

The pH of a solution can have several effects of the structure and activity of enzymes. For example, pH can have an effect of the state of ionization of acidic or basic amino acids. Acidic amino acids have carboxyl functional groups in their side chains. Basic amino acids have amine functional groups in their side chains. If the state of ionization of amino acids in a protein is altered then the ionic bonds that help to determine the 3-D shape of the protein can be altered. This can lead to altered protein recognition or an enzyme might become inactive.

Changes in pH may not only affect the shape of an enzyme but it may also change the shape or charge properties of the substrate so that either the substrate cannot bind to the active site or it cannot undergo catalysis.

In general, an enzyme has a pH optimum. However the optimum is not the same for each enzyme. For example in the figure below is represented a situation in which two different enzymes might have very different pH optima. The one depicted by the green curve might represent the pH optimum for the enzyme pepsin which degraded proteins (protease) in the very acidic lumen of the stomach. The second curve (in red) might represent the enzyme carbonic anhydrase that works in the neutral pH of your cytosol.



9. A change in pH can lead to an altered shape of an enzyme or its substrate. This can lead to what? (2 points)