

2.10_Enzymes: The Keys to Life's Reactions

Enzymes are **biological catalysts** that are primarily proteins and are essential for accelerating specific chemical reactions in living organisms. They work by reducing the activation energy required for a reaction to occur without being consumed in the process. This allows them to be reused, catalyzing reactions repeatedly. Without enzymes, many crucial bodily functions would happen too slowly to sustain life.

How Enzymes Work: The Lock-and-Key Model

Each enzyme has a specific region called an **active site**. This active site has a unique shape that is complementary to a specific **substrate** molecule, much like a lock and a key. The substrate binds to the active site, forming an **enzyme-substrate complex**. The reaction then occurs, and the products are released from the active site.

Factors Affecting Enzyme Activity

The rate at which an enzyme works is affected by several environmental factors.

- **Temperature:** As temperature increases, the kinetic energy of the enzyme and substrate molecules increases, leading to more frequent collisions and a faster reaction rate. The temperature at which an enzyme is most active is known as its **optimum temperature**. Above this temperature, the enzyme starts to lose its shape.
 - **pH:** Each enzyme has an optimum pH at which it functions most effectively. Any significant change from this optimum pH can reduce the enzyme's activity.
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Denaturation

If an enzyme is exposed to a temperature or pH level far outside its optimum range, its active site can lose its specific shape. This is called **denaturation**. Once denatured, the substrate can no longer fit into the active site, and the enzyme permanently loses its ability to function. This is why biological washing powders, which contain enzymes, do not work well with very hot water.

Pearson Edexcel Practice Questions and Examiner Report

Multiple Choice Questions (10 MCQs)

1. What is the main function of an enzyme?

- A. To increase the products of a reaction.
- B. To decrease the activation energy of a reaction.
- C. To provide energy for a reaction.
- D. To act as a reactant in a reaction.

- **Examiner's Report:** The correct answer is B. Many candidates incorrectly choose option A, confusing the role of a catalyst with the outcome of a reaction. Enzymes speed up a reaction by reducing the energy needed for it to start, not by changing the amount of product.

2. Enzymes are made of which type of biological molecule?

- A. Carbohydrates
- B. Lipids
- C. Proteins
- D. Nucleic acids

- **Examiner's Report:** The correct answer is C. This question tests a fundamental piece of knowledge. Incorrect responses often mix up the four main biological molecules.

3. The specific region on an enzyme where a substrate binds is called the:

- A. Active site.
- B. Binding site.
- C. Substrate site.
- D. Reaction site.

- **Examiner's Report:** The correct answer is A. This is a common terminology question. Most candidates who have studied the topic correctly identify the active site.

4. Which of the following describes the relationship between an enzyme and its substrate?

- A. The active site is a general shape that fits any substrate.
- B. The active site and substrate have complementary shapes.

C. The substrate changes shape to fit the active site.

D. The enzyme changes shape permanently after the reaction.

- **Examiner's Report:** The correct answer is B. This tests the core concept of the lock-and-key model. Incorrect answers often confuse the roles of the enzyme and substrate or assume a general fit.

5. At its optimum temperature, an enzyme's activity is at its:

A. Lowest point.

B. Peak.

C. Starting point.

D. Denaturation point.

- **Examiner's Report:** The correct answer is B. This is a straightforward recall question. Candidates who get this wrong often confuse optimum temperature with denaturation temperature, which is much higher.

6. An enzyme's active site has lost its specific shape. What term describes this process?

A. Synthesis

B. Activation

C. Degradation

D. Denaturation

- **Examiner's Report:** The correct answer is D. This is a key vocabulary term. Candidates who fail to answer this often lack a clear understanding of the effects of high temperature or extreme pH on enzymes.

7. A student is investigating the effect of temperature on the enzyme amylase, which breaks down starch. What would be the most suitable way to measure the rate of reaction?

A. Measuring the pH of the solution.

B. Measuring the temperature change over time.

C. Using a colorimeter to measure the color change with iodine solution over time.

D. Measuring the volume of products released.

- **Examiner's Report:** The correct answer is C. This assesses practical skills. The amylase reaction can be monitored by testing for the disappearance of the starch substrate using iodine, which changes from orange-brown to blue-black in the presence of starch. Many students confuse this with a direct measurement of the product.

8. Which of the following would cause an enzyme to denature?

- A. Placing it in a solution with a pH of 7.
- B. Increasing the substrate concentration.
- C. Cooling the enzyme to 0°C.
- D. Heating the enzyme to 100°C.

- **Examiner's Report:** The correct answer is D. This tests the student's knowledge of extreme conditions. Cooling to 0°C would simply slow the reaction, but not permanently denature the enzyme.

9. What is the purpose of a water bath when investigating the effect of temperature on enzyme activity?

- A. To provide a source of substrate.
- B. To provide a way to measure the pH.
- C. To maintain a constant temperature.
- D. To denature the enzyme.

- **Examiner's Report:** The correct answer is C. This assesses the student's understanding of experimental design. A water bath is used to ensure a constant temperature for a fair test.

10. The enzyme lipase breaks down lipids into which products?

- A. Fatty acids and glycerol
- B. Amino acids
- C. Sugars
- D. Starch

- **Examiner's Report:** The correct answer is A. This question tests the specific function of a named enzyme. Incorrect answers show a lack of knowledge of the products of digestion for the different biological molecules.
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