Class: 9th

Subject: Physics

Chapter 7: ENZYMES

Exercise MCQs:

1. Primarily, all enzymes are:

(a) Nucleic acids

(b) Proteins ✅

(c) Carbohydrates

(d) Lipids

2. Which best defines an enzyme?

(a) A chemical that breaks down food.

(b) A hormone that regulates metabolism.

(c) A protein that speeds up reactions. ✅

(d) A molecule that stores energy.

3. What can happen if an enzyme is exposed to temperature that is higher than its optimal temperature?

(a) Enzyme activity rate will increase.

(b) Enzyme's shape will change, potentially reducing its activity. ✅

(c) Enzyme will speed up the reaction and remain stable.

(d) Enzyme will become a substrate itself.

4. Enzymes are specific in their action because:

(a) Their active sites fit specific substrates. ✅

(b) They are always proteins.

(c) They are consumed in reactions.

(d) They work only at high temperatures.

5. Prosthetic groups are:

(a) Required by all enzymes.

(b) Proteins in nature.

(c) Loosely attached with enzymes.

(d) Tightly bound to enzyme. ✅

6. How does increasing temperature affect enzyme activity?

(a) Increases activity to a point ✅

(b) Always decreases activity

(c) Makes enzymes non-functional

(d) No effect on enzyme

7. How does competitive inhibitor affect enzyme action?

(a) Attaches with the substrate.

(b) Changes enzyme shape.

(c) Attaches and blocks the active site. ✅

(d) Blocks the cofactors.

8. An enzyme works best at a pH of 7.4. It is placed in an acidic solution with a pH of 4.0. How will this affect the enzyme?

(a) The active site will be modified, reducing substrate binding. ✅

(b) The enzyme will catalyse reactions faster due to

increased H ions.

(c) The enzyme will gain additional active sites.

(d) The substrate will become inactive in an acidic environment.

9. What is TRUE according to the induced fit model of enzyme action?

(**a**) Enzyme's active site changes shape to bind the substrate. ✅

(b) Substrate changes shape to bind to active site.

(c) No shape changes occur in active site or substrate.

(d) Substrate attaches the enzyme at a site other than active site.

10. What is TRUE about the optimum pH values of the following enzymes of digestive system?

(**a**) Pepsin works at low pH while trypsin works at high pH ✅

(b) Both work at high pH

(c) Both work at low pH

(d) Pepsin works at high pH while trypsin works at low pH

Important MCQs:

1. What is metabolism?

(a) Digestion only

(b) Physical changes only

(c) Sum of all chemical reactions ✅

(d) Only energy release

2. What happens during catabolism?

(a) Molecules are formed

(b) Energy is consumed

(c) Molecules are broken down to release energy ✅

(d) Oxygen is absorbed

3. Which process is an example of catabolism?

(a) Photosynthesis

(b) Protein synthesis

(c) Lipolysis ✅

(d) DNA replication

4. What is required during anabolism?

(a) No energy

(b) Energy input ✅

(c) Carbon dioxide only

(d) Heat only

5. Which of the following is an anabolic process?

(a) Cellular respiration

(b) Lipolysis

(c) Photosynthesis ✅

(d) Fermentation

6. What is the chemical nature of enzymes?

(a) Carbohydrates

(b) Proteins ✅

(c) Fats

(d) Nucleic acids

7. How do enzymes affect chemical reactions?

(a) They slow them down

(b) They consume substrates

(c) They act as catalysts ✅

(d) They change into products

8. What is the structure of enzymes?

(a) Fibrous

(b) Sheet-like

(c) Globular ✅

(d) Helical

9. Amylase is specific for which substance?

(a) Fat

(b) Glucose

(c) Protein

(d) Starch ✅

10. Enzymes that work inside the cells are called:

(a) Extracellular enzymes

(b) Secretory enzymes

(c) Intracellular enzymes ✅

(d) Digestive enzymes

11. Which is an extracellular enzyme?

(a) Enzyme in mitochondria

(b) DNA polymerase

(c) Stomach enzyme for digestion ✅

(d) Enzyme in chloroplast

12. Inorganic cofactors of enzymes include:

(a) Biotin

(b) NAD

(c) Iron ions ✅

(d) Enzyme itself

13. Prosthetic groups are:

(a) Loosely bound cofactors

(b) Tightly bound cofactors ✅

(c) Made of fat

(d) Temporary structures

14. Which of the following is a prosthetic group?

(a) NAD

(b) ATP

(c) Biotin ✅

(d) Glucose

15. In the food industry, enzymes are used to:

(a) Kill bacteria

(b) Convert starch into sugars ✅

(c) Make vitamins

(d) Act as preservatives

16. What is the function of the active site in an enzyme?

(a) It stores energy

(b) It binds to inhibitors

(c) It catalyzes reactions ✅

(d) It digests enzymes

17. In the Lock and Key model, the enzyme's active site is:

(a) Flexible

(b) Constant and fits the substrate exactly ✅

(c) Made of fat

(d) Changed after reaction

18. Who proposed the Lock and Key model?

(a) Robert Hooke

(b) Daniel Koshland

(c) Emil Fischer ✅

(d) Louis Pasteur

19. According to the Induced Fit model, the enzyme's active site:

(a) Never changes

(b) Is reshaped by substrate binding ✅

(c) Is destroyed by heat

(d) Becomes inactive always

20. What is the optimum temperature for most human enzymes?

(a) 25°C

(b) 100°C

(c) 37°C ✅

(d) 45°C

21. What happens to enzymes at high temperatures beyond the optimum level?

(a) They work faster

(b) They denature ✅

(c) They become more active

(d) They multiply

22. Which enzyme works best in acidic pH?

(a) Amylase

(b) Trypsin

(c) Pepsin ✅

(d) Lipase

23. What is meant by saturation of active sites?

(a) Enzyme activity stops

(b) No enzymes are present

(c) All enzyme active sites are occupied ✅

(d) Substrate is missing

24. What is a competitive inhibitor?

(a) A molecule that destroys enzyme

(**b**) A substance that fits into the active site and blocks substrate ✅

(c) A molecule that activates enzyme

(d) A hormone-like enzyme

25. Which of the following is a non-competitive inhibitor?

(a) Vitamin B

(**b**) Mercury ✅

(c) Glucose

(d) Amylase

Exercise Short Questions:

1. Define metabolism. Differentiate between catabolism and anabolism.

- **Metabolism** is the sum of all chemical reactions that occur in a living organism to maintain life.
- **Catabolism** is the breakdown of complex

molecules into simpler ones with the release of energy.

- **Anabolism** is the synthesis of complex molecules from simpler ones, and it requires energy.

2. Which type of metabolism demands input of energy? Give an example.

Anabolism requires input of energy.

Example: The synthesis of proteins from amino acids.

3. Define an enzyme. What is its role in metabolism?

- **An enzyme** is a biological catalyst, usually a protein, that speeds up chemical reactions in the body without being consumed.
- **In metabolism,** enzymes control and speed up both catabolic and anabolic reactions.

4. What is the active site of enzyme? State its importance in enzyme specificity.

- The **active site** is the specific region on the

enzyme where the substrate binds and the reaction occurs.

- It **determines enzyme** specificity because only a specific substrate fits into the enzyme's active site, like a key fits into a specific lock.

5. Provide an example of a specific enzyme-substrate pair.

Amylase (enzyme) acts on starch (substrate) to break it down into simpler sugars.

6. What is the effect of substrate concentration on enzyme activity?

As substrate concentration increases, enzyme activity also increases—until all active sites are occupied. After saturation, further increase in substrate does not increase the reaction rate.

7. Provide two examples of enzymes that operate optimally at specific pH.

- Pepsin works best at acidic pH (1.5 to 2.0) in the stomach.
- Trypsin works best at alkaline pH (7 to 8) in the

small intestine.

8. What do you mean by optimum temperature and pH?

- **Optimum temperature** is the temperature at which an enzyme works best. For human enzymes, it is usually 37°C.
- **Optimum pH** is the pH value at which an enzyme shows maximum activity.

9. Which type of enzyme inhibitors inhibit the enzymes without attaching to the active site?

Non-competitive inhibitors attach to a site other than the active site and inhibit the enzyme by changing its shape.

10. Differentiate between competitive and non-competitive inhibition.

- In **competitive inhibition**, the inhibitor resembles the substrate and binds to the active site, blocking the substrate.
- In **non-competitive** inhibition, the inhibitor binds elsewhere on the enzyme, changing its

shape and making the active site ineffective.

Important Short Questions:

1. What is metabolism?

Metabolism is the sum of all chemical reactions that occur within an organism to sustain life. It includes both energy-releasing (catabolism) and energy-consuming (anabolism) processes.

2. What is catabolism? Give an example.

Catabolism is the breakdown of complex molecules into simpler ones with the release of energy. Example: Cellular respiration, where glucose is broken down into CO_2 and H_2O.

3. What is anabolism? Give an example.

Anabolism is the process of building complex molecules from simpler ones using energy. Example: Photosynthesis, where CO_2 and H_2O are converted into glucose using sunlight.

4. What are enzymes?

Enzymes are biological catalysts that speed up chemical reactions without being consumed. They are usually proteins and are specific to their substrates.

5. What is the active site of an enzyme?

The active site is the specific region on the enzyme where the substrate binds. It plays a key role in determining the enzyme's specificity and catalytic action.

6. What is enzyme-substrate specificity? Give an example.

Enzymes are highly specific and only work on particular substrates. Example: Amylase acts specifically on starch to break it into sugars.

7. What is the effect of temperature on enzyme activity?

Enzyme activity increases with temperature up to an optimum point (usually 37°C in humans). Beyond this, high temperatures denature enzymes, reducing their activity.

8. What do you mean by optimum temperature and pH?

Optimum temperature and pH are the specific conditions at which an enzyme shows maximum activity. For most human enzymes, the optimum temperature is 37°C, and the pH varies depending on the enzyme.

9. What is the role of cofactors in enzyme activity?

Cofactors are non-protein components required for enzyme activity. They can be metal ions (inorganic) or organic molecules like vitamins (coenzymes and prosthetic groups).

10. What is the difference between competitive and non-competitive inhibition?

In competitive inhibition, the inhibitor resembles the substrate and binds to the active site. In non-competitive inhibition, the inhibitor binds elsewhere on the enzyme, changing its shape and reducing activity.

11. What is an active site of an enzyme?

An active site is a pocket or cleft on the enzyme's surface where the substrate binds and the catalytic reaction occurs.

12. What is the Lock and Key Model of enzyme action?

It is a model that suggests the enzyme's active site has a fixed shape, and the substrate fits into it like a key fits into a lock.

13. Who proposed the Lock and Key Model?

Answer:

It was proposed by Emil Fischer in 1894.

14. What is the Induced Fit Model of enzyme action?

This model states that the enzyme's active site is flexible and changes shape to fit the substrate when it binds.

15. How does temperature affect enzyme activity?

Enzyme activity increases with temperature up to an optimum (37°C), but very high temperatures denature the enzyme, reducing its activity.

16. What is denaturation of an enzyme?

Denaturation is the loss of the enzyme's globular structure due to high temperature or pH, resulting in loss of function.

17. What is the optimum pH of pepsin and trypsin?

Pepsin works best in acidic pH (1.5–2.0), while trypsin works in alkaline pH (7–8).

18. What happens when substrate concentration increases?

Enzyme activity increases until all active sites are occupied; after that, the rate does not increase further (saturation point).

19. What is competitive inhibition?

It occurs when an inhibitor mimics the substrate and binds to the active site, blocking the real substrate.

20. How does non-competitive inhibition work?

The inhibitor binds to a site other than the active site, changing the enzyme's shape so the substrate can no longer bind effectively.

Exercise Long Questions:

Q1: Describe the characteristics of enzymes.

Enzymes are biological catalysts that increase the speed of chemical reactions in living organisms without being consumed. They play an essential role in metabolism. The main characteristics of enzymes are:

Protein Nature:

Enzymes are mostly proteins, composed of long chains of amino acids. They have a specific 3D structure necessary for their function.

Globular Structure:

Enzymes have a globular shape, which creates specific regions known as active sites. These active sites are responsible for substrate binding and catalysis.

Specificity:

Enzymes are highly specific in action. Each enzyme catalyzes only one type of reaction or acts on a

specific substrate. For example, amylase only breaks down starch.

Reusability:

Enzymes are not used up in the reaction. After catalyzing a reaction, they remain unchanged and can be used again.

Efficiency:

Enzymes greatly accelerate reactions. They can make chemical reactions occur millions of times faster than without them.

Sensitivity to Conditions:

Enzymes work best under specific conditions such as optimal temperature and pH. Changes in these can reduce or stop their activity.

Intracellular and Extracellular:

Some enzymes function inside the cells (intracellular), while others are secreted outside cells (extracellular) like digestive enzymes.

Requirement of Cofactors:

Some enzymes need additional molecules to work efficiently. These are called cofactors and may be inorganic (like metal ions) or organic (like vitamins or NAD).

Q2: Describe how temperature extremes can inhibit enzyme activity and lead to enzyme denaturation.

Temperature is a key factor that affects enzyme activity:

Optimum Temperature:

Most human enzymes function best at around 37°C (normal body temperature). This is called the optimum temperature.

Effect of Low Temperature:

At low temperatures, enzyme activity is slow because molecular movement is reduced, so substrate and enzyme interactions are infrequent.

Effect of High Temperature:

As temperature increases, enzyme activity initially

rises because molecules move faster, leading to more collisions between enzyme and substrate.

Denaturation:

- If temperature increases beyond a certain point, the heat disrupts the hydrogen and ionic bonds that maintain the enzyme's structure.
- The enzyme loses its 3D shape (denaturation), especially the active site, making it unable to bind to the substrate.
- This causes a rapid decline in enzyme activity, and the damage is often irreversible.

Q3: How does pH affect enzyme activity?

Optimum pH:

Each enzyme has an optimum pH at which it works best. This is the pH value where the enzyme maintains its shape and its active site fits the substrate perfectly.

Effect of pH Changes:

A small change in pH can affect the ionization of

amino acids in the enzyme, especially those at the active site.

This can reduce the enzyme's ability to bind with the substrate and slow down or stop the reaction.

Extreme pH Values:

Very high or low pH values can alter the enzyme's structure (denature it), making it non-functional.

Examples:

Pepsin, which works in the stomach, has an optimum pH of 1.5 to 2.0 (acidic). Trypsin, which works in the small intestine, has an optimum pH of 7 to 8 (alkaline).

Q4: Describe the factors that affect the activity of enzymes.

There are three major factors that affect enzyme activity:

a) Temperature:

- Enzyme activity increases with temperature up to an optimum (usually 37°C for humans).

- Beyond the optimum temperature, the enzyme starts to denature and lose its activity.

b) pH:

- Enzymes have specific pH ranges where they function best.
- Deviations from this range alter the charge and structure of the enzyme, reducing its efficiency.

c) Substrate Concentration:

- As substrate concentration increases, the rate of reaction increases, because more enzyme-substrate complexes are formed.
- However, when all enzyme active sites are occupied, the reaction rate stops increasing. This is called saturation.

Q5: Compare the Lock-and-Key and Induced Fit models of enzyme action.

There are two major models to explain how enzymes work:

Lock-and-Key Model:

- Proposed by Emil Fischer in 1894.
- Suggests that the enzyme's active site has a fixed shape.
- Only a specific substrate fits into this fixed shape like a key fits into a lock.
- Enzyme-substrate complex is formed, reaction occurs, and products are released.

Induced Fit Model:

- Proposed by Daniel Koshland in 1958.
- Suggests that the active site is flexible, not rigid.
- When the substrate approaches, the enzyme changes its shape slightly to accommodate the substrate.
- This change improves the fit and enhances the efficiency of catalysis.

Comparison:

Comparison Between Lock-and-Key and Induced Fit Models

Feature	Lock-and-Key Model	Induced Fit Model
Active Site	Fixed shape	Flexible and adaptable
Substrate Binding	Perfect fit from the beginning	Enzyme changes shape upon binding
Explanation Simplicity	Simpler concept	More accurate in modern biology

Both models help explain enzyme specificity, but the Induced Fit model better accounts for the flexibility seen in real enzymes.

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further

exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.