

## Unit 6: Enzymes

### Short Questions

#### 1. Define Metabolism.

Text Book Page # 107 (LHR 2012, GRW 2015, SWL 2014)

**Ans:** Meaning:

The term metabolism is derived from a Greek word meaning "Change".

**Definition:**

"Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life".

- These processes allow organisms to grow and reproduce, maintain their structure, and respond to their environments.

#### 2. Who gave the concept of Metabolism?

(SWL 2015)

**Ans:** The concept of metabolism was first of all given by Ibn-e-Nafees, who stated that, "The body and its parts are always undergoing change."

#### 3. What is the difference between catabolism and Anabolism?

(LHR 2014, 2016, DGK 2015, BWP 2015, SGD 2014, 2015, RWP 2015)

**Ans:**

CATABOLISM	ANABOLISM
<ul style="list-style-type: none"><li>• Catabolism includes the biochemical reactions in which larger molecules are broken down.</li><li>• Energy is released in catabolism.</li></ul> <p><b>Example:</b> Cellular respiration</p>	<ul style="list-style-type: none"><li>• Anabolism includes the biochemical reactions in which larger molecules are synthesized.</li><li>• Energy is utilized in anabolism.</li></ul> <p><b>Example:</b> Photosynthesis</p>

#### 4. What are enzymes?

**Ans:** "Enzymes are proteins that catalyze (i.e. speed up) biochemical reactions and are not changed during the reaction."

During metabolism, chemicals are transformed from one form to the other by enzymes. Enzymes are crucial to metabolism because they act as biocatalysts and speed up and regulate metabolic pathway.

#### 5. What is the difference between substrate and product?

(LHR 2013, GRW 2013, LHR 2014)

**Ans:** The molecules at which enzymes act are called substrates, and enzyme converts them into different molecules, called products.

## 6. Define Activation Energy.

(LHR 2015, BWP 2015)

**Ans: Definition:**

"The minimum amount of energy required to start the biochemical reaction is called activation energy".

**Need:**

The need for activation energy acts as a barrier to the beginning of reaction. Enzymes lower such barriers by decreasing the requirement of activation energy

## 7. How do enzymes lower activation energy?

(MTN 2014, 2015, SWL 2015, FSD 2014, 2015)

**Ans:** Enzymes lower the activation energy in several ways:

- They may alter the shape of substrate and reduce the requirement of energy for this change.
- Some enzymes do so by disrupting the charge distribution on substrates.
- Enzymes also lower activation energy by bringing substrate in correct orientation to react.

## 8. Differentiate between intracellular and extracellular enzymes. Text Book Page # 108

(GRW 2015, MTN 2015)

**Ans:** Enzymes can be categorized on the basis of the site where they work i.e. they may be intracellular enzymes (e.g. enzymes of glycolysis working in the cytoplasm) or may be extra cellular enzymes (e.g. pepsin enzyme working in the stomach cavity)

## 9. Illustrate with the help of Diagram that enzymes lower activation energy.

**Ans:**

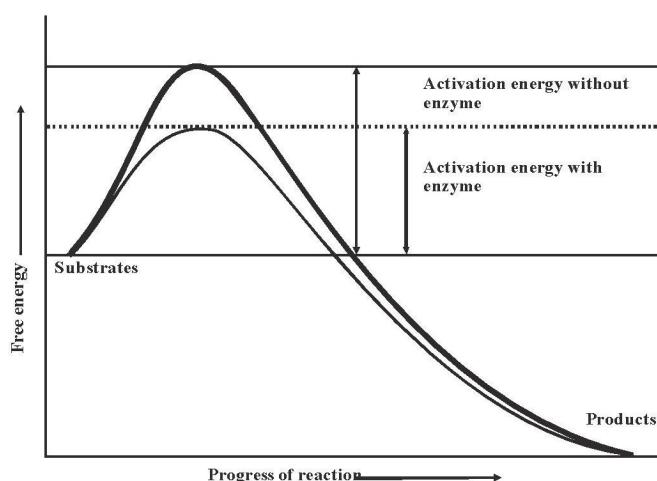


Figure: Enzymes Lower the Activation Energy

## 10. Who first used the term enzyme?

(LHR 2015)

**Ans:** In 1878, German Physiologist Winhelm Kuhne first used the term Enzyme

**11. Write down the two characteristics of enzymes? (LHR 2016, SGD 2015)**

**Ans:**

- Almost all enzymes are proteins i.e. they are made of amino acids.
- Enzymes are usually very specific for the type of reaction and for the nature of their substrates.

**12. Define Active Site.**

**Text Book Page # 109**

**(LHR, GRW 2015, SWL 2014)**

**Ans:** "Only a small portion of enzyme molecule is directly involved in catalysis. This catalytic region is known as active site".

- It recognizes and binds substrate and then carries out reaction.

**13. What are co-factors?**

**(GRW 2014, 2015)**

**Ans:** "Some enzymes do not need any additional components to work. However, others require some components which are called Co-factors".

- Co-factors are non-protein molecules or ions. Cofactors can be Inorganic (e.g. Metal ions) and Organic (e.g. Flavin & Heme)

**14. Write difference between cofactors and coenzymes.**

**(SWL 2015, MTN 2015, DGK 2015, SGD 2015)**

**Ans:**

COFACTORS	COENZYMES
<ul style="list-style-type: none"><li>• Some enzymes need some components which are called cofactors.</li><li>• Cofactors are non-proteins molecules or ions.</li><li>• Cofactors can be either inorganic (e.g. Metal ions) or organic e.g. Flavin or heme.</li></ul>	<ul style="list-style-type: none"><li>• If organic cofactors are loosely attached with enzymes. They are called Coenzymes.</li><li>• Coenzymes transport chemical groups from one enzyme to another.</li><li>• Some important vitamins (e.g. riboflavin, thiamine and folic acid) act as coenzymes.</li></ul>

**15. What is the difference between prosthetic group and co-enzymes?**

**(LHR 2014, GRW 2015)**

**Ans:** Cofactors can be of two types:

**i. Prosthetic Groups:**

"If the organic cofactors are tightly bound to enzyme, they are called prosthetic groups."

**Example:**

Heme

**ii. Co-enzymes:**

"If the organic cofactors are loosely attached with enzyme, they are called coenzymes". Coenzymes transport chemical groups from one enzyme to the other.

Some important vitamins act as coenzymes e.g.,

- Riboflavin
- Thiamine
- Folic acid

**16. Name the vitamins which act as coenzymes.**

(MTN 2015)

**Ans:** Following are some important vitamins which act as coenzymes.

- Riboflavin
- Thiamine
- Folic Acid

**17. Give any two uses of enzymes. / What is the main use of enzymes in food industry?**

(LHR, GRW 2013, 2014, 2016, MTN 2015, SGD 2014, 2015, RWP 2014)

**Ans:** Enzymes are extensively used in different industries for fast chemical reactions.

**(i) Food Industry:**

Enzymes that break starch into simple sugars are used in the production of:

- White bread
- Buns

**(ii) Brewing Industry:**

Enzymes break starch and proteins. The products are used by yeast for fermentation to produce alcohol.

**18. Name only factors affecting the rate of enzyme action.** (LHR 2015, RWP 2014)

**Ans:** Following are the names of some important factors which affect the rate of enzyme action.

- Temperature
- Substrate concentration
- pH

**19. Define Optimum temperature.**

Text Book Page # 110 (LHR 2014, 2016, SGD 2015, RWP 2015)

**Ans:** "Every enzyme works at its maximum rate at a specific temperature which is called optimum temperature for that enzyme."

- The optimum temperature for maximum working speed of enzymes in human body is 37°C.

**20. What do you mean by denaturation of enzyme? How temperature affects rate of enzymes reaction?** (LHR 2013, 2016, GRW 2014, 2015, DGK 2014)

**Ans:** When temperature rises to a certain limit, heat adds in the activation energy and also provides kinetic energy for the reaction. So the reactions are accelerated. But when the temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of

enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

- Denaturation results in a rapid decrease in rate of enzyme action and it may be blocked completely.

**21. Birds have higher body temperature than mammals. What would happen to activity of a bird's enzyme if it is given temperature of 37°C?**

**Ans:** If a bird is given temperature of 37°C, the reaction rate will slow down as the bird's body have higher temperature than mammals.

**22. What would happen to reaction if enzyme concentration is kept constant and amount of substrate is increased? (SGD 2014)**

**Ans:** If enzyme concentration is kept constant, and the amount of substrate is increased, a point is reached where any further increase in the substrate does not increase the rate of reaction any more.

**Saturation:**

When the active sites of all enzymes are occupied, at high substrate concentrations, any more substrate molecules do not find free active sites. This state is called saturation of active sites and reaction rate does not increase.

**23. Draw a diagram showing effects of substrate concentration on enzyme activity.**

Text Book Page # 111

**Ans:**

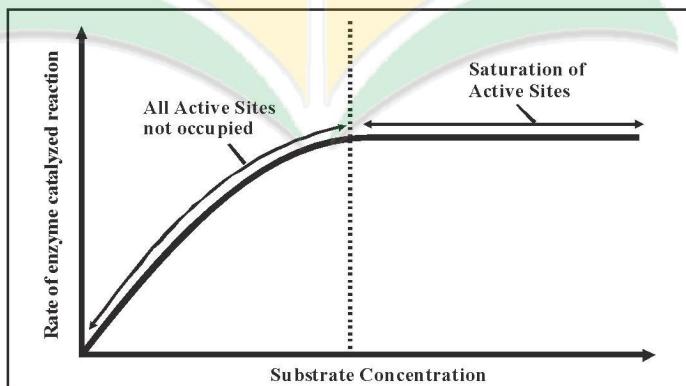


Figure: Effect of Substrate Concentration on Enzyme Activity

**24. Define optimum pH. How does pH affect enzyme activity?**

(GRW 2012, LHR 2014, DGK 2014, 2015)

**Ans:** "All enzymes work at their maximum rate in a narrow range of pH, called as the optimum pH".

Every enzyme has its specific optimum pH value.

**Effect of pH Change:**

A slight change in optimum pH of an enzyme causes retardation in enzyme activity or blocks it completely. Change in pH can effect the ionization of amino acids at the active site.

**25. Describe lock and key model for enzyme action. Text Book Page # 112  
(LHR 2012, GRW 2013, 2014, SWL 2014, MTN 2014, SWL 2015, DGK 2015, FSD 2014)**

**Ans:** In order to explain the mechanism of enzyme action, a German chemist Emil Fischer in 1894, proposed 'Lock and Key Model' for enzyme action.

**Model:**

According to this model:

"Both enzyme and substrate possess specific shapes that fit exactly into one another".

**Enzyme Specificity:**

This model explains enzyme specificity for its substrates.

**26. What is induced fit model?**

**(SWL 2014), (DGK 2014), (MTN 2015), (BWP 2015), (SGD 2014), (RWP 2015)**

**Ans:** In 1958, an American biologist Daniel Koshland suggested a modification to Lock and Key model and proposed 'Induced-fit model'.

**Model:**

According to this model,

"The active site is not a rigid structure rather it is molded into the required shape to perform its function."

**Advantage:**

This model is more acceptable than Lock and Key Model.

**27. How specificity of enzymes is determined?**

**Ans:** Specificity of different enzymes is determined by the shapes of their active sites. Active sites possess specific geometric shapes that fit with specific substrates.