# Biomedical Admissions Test (BMAT)

## Section 2: Biology

### Questions by Topic

### B8 - Enzymes

# B8: Enzymes - Questions by Topic

*(Mark Scheme and explanations at the end)*

**1** The following statements are about enzymes.

**1** Enzymes are biological catalysts, they speed up reactions such as respiration and photosynthesis.

**2** Each enzyme will only bind to a specific substrate due to the unique shape of the active site.

**3** Nearly all metabolic processes occurring in the cell are fast enough, however some require catalysts.

**4** An enzyme will always join two substrates together.

**5** The enzyme substrate complex forms during the reaction and changes the active site of the enzyme permanently.

Which of these statements are correct?

**A** 1, 2, 3 and 4
**B** 1, 2, 3 and 5
**C** 1, 2 and 4
**D** 1, 2 and 4
**E** 1, 2 and 5
**F** 1 and 2
**G** 1 and 3
**H** 2 and 5

**2** Enzymes are biological catalysts and are affected by the environment in our body. The following statements are about the factors that affect the rate of enzyme reaction.

**1** Each enzyme works best at a certain temperature and pH, these are known as the optimum conditions.
**2** A denatured active site can be reversed when the temperature is lowered.
**3** Enzymes that work in the stomach work at an optimum pH of around 8.
**4** A change pH either way from the optimum results in a decrease in the rate of reaction.
**5** A reduction in the energy available for the reaction to occur can lead to a decrease in the rate of reaction.

Which of these statements are correct?

**A** 1, 2, 3 and 4
**B** 1, 2, 3 and 5
**C** 1, 2 and 4
**D** 1, 2 and 5
**E** 1, 4 and 5
**F** 1 and 2
**G** 2 and 4
**H** 2 and 5

**3** The following statements are about enzymes.

**1** Carbohydrases digest large soluble carbohydrates into smaller ones.
**2** Maltase catalyses the breakdown of maltose into glucose.
**3** Large insoluble proteins are digested by proteases into amino acids.
**4** Breakdown of starch into maltose is catalysed by amylase, in the stomach and small intestine.
**5** Lipase catalyses the breakdown of lipids into fatty acids and water.

Which of these statements are correct?

**A** 1, 2, 3 and 4
**B** 1, 2, 3 and 5
**C** 1, 2 and 4
**D** 1, 3 and 4
**E** 1, 2 and 5
**F** 1 and 2
**G** 1 and 4
**H** 2 and 3

**4** The following statements are about enzymes.

**1** Extracellular enzymes are produced by specialised cells present in glands and tissues.
**2** Most enzymes work outside cells.
**3** Babies require proteases to pre-digest food.
**4** Digestive enzymes are extracellular.
**5** Enzymes involved in respiration and photosynthesis are extracellular.

Which of these statements are correct?

**A** 1, 2, 3 and 4
**B** 1, 2, 3 and 5
**C** 1, 2 and 4
**D** 1, 3 and 4
**E** 1, 2 and 5
**F** 1 and 2
**G** 1 and 4
**H** 2 and 3

**5** The following statements are about enzymes.

**1** The rate of reaction can decrease if the bonds holding the enzyme together break.
**2** A substrate can be broken by the removal of water.
**3** An enzyme is changed by the reaction.
**4** The active site never changes shape.
**5** The metabolic pathways in a cell are determined by the enzymes present in the cell.

Which of these statements are correct?

**A** 1, 2, 3 and 4
**B** 1, 2, 3 and 5
**C** 1, 2 and 4
**D** 1, 3 and 4
**E** 2, 3 and 5
**F** 1 and 2
**G** 1 and 5
**H** 2 and 4

**6** Which of the following is not true of enzymes in humans?

**A** They are biological catalysts.
**B** These are proteins.
**C** They all function best at pH 7.
**D** They are specific to a particular substrate.
**E** An extreme increase in temperature will denature human enzymes.

**7** Which of the following are not enzymes?

**1** Bile
**2** Maltose
**3** Protease
**4** Amylase

**A** 1 and 2 only
**B** 1 and 3 only
**C** 2 and 3 only
**D** All of the statements

**8** Which of the following correctly shows a location where an enzyme is produced and what it digests?

| | **Enzyme** | **Location** | **Digests** |
|---|---|---|---|
| **A** | Amylase | Salivary glands | Starch |
| **B** | Amylase | Pancreas | Maltose |
| **C** | Lipases | Pancreas | Glycerol |
| **D** | Lipases | Salivary glands | Lipids |
| **E** | Proteases | Salivary glands | Proteins |
| **F** | Proteases | Stomach | Amino acids |

**9** Which is not the product of enzyme breakdown?

**A** Maltose
**B** Glucose
**C** Amino acids
**D** Amylose
**E** Glycerol

**10** Which of the following statements about bile is incorrect?

**1** Bile is produced in the liver.
**2** Bile is stored in the liver.
**3** Bile is produced in the gall bladder.
**4** Bile is stored in the gall bladder.

**A** 2 and 3 only
**B** 1 and 4 only
**C** 1 only
**D** 4 only
**E** None of the above

# Answers and Explanations

**1** **The answer is F.**

**1** is correct - as the enzymes help to **increase** the rate of reactions in the body, they catalyse chemical reactions, in animals and plants.

**2** is correct - because enzymes are proteins, and every enzyme has an area with a **unique 3D shape** known as the **active site.** The unique shape means only a specific substrate will fit into the active site. This is the **lock and key hypothesis**, where the substrate is the key and the active site is the lock.

**3** is incorrect - because **body temperature is too low** for chemical reactions to occur fast enough for metabolic processes, hence they occur too slowly to maintain life. Therefore nearly all the metabolic processes in the body need to be controlled by enzymes that are needed to catalyse chemical reactions so they occur **fast enough to sustain life.**

**4** is incorrect - enzymes will convert molecules (reactants) into different molecules (products). An enzyme can not only act by **joining two substrates together** to form one product but it can also **act on one substrate** to form two products.

**5** is incorrect - It is true that an **enzyme substrate complex** is formed when the substrate fits into the active site. In order for the active site to fit closely and more accurately to the substrate it may change shape slightly. This can ensure that the reaction takes place efficiently. However this does not change the active site of the enzyme permanently, the **enzyme remains unchanged after the reaction.**

Since **1** and **2** are the only correct statements, **F** must be the correct answer.

**2** **The answer is E**

**1** is correct - Each enzyme has **optimum conditions**, certain **temperature or pH** in which the enzyme works best. As enzymes have bonds that hold them and their active site in place, moving away from optimum conditions can affect these bonds changing their shape.

**2** is incorrect - this is because as **temperature increases** the particles **gain more kinetic energy** and therefore move around **faster.** Thus there is more chance that the substrates will collide and fit into the active site because they have **sufficient energy.** This **increases the rate of the reaction.** Once the temperature has gone **above the optimum** the enzyme begins to **denature**, this results in a decrease in the rate of reaction. The reaction stops once the enzyme is fully denatured. If the temperature is lowered the enzyme can **still not catalyse the reaction**, as the structure of the **active site is still changed.**

**3** is incorrect - this is because an enzyme that works in the **stomach** works at an **optimum pH of around 2.** Whereas an enzyme that works in the **small intestine** has an **optimum temperature of around 8.**

**4** is correct - enzymes are functional at a particular pH, when the **pH is below or above** the optimum pH the rate of reaction decreases, this is because the enzyme **denatures.**

**5** is correct - kinetic energy enables particles to gain more energy which increases the chances of the substrate colliding into the active site of the enzyme. Thus if there is a decrease in the energy available for the reaction then the particles **will not have sufficient energy** for the reaction to place.

Since **1, 4** and **5** are the only correct statements, **E** must be the correct answer.

**3** **The answer is H.**

**1** is incorrect - it is correct that carbohydrases are the enzymes that catalyse the breakdown of carbohydrates and speed up digestion. However carbohydrases digest **large insoluble carbohydrates (polymers)** into **smaller soluble carbohydrates.**

**2** is correct - maltose is a **disaccharide** that is present from the b**reakdown of starch.** The enzyme that catalyses the breakdown of maltose into glucose is **maltase.**

**3** is correct - as the enzymes that digests proteins are called **proteases.** The **large insoluble proteins** (polymers) are broken down into **amino acids** which are **smaller and insoluble** therefore easier to digest.

**4** is incorrect - it is true that **amylase catalyses the breakdown of starch into maltose**, however this occurs in the **mouth**, not in the stomach or small intestines, as salivary glands release amylase.

**5** is incorrect - it is true that the enzyme that catalyses the **breakdown of lipids** is **lipase**, however the products of this reaction are **fatty acids and glycerol**, not fatty acids and water.

Since **2** and **3** are the only correct statements, **H** must be the correct answer.

**4** **The answer is D.**

**1** is correct - it is true that extracellular enzymes are made by specialised cells that are in glands and tissues. For example, salivary glands, stomach lining, pancreas and the intestinal lining.

**2** is incorrect - **most enzymes are intracellular**, this means they work inside cells. **Digestive enzymes work outside cells**, hence they are extracellular. These digestive enzymes are made in specialised cells and are secreted from the cells and they come into contact with food molecules to digest.

**3** is correct - babies are not good at chewing when they start eating solid food, therefore **proteases** are often used to **predigest the food** (the large insoluble proteins) so they are able to **absorb amino acids** without having to digest the large proteins.

**4** is correct - it is true that digestive enzymes work outside cells, they are **extracellular enzymes.**

**5** is incorrect - enzymes that are involved in respiration and photosynthesis are **intracellular,** this means they work inside cells, like most enzymes.

Since **1, 3** and **4** are the only correct statements, **D** must be the correct answer.

**5** **The answer is E.**

**1** is correct - it is true that if the bonds that hold the enzyme together in a **specific 3D shape** break then the active site is no longer the specific shape that it was, therefore the rate of reaction can **decrease** as the substrate does not fit into the active site. The enzyme is said to be **denatured.**

**2** is incorrect - as a substrate can be broken by a **hydrolysis reaction**, this is the **addition of water**, not the removal.

**3** is incorrect - this is because when an enzyme catalyses a reaction it **does not get used up** and remains **unchanged.**

**4** is incorrect - it is true that the enzyme remains unchanged after a reaction however when the substrate collides and fits into the active site, it is said that the active site **changes shape slightly** to ensure that the substrate fits into the active site better, so the reaction takes place efficiently.

**5** is correct - most enzymes are **intracellular** and therefore the enzymes that are present in a cell will determine which chemical reactions will take place. Metabolic pathways are made up of **chemical reactions,** hence the enzymes present determine which reactions can be catalysed and the **metabolic pathways** that can occur in the cell.

Since **1** and **5** are the only correct statements, **G** must be the correct answer.

**6** **C is the answer.** Enzymes each function best at their own optimum pH. For example, proteases in the stomach will work best at a lower pH.

**A** is true as enzymes act to increase the rate of reaction.
**B** is true as enzymes are a specific type of protein
**D** is true because this is the 'lock and key' theory.
**E** is true because high temperatures cause the active sites of the enzymes to change, which is denaturation.

**7** **A is the answer.** Malt**o**se is not an enzyme but a sugar made from two glucose monomers and bile acts to emulsify molecules but is not itself an enzyme.

**8** **A is the answer.** One of the locations in which amylase is produced is the salivary gland and it does digest starch.

**B** is incorrect as amylase doesn't digest maltose.
**C** is incorrect because lipases digest lipids not glycerol.
**D** is incorrect because lipases aren't produced in the salivary glands.
**E** is incorrect because proteases aren't produced in the salivary glands.
**F** is incorrect because proteases don't digest amino acids

The correct locations and what they digest is below.

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| Enzyme | Location | Digests |
|---|---|---|
| Amylase | Salivary glands<br>Pancreas<br>Small intestine | Starch |
| Maltase | Salivary glands<br>Pancreas<br>Small intestine | Maltose |
| Proteases | Stomach<br>Pancreas<br>Small Intestine | Protein |
| Lipases | Pancreas<br>Small Intestine | Lipids |

**9** **D is the answer.** Amylose is a form of starch rather than the result of a substance being broken down.

**A** is the product of starch being broken down by amylase.
**B** is the product of maltase breaking down maltose.
**C** is the product of proteins being broken down by proteases.
**E** is a product of lipids being broken down by lipases.

**10** **B is the answer.** Bile is made in the liver, stored in the gallbladder and acts in the small intestine to emulsify lipids to increase their surface area and thus the rate of breakdown.