Biomolecules

Case Study Based Questions

Read the following passages and answer the questions that follow:

1. Jatin is experimenting in his lab where he is grinding living tissues with the help of mortar and pestle. He wants to find various biomolecules found in living tissues.

(A) What chemical is used to grind living tissues in chemical analysis?

(a) Trichloroacetic acid

(b) Ethanol

(c) Benzene

(d) Both (a) and (b)

(B) What are the fractions found by performing the chemical analysis of living tissues?

(a) Acid-soluble pool

(b) Acid-insoluble pool

(c) Both (a) and (b)

(d) None of the above

(C) What is the technique called for the analysis of inorganic constituents in living tissues?

(a) Oxidative phosphorylation

(b) Ash analysis

(c) Centrifugation

(d) None of the above

(D) Which among the following comes under filtrate?

(a) Monosaccharides

(b) Nucleoside
(c) Proteins
(d) Disaccharides

(E) What are some of the inorganic constituents found in living tissues?

(a) Sodium
(b) Potassium
(c) Calcium
(d) All of these

Ans. (A) (a) Trichloroacetic acid
Explanation: Trichloroacetic acid is used to grind living tissues in chemical analysis. Ethanol and benzene are not used here. Ethanol and Benzene both are just a non- polar solvents, which do not contribute to the grinding of living tissues.
(B) (c) Both (a) and (b)
Explanation: There are two fractions found by performing the chemical analysis of living tissues. These are acid-soluble pools and acid-insoluble pools.
(C) (b) Ash analysis
Explanation: For analysis of inorganic constituents in living tissues, we perform a method called ash analysis. Oxidative phosphorylation has no relation with this chemical analysis.
(D) (a) Monosaccharides
Explanation: Monosaccharides and nucleotides are small molecules so they come under filtrate. Protein is a macromolecule that comes under retentate.
(E) (d) All of these
Explanation: Sodium, potassium, and calcium, all are inorganic elements found in living tissues.

2. Rekha sends his 13-year-old daughter Rita to bring vegetable oil from the market. Rita brings home ghee. Her mother then told her to return ghee back to the shop and bring back sunflower oil. Rita asks her mother why ghee and oil do different works. Then Rekha told her that sunflower oil is much healthier than ghee.

(A) What type of oil is vegetable oil?
(B) Rita observed that ghee in her home gets frozen in cold weather but vegetable oil remains liquid. Why?

(C) Which type of oil should one consume and why?

Ans. (A) Vegetable oil is unsaturated oil or fatty acid.
(B) The unsaturated fatty acid has low melting and boiling point, whereas saturated fatty acid has high melting and boiling point. Ghee is saturated, so its melting point is high, thus it remains frozen in cold weather. But vegetable oil has a low melting point, so it remains liquid in cold weather.
(C) One should consume unsaturated oils because unsaturated fats are an essential component of a balanced diet. These fats aid in the prevention of heart disease and the reduction of cholesterol levels.

3. Rohini is a kid who has been feeling lazy and tired. She went to her doctor. Her doctor told her to take a good amount of protein in her diet. She is suffering from a condition of low protein in her body. Hopefully, according to the doctor, she will feel all good and better. Answer the following questions based on the situation.

(A) What is the name of the disease from which Rohini is suffering?

(a) Kwashiorkor
(c) Diabetes
(b) Anemia
(d) Both (a) and (b)

(B) What is the basic unit of proteins?

(a) Monosaccharides
(b) Nucleotide
(c) Amino acids
(d) None of the above

(C) What is the role of protein in the human body?

(a) Body repair
(b) New cell formation
(c) Both (a) and (b)
(d) Body degradation

(D) Which of the following is a property of amino acids?

(a) Having low metting and boiling points.
(b) having a high molecular weight.
(c) Organic solvents are insoluble in it.
(d) All of the above

(E) Assertion (A): There are 20 essential amino acids.
Reason (R): Essential amino acids are those amino acids that are not synthesised inside the human body.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Ans. (A) (a) Kwashiorkor
Explanation: Kwashiorkor is a disease that occurs in children suffering from protein deficiency.
(B) (c) Amino acids
Explanation: Amino acids are the basic unit of proteins whereas monosaccharide is the basic unit of carbohydrates and nucleotides are the basic unit of nucleic acid.
(C) (c) Both (a) and (b)

Explanation: Every cell in the human body is made up of proteins. Proteins are the building block so we need proteins for body repair and the formation of new cells. Proteins are an important source of energy also.

(D) (d) All of the above

Explanation: The properties of amino acids are:

(a) They have low melting and boiling points.

(b) They are crystalline white liquids having a high molecular weight.

(c) A pleasant, flavourless, or bitter flavour is shown by a few of the amino acids.

(d) Organic solvents are insoluble in most amino acids, which are soluble in water.

(E) (d) A is false but R is true.

Explanation: There are 9 essential amino acids, which cannot be synthesised inside the human body, so we need to take them from our food.

4. The proteins are composed of amino acids. They are organic compounds containing nitrogen, carbon, hydrogen, and oxygen and also a variable side chain group. For the efficient growth and operation of the many organs in the human body, 20 essential amino acids are required. Nine of the 20 are considered to be the most significant amino acids. Amino acids, the molecules' building blocks, are the components of proteins. By holding cells together, they provide many of a cell's structural components and help in tissue formation.

(A) On the basis of side chains, amino acids are differentiated into how many types?

(B) What is the importance of amino acids especially for human beings?

(C) Write about any two functions which are performed by essential amino acids.

Ans. (A) There are seven types of amino acids differentiated on the basis of side chains present.

(B) Amino acid is the compound that forms the building blocks of proteins. Proteins are essential components that make up 75% of the human body and are responsible for the overall development.

(C) In the human body, 9 essential amino acids are required. The functions performed by them are:

(1) Essential amino acids Like phenylalanine, valine, and threonine help in maintaining the nervous system, promote muscle growth and strengthen the immune system.

(2) Essential amino acid, tryptophan is involved in the production of vitamin B3 and

serotonin hormones that play a vital role in regulating sleep, boosting mood, and in maintenance of appetite.

5. Enzymes are proteins that act as biological catalysts (biocatalysts). Almost all enzymes are proteins. Some Nucleic acids behave like enzymes. They are called ribozymes. Enzymes have tertiary structures and many crevices called 'active sites! Enzymes act upon substrates and change them into products. Substrate binds to the active sites of enzymes. Like all catalysts, enzymes increase the rate of reaction by lowering their activation energy. Some enzymes are used commercially, for example, synthesis of antibiotics, smart detergent to remove fat stains on clothes, in biscuit factories and in meat tenderizer process.

(A) Which enzyme is used by the biscuit manufacturers to lower the protein level of flour?

(a) Amylases
(b) Proteases
(c) Cellulases
(d) Xylases

(B) Which of the following statements is/are correct about enzymes?

(a) An enzyme is a protein which acts as a biocatalyst to accelerate the rate of reaction.
(b) Life would not exist without the presence of enzymes in cells.
(c) Enzymes participate in various cellular metabolic processes.
(d) All of the above

(C) A protein having both structural and enzymatic properties is:

(a) Collagen
(b) Trypsin
(c) Myosin
(d) Actin

(D) The diagram shows a metabolic pathway:

$$A \xrightarrow{\text{Enzyme 1}} B \xrightarrow{\text{Enzyme 2}} C \xrightarrow{\text{Enzyme 3}} D$$

What would happen to the rate of production of 'D', if enzyme 1 was not present?

(a) It would stop.
(b) It would be increased.
(c) It would be decreased.
(d) No effect.

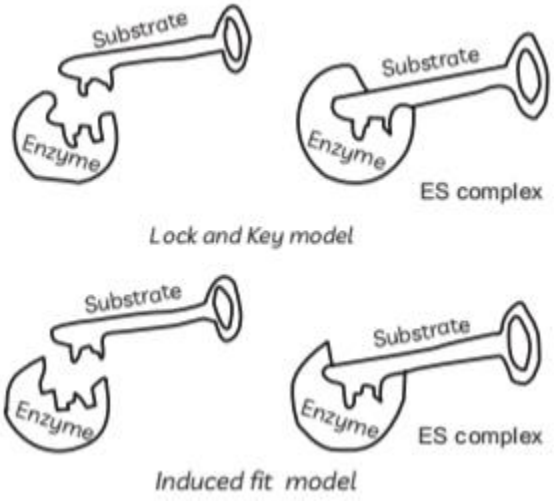
(E) Assertion (A): All enzymes are not proteins.
Reason (R): RNA molecules that possess catalytic activity are called ribozymes.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Ans. (A) (b) Proteases
Explanation: Proteases are used by biscuit manufacturers to lower the protein level of flour. Trypsin is used to pre-digest baby foods.
(B) (d) All of the above
Explanation: Biochemical reactions are sped up by enzymes, which operate as biological catalysts. The most popular explanation proposes that enzymes bind to the substrate molecule and create a transition state. An energy barrier that the substrates must pass separates the products from the substrates as the reaction progresses. The activation energy is the name given to this energy barrier. In contrast to the activation energy barrier in the absence of enzymes, the activation energy barrier in the case of a transition state is significantly lower. Because a transition state is formed and less activation energy is needed, processes catalysed by enzymes proceed at a higher rate. This modification is the result of what appears to be an increase in substrate molecule energy level.
(C) (c) Myosin
Explanation: Myosin is structural as well as functional protein. Myosin is also a functional protein as it has a specific function and is involved in muscle contraction and in various motility processes.
(D) (a) It would stop.
(E) (a) Both A and R are true and R is the correct explanation of A.

6. Enzymes are important to the human body because they facilitate important chemical reactions that allow our body to function properly. Their productivity can be influenced by factors such as temperature and pH (how acidic or basic a substance is). There are various practical applications of enzymes in medical situations, such as in the emergency room, when a reaction must occur quickly in the body for the health of the patient. Certain medicines also act as catalysts in the same sense, speeding up chemical reactions that need to occur faster in the body. Overall, enzymes are important in

situations where a chemical reaction must occur within a certain time frame.
(A) Give examples of slow and fast reactions.
(B) What is the active site of an enzyme?
(C) Illustrate the lock and key hypothesis of enzyme action by using a diagram.

Ans. (A) Examples of slow reactions are rusting of a water pipe, a piece of newspaper turning yellow and so forth.
Examples of fast reactions are striking a match, burning of petrol in the car engine and so forth.
(B) An active site is a crevice on the enzyme molecule into which a substrate molecule fits.
(C)



7. Richa was curious about enzymes working in our bodies. Our cells use a myriad of enzymes to do basically everything from replication to energy production. Following are a couple of examples of some other catalysts.
Enzymes are probably still the most common catalysts you come in contact with in your daily life since they are used in both laundry and dishwasher detergents. Mostly they are proteases used to get rid of protein stains like an egg yolk that is otherwise hard to dislodge, but other enzymes are added as well. Fun fact - most of the detergent enzymes are produced in a surprisingly small number of factories, meaning that all those different brands of detergents competing with each other in the market place actually use the same active ingredients produced by the same few companies.

(A) Enzymes are made up of:
(a) fats

(b) proteins
(c) nucleic acids
(d) vitamins

(B) Which statement about enzymes is true?

(a) Enzymes accelerate reactions by lowering the activation energy
(b) Enzymes are proteins whose three- dimensional form is key to their function
(c) Enzymes do not alter the overall change in free energy for a reaction
(d) All of the above

(C) Enzyme activity decreases at higher temperature because:

(a) new bonds are formed
(b) of reformation of proteins
(c) denaturation of its active site occurs
(d) proteins temperature denature at high

(D) Enzyme-driven metabolic pathways can be made more efficient by:

(a) grouping enzymes into multienzyme free-floating complexes
(b) concentrating enzymes with specific cellular compartments
(c) fixing enzymes into membranes so they are adjacent to each other
(d) all of the above

(E) Diastase takes part in digestion of which one:

(a) protein
(b) starch
(c) amino acids
(d) fat

Ans. (A) (b) proteins
Explanation: The enzymes are the tertiary and quaternary structures of the protein, the only exception to it is the presence of the catalytic RNA molecules.
(B) (d) All of the above
Explanation: Enzymes catalyse the biochemical reaction, they increase the rate of reaction by lowering the activation barrier. They are generally tertiary and quaternary proteins, they are not consumed in the reaction.
Explanation: Enzymes
(C) (d) proteins denature at high temperature are proteins. Proteins get denatured at higher temperatures. Hence, the activity of enzymatic proteins also decreases at higher

temperatures.

(D) (d) all of the above

Explanation: Enzyme-driven metabolic pathways can be made more efficient by concentrating enzymes within specific cellular compartments, grouping enzymes into free-floating, multienzyme complexes and fixing enzymes into membranes so that they are adjacent to each other.

(E) (b) starch

Explanation: Any set of enzymes that catalyse the breakdown of starch into maltose is known as diastase. Urine diastase is effective in detecting ambiguous abdominal situations, particularly when pancreatitis, stones in the common bile provided the diastase level is associated with clinical symptoms of the patient.duct, jaundice, and ruling out postoperative pancreatic damage are suspected;