

1. Lactose is a disaccharide found in milk. In the small intestine, it is digested into glucose and galactose by the enzyme lactase. Molecules of lactase are located in the plasma membranes of cells lining the small intestine.

(a) What evidence in the paragraph suggests that galactose is a monosaccharide?

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(1)

(b) (i) Name **one** other digestive enzyme that is located in the plasma membranes of cells lining the small intestine.

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(1)

(ii) Give an advantage of lactase and other digestive enzymes being located in the plasma membranes of cells lining the small intestine, rather than being secreted into the lumen of the small intestine.

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(1)

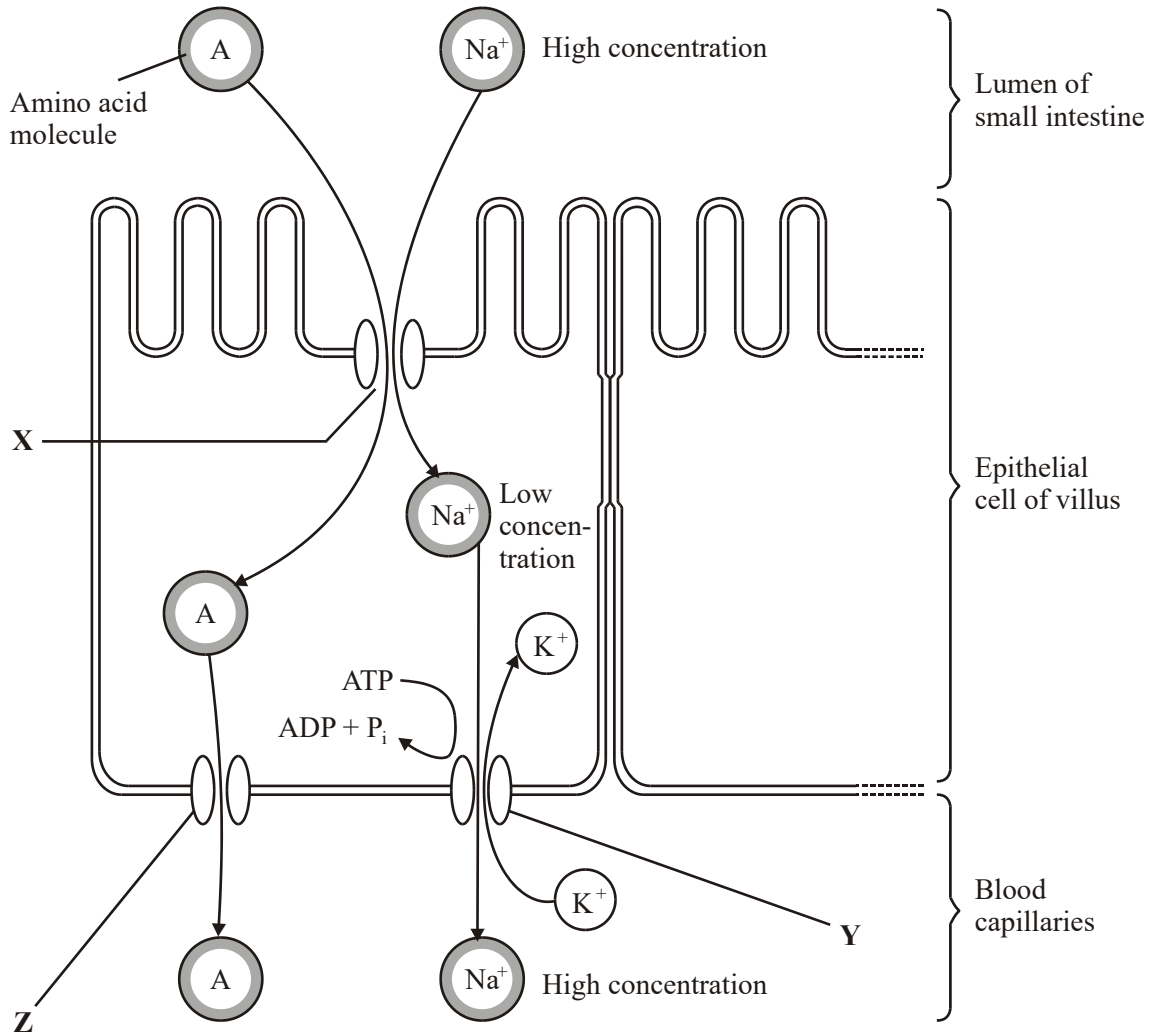
(c) The absorption of galactose from the small intestine is reduced if the absorbing cells are treated with a respiratory inhibitor, such as cyanide. Suggest an explanation for this.

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(2)

(Total 5 marks)

2. The diagram shows one method by which amino acids are absorbed from the small intestine into the blood. They are co-transported into the epithelial cell with sodium ions (Na^+) at point X on the diagram. Normally, the concentration of sodium ions inside the epithelial cell is low.



Source: adapted from M. ROWLAND, *Biology (University of Bath Science 16-19)* (Nelson Thornes) 1992.

Dinitrophenol (DNP) prevents oxidative phosphorylation. When treated with DNP, the sodium-potassium pump at **Y** no longer works. As a result, the concentration of sodium ions in the cell rises and amino acid absorption stops.

(i) Explain why pump **Y** will **not** work in the presence of DNP.

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(2)

(ii) Explain why sodium ions and amino acids are **not** absorbed from the lumen of the small intestine in the presence of DNP.

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(2)

(iii) By what mechanism would amino acids leave the epithelial cell at point **Z**?

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(1)

(Total 5 marks)

3. (a) Dietary recommendations are that lipid intake should make up 30% of energy intake. The recommended energy intake for most women aged 19-49 is 8100 kJ day⁻¹. The energy content of lipid is 37.8 kJ g⁻¹. Calculate the recommended lipid intake per day for these women. Show your working.

Answer g

(2)

In humans, triglycerides are the main form of dietary lipids. They are digested in the gut and the products of digestion are absorbed by the small intestine.

- S (b) Describe a biochemical test that could be performed on a sample of food to determine whether it contained triglycerides.

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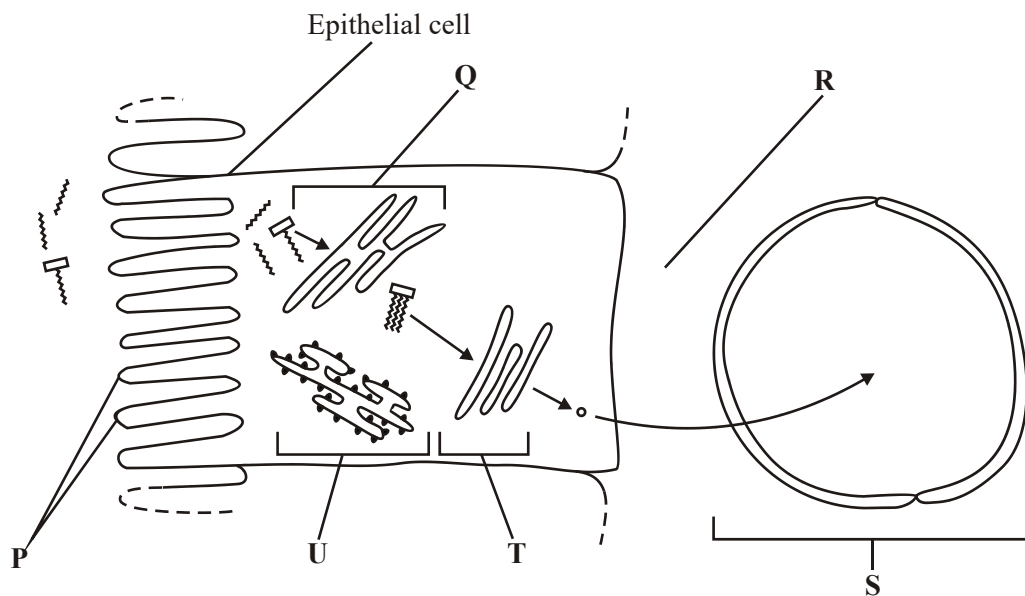
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- (c) The diagram shows the events that occur in the absorption of monoglycerides and fatty acids. These molecules enter the epithelial cells of the small intestine by diffusion. Once inside they are reassembled into triglycerides in organelle Q. The triglyceride molecules are formed into chylomicrons in organelle T. Chylomicrons are made from many triglyceride molecules surrounded with protein molecules. The chylomicrons leave the cell and enter vessel S.



S (i) Explain the importance of the structures labelled **P**.

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(1)

(ii) Name

R;

S.

(2)

S (iii) Describe the role played by organelle **U** in the formation of chylomicrons.

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S (iv) Suggest how the chylomicrons leave the epithelial cell. Give a reason for your answer.

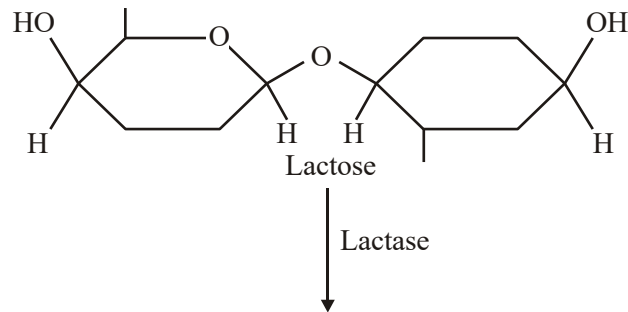
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(Total 11 marks)

4. Lactose is a disaccharide found in milk. In the human small intestine, the enzyme lactase catalyses the hydrolysis of lactose to the monosaccharides, galactose and glucose. These monosaccharides are then absorbed into the blood.

- S (a) Complete the diagram to show the hydrolysis of lactose to galactose and glucose.



(2)

- S (b) Some people are lactose intolerant because they do not produce enough lactase enzyme in the small intestine. Lactose accumulates in the intestines and either remains unhydrolysed or is converted to other soluble substances by bacteria in the intestine. Explain how this could lead to diarrhoea in a lactose-intolerant individual.

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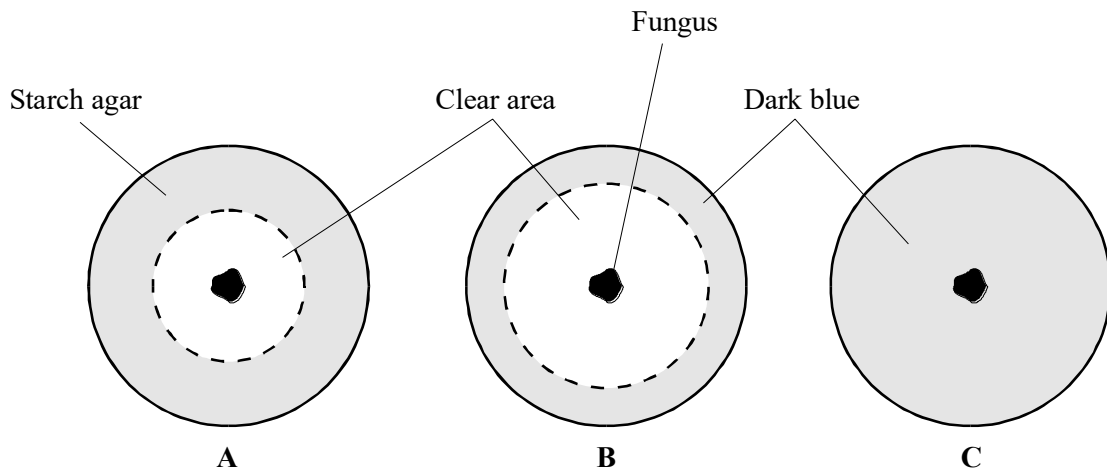
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(2)

(Total 4 marks)

5. In an investigation of digestion in fungi, three Petri dishes with agar medium containing equal concentrations of starch were used. Equal sized samples of three different saprophytic fungi were placed in the centre of the agar in each dish. After incubating for 48 hours, each dish was flooded with iodine solution and the diameter of the clear area was measured. The diagrams show the appearance of the dishes after 48 hours.



- (a) Explain the appearance of the agar in Petri dishes **A** and **B** after flooding with iodine solution.

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- (b) What do the results of the investigation suggest about fungus **C**?

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(1)

(Total 5 marks)

6. The table shows some information about the small intestines of a mammal and a reptile of similar size and age.

	Mammal	Reptile
Time taken for food to pass through small intestine / hours	5	150
Length of small intestine / cm	48	25
Total surface area of small intestine / cm ²	576	90
Efficiency of absorption as percentage of food eaten	54	49

(a) (i) Describe **two** features of a mammal's small intestine which might account for the difference in surface area.

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2.
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(2)

(ii) The absorption efficiency of the reptile is similar to that of the mammal. Use the information in the table to explain why.

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(1)

(b) Describe how sugars are absorbed from the small intestine into the blood of a mammal.

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(4)
(Total 7 marks)

7. Explain how the small intestine is adapted to its function in the absorption of the products of digestion.

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(Total 6 marks)

8. Describe how maltose in the small intestine is digested, absorbed and transported to the liver as glucose.

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(Total 7 marks)

9. A developing fetus gets its carbohydrate from the food eaten by its mother.

(a) Describe how carbohydrate eaten as starch is digested to produce glucose.

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(4)

(b) Describe how glucose is absorbed from the small intestine.

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(4)
(Total 8 marks)

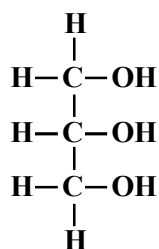
10. In humans, triglycerides are stored under the skin in the cells of the adipose layer. Triglycerides are compounds of glycerol and fatty acids.

(a) Explain why the adipose layer is described as a 'tissue'

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(1)

(b) The structural formula of glycerol is:



The structural formula of a fatty acid is: **R - COOH**.

(i) In the space below, draw the structural formula of a triglyceride.

(2)

(ii) Name the process in which fatty acids are combined with glycerol.

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(1)

- (c) The triglycerides in adipose tissue occur as oily droplets, not as solid fats. The three fatty acids in a triglyceride may be all the same or a mixture of different fatty acids. The table shows the melting points of triglycerides with various combinations of fatty acids. It gives the number of carbon atoms in each fatty acid and whether the fatty acid is saturated (S) or unsaturated (U).

Number of carbon atom in each fatty acid			Melting Point / °C
1st	2nd	3rd	
16 (S)	16 (S)	16 (S)	66
16 (S)	18 (U)	16 (S)	36
18 (U)	16 (S)	16 (S)	35
16 (S)	18 (U)	18 (U)	18
18 (U)	16 (S)	18 (U)	18
18 (S)	18 (S)	18 (U)	42

- (i) Describe the effect on melting point of including unsaturated fatty acids in a triglyceride.

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(1)

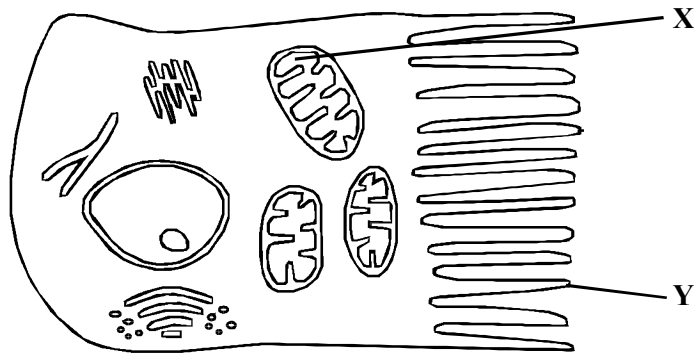
- (ii) Analysis of the triglycerides in adipose tissue shows that about 50% of the fatty acids are unsaturated. Suggest the advantage of this.

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(Total 7 marks)

11. The diagram below shows a cell from layer A of the small intestine.



(i) Name the structures labelled X and Y.

X

Y

(2)

(ii) Explain the importance of **each** structure in the absorption of digested foods.

X

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Y

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(2)
(Total 4 marks)

12. Describe and explain the roles of diffusion, facilitated diffusion and active transport in the absorption of digested food by the ileum.

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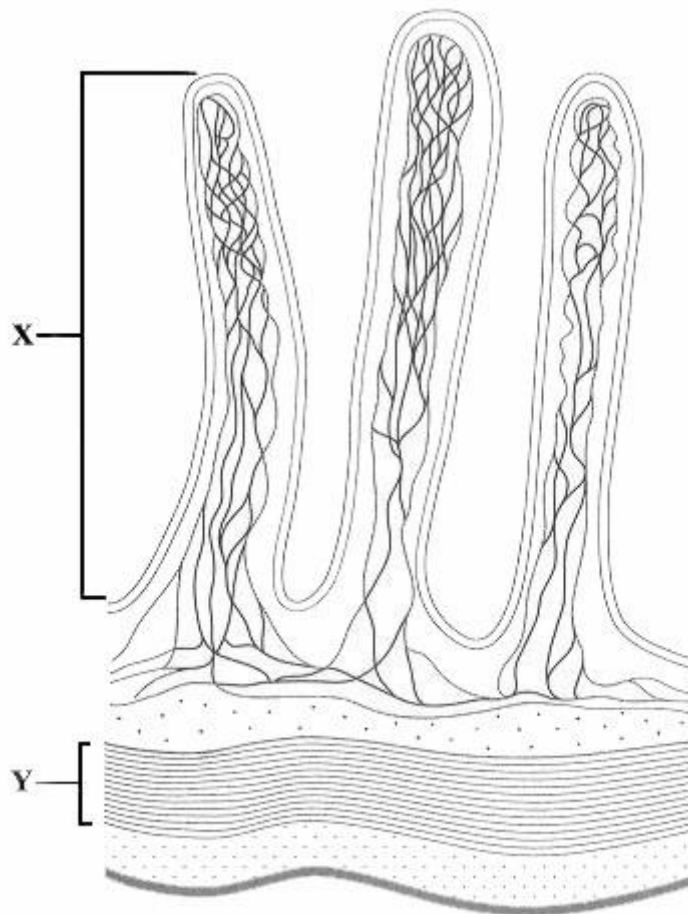
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(Total 6 marks)

13. The diagram shows part of the gut wall of an animal.



(a) (i) Name the structure labelled **X**.

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(1)

(ii) Describe the function of the layer labelled **Y**.

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(2)

(b) Describe and explain how **two** features shown in the diagram increase the rate of absorption of digested food.

Feature 1

Description

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Explanation

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Feature 2

Description

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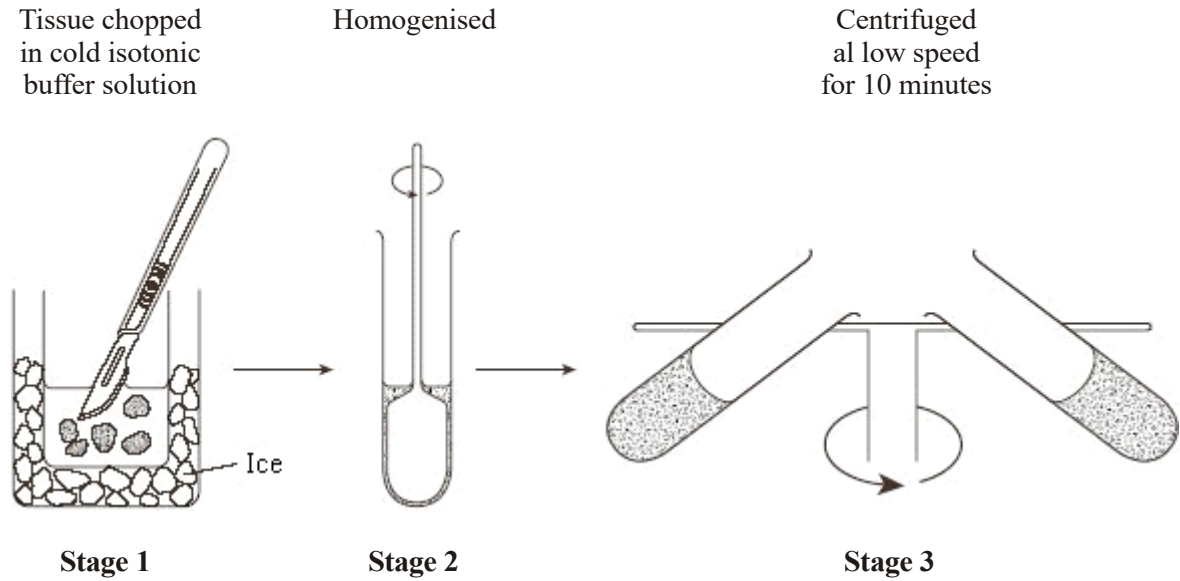
Explanation

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(4)
(Total 7 marks)

14. Mitochondria were isolated from the liver tissue using differential centrifugation. The tissue was chopped in cold, isotonic buffer solution. A buffer solution maintains a constant pH. The first stages in the procedure are shown in the diagram.



- (i) The tissue was chopped in cold, isotonic buffer solution. Explain the reason for using a *cold* solution;
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- an *isotonic* solution;
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- a *buffer* solution.
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(3)

- (ii) Why is the liver tissue homogenised?
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(1)

(iii) Describe what should be done after **Stage 3** to obtain a sample containing only mitochondria.

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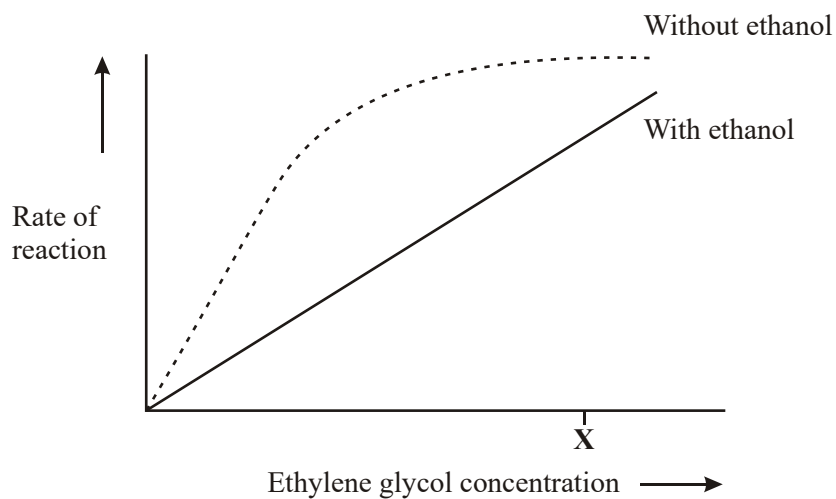
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(Total 6 marks)

15. Ethylene glycol is a substance used in car anti-freeze. If it is accidentally swallowed it enters the liver cells where it is converted to poisonous oxalic acid. Ethanol inhibits the production of oxalic acid and can be used to treat patients who have swallowed anti-freeze.

In an investigation, the rate of reaction of an enzyme that makes oxalic acid was measured with and without ethanol present. The graph shows the results.



(i) Increasing the concentration of ethylene glycol above **X** without ethanol present does not increase the rate of the reaction. Explain why.

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- (ii) Use the information in the graph to explain how ethanol prevents oxalic acid production.

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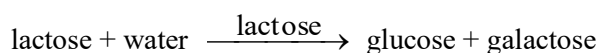
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(2)
(Total 4 marks)

16. Lactose is present in milk. It is broken down by lactase into glucose and galactose. This is shown in the equation.



- (a) Name the type of reaction shown in the equation.

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(1)

- (b) The molecular formula of galactose is $\text{C}_6\text{H}_{12}\text{O}_6$. What is the molecular formula of lactose?

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(2)

- (c) Doctors use a lactose tolerance test to find out if a person is lactose intolerant. In this test, the person is given a solution of lactose to drink. Blood glucose concentration is then measured over the next two hours.

A lactose tolerance test was carried out on a healthy man who was lactose tolerant, and on a man who was lactose intolerant. The results for the first hour are shown in the table.

Time/minutes	Blood glucose concentration/ mmol dm^{-3}	
	Healthy, lactose tolerant man	Lactose intolerant man
0	3.8	3.8
15	4.7	3.9
30	6.1	3.8
45	6.6	3.9
60	6.2	3.9

(i) The blood glucose concentration changed in the healthy man after he had taken the test. Describe how.

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(ii) Explain the results for the lactose intolerant man.

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(Total 8 marks)

17. (a) Describe the role of the enzymes of the digestive system in the complete breakdown of starch.

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(b) Describe the processes involved in the absorption of the products of starch digestion.

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(5)

(Total 10 marks)