EXAM PAPERS PRACTICE

Digestion And Absorption

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

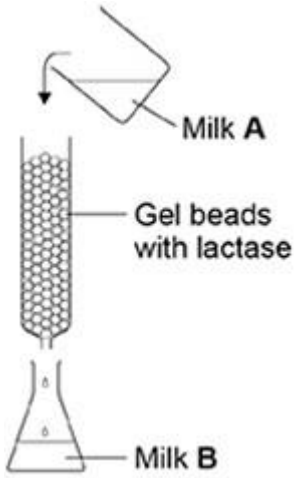
Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Digestion And Absorption

1 Many humans are unable to digest lactose. A scientist investigated the production of lactose-free milk. He produced gel beads containing the enzyme lactase and placed the beads in a column. He poured milk (Milk **A**) into the column and collected the milk (Milk **B**) after it had moved through the column over the beads. This is shown in the diagram below.



(a) Milk **A** contains no glucose. Milk **B** contains glucose. Explain why Milk **B** contains glucose.

_____

_____

_____

(1)

(b) The enzyme was trapped within the gel beads. Suggest **one** advantage of trapping the enzyme within the gel beads.

_____

_____

_____

(1)

The scientist varied the flow rate of the milk through the column. The effect of flow rate on the concentration of glucose in Milk **B** is shown in the table below.

Flow rate of milk through the column / cm^3 $minute^{-1}$	**Concentration of glucose in Milk B / arbitrary units**
50	45
100	6

(c) Explain the difference in the results in the table.

_____

_____

_____

(1)

(d) The gel beads were all similar sizes. Use the formula below to calculate the volume of one of the beads with a 3.0 mm diameter.

Volume of sphere = $\frac{4}{3}\pi r^3$

Volume = _____ mm^3

(1)

(e) Galactose has a similar structure to part of the lactose molecule.
Explain how galactose inhibits lactase.

_____

_____

_____

_____

_____

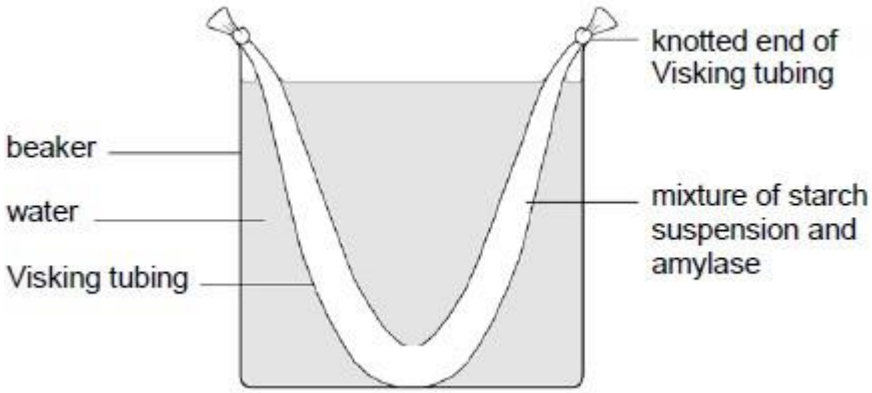
(2)

(Total 6 marks)

2 (a) Cells lining the ileum of mammals absorb the monosaccharide glucose by co-transport with sodium ions. Explain how.

(3)

A student set up the experiment shown in the diagram below.



The material from which Visking tubing is made is partially permeable.

After 15 minutes, the student removed samples from the liquid in the beaker and from the liquid inside the Visking tubing. She carried out biochemical tests on these samples. She drew the table below to record her results.

(b) Complete the table by placing a tick (✓) in each box that you expect to have shown a positive result.

Biochemical test	**Liquid from beaker**	**Liquid inside Visking tubing**
Biuret reagent		
Iodine in potassium iodide		
Benedict's solution		

(3)

(c) Justify your answers to part **(b)**.

(3)

(Total 9 marks)

3 (a) Messenger RNA (mRNA) is used during translation to form polypeptides.
Describe how mRNA is produced in the nucleus of a cell.

(6)

(b) Describe the structure of proteins.

(5)

(c) Describe how proteins are digested in the human gut.

(4)

(Total 15 marks)

4 A student investigated the effect of chewing on the digestion of starch in cooked wheat.

He devised a laboratory model of starch digestion in the human gut. This is the method he used.

1. Volunteers chewed cooked wheat for a set time. The wheat had been cooked in boiling water.
2. This chewed wheat was mixed with water, hydrochloric acid and a protein-digesting enzyme and left at 37 °C for 30 minutes.
3. A buffer was then added to bring the pH to 6.0 and pancreatic amylase was added. This mixture was then left at 37 °C for 120 minutes.
4. Samples of the mixture were removed at 0, 10, 20, 40, 60 and 120 minutes, and the concentration of reducing sugar in each sample was measured.
5. Control experiments were carried out using cooked wheat that had been chopped up in a blender, not chewed.

(a) What reducing sugar, or sugars, would you expect to be produced during chewing? Give a reason for your answer.

(2)

(b) In this model of digestion in the human gut, what other enzyme is required for the complete digestion of starch?

_____

(1)

(c) What was the purpose of step 2, in which samples were mixed with water, hydrochloric acid and pepsin?

_____

_____

(1)

(d) In the control experiments, cooked wheat was chopped up to copy the effect of chewing.

Suggest a more appropriate control experiment. Explain your suggestion.

_____

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_____

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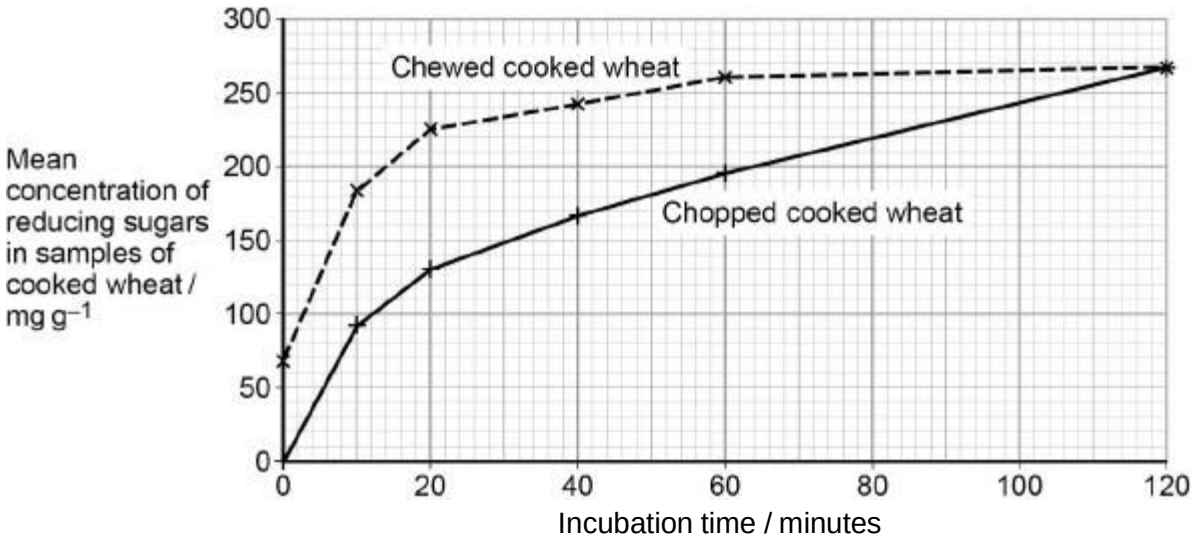
(2)

(e) The figure below shows the student's results.



Explain what these results suggest about the effect of chewing on the digestion of starch in wheat.

(3)

(Total 9 marks)

5 (a) Most blood glucose comes from starch and disaccharides in the diet.
Describe a test you could use to check if food in the diet contained starch.

(2)

(b) Explain how digestion of starch in the gut (small intestine) leads to an increase in the concentration of glucose in the blood. Details of co-transport are **not** required.

(3)

(c) Suggest a method you could use to estimate the concentration of glucose in several different solutions that all turned brick red with Benedict's reagent in 3 minutes.

(1)

(Total 6 marks)

6 (a) Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

(1)

(b) Describe how you would test for the presence of a lipid in a sample of food.

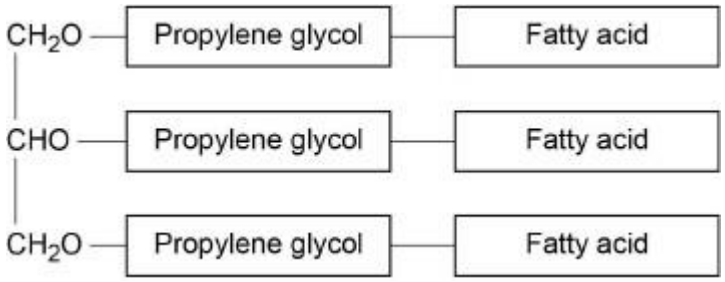
(2)

(c) Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

Describe how a saturated fatty acid is different from an unsaturated fatty acid.

(1)

The diagram shows the structure of a fat substitute.



(d) This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

(2)

(e) This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

(1)

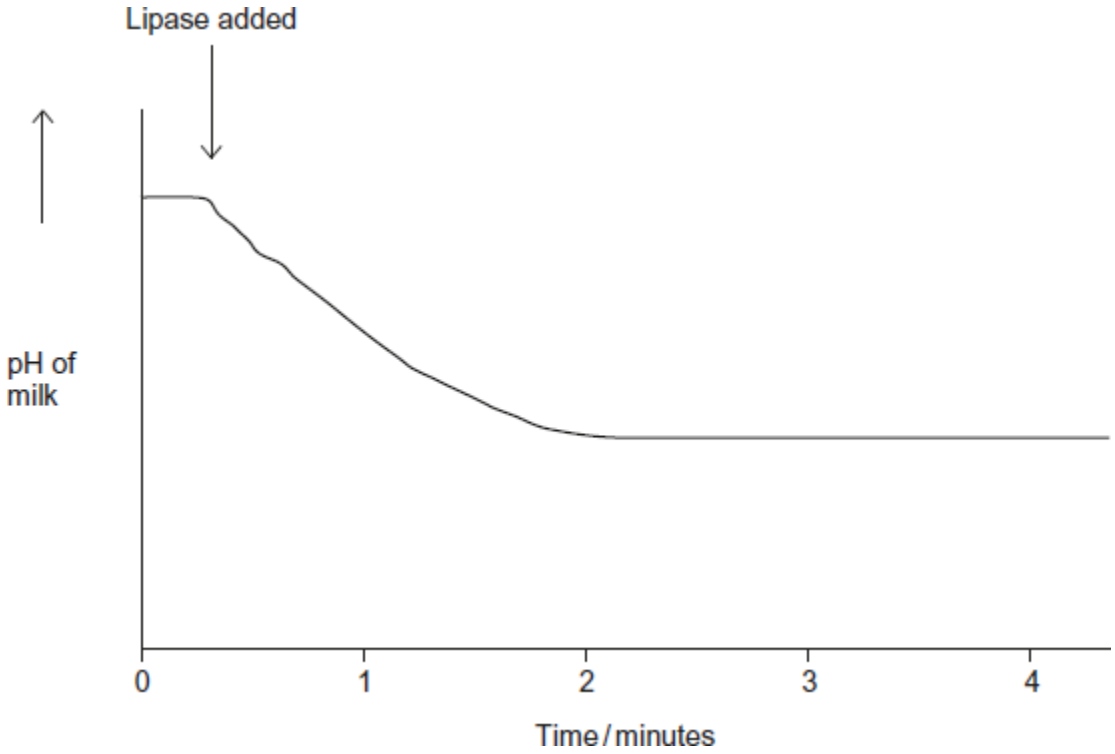
(Total 7 marks)

7 Lipase is an enzyme that hydrolyses triglycerides.

A student investigated the hydrolysis of triglycerides in milk by human lipase at 20 °C.

He recorded the pH of a sample of milk before and after adding lipase. He used a pH meter to record pH.

His results are shown in the graph.



(a) Suggest **one** advantage of using a pH meter rather than a pH indicator in this experiment.

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_____

_____

(1)

(b) Explain why the pH decreases when the lipase is added to the milk.

_____

_____

_____

(1)

(c) Suggest why the pH remained constant after 2 minutes.

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(2)

(d) The student carried out his experiment at 20 °C. He then repeated the experiment at 15 °C. Draw a line on the graph to show the results you would expect at 15 °C.

(2)

(Total 6 marks)

8 (a) Endopeptidases and exopeptidases are involved in the hydrolysis of proteins.

Name the other type of enzyme required for the complete hydrolysis of proteins to amino acids.

_____

(1)

(b) Suggest and explain why the combined actions of endopeptidases and exopeptidases are more efficient than exopeptidases on their own.

_____

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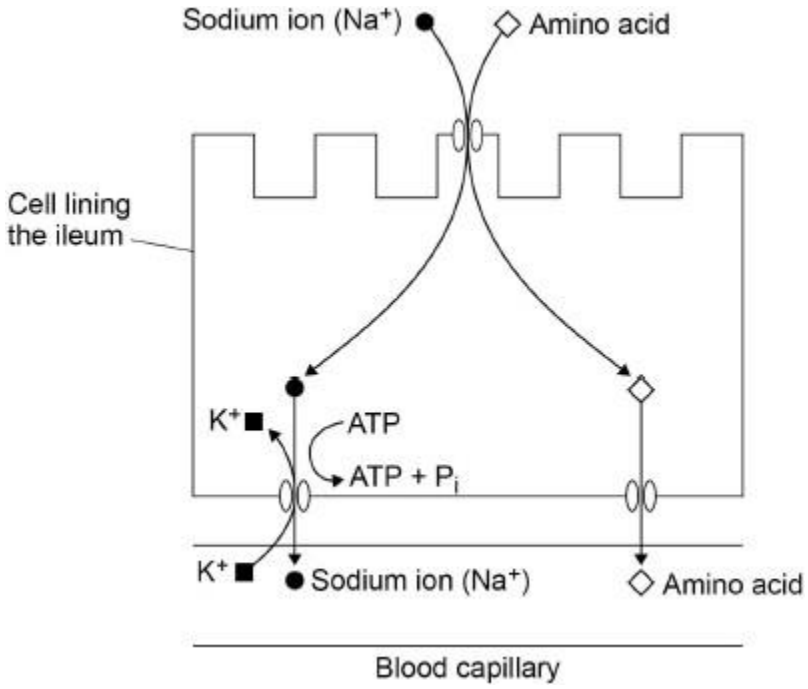
(2)

(c) The diagram shows the co-transport mechanism for the absorption of amino acids into the blood by a cell lining the ileum.



The addition of a respiratory inhibitor stops the absorption of amino acids.

Use the diagram to expain why.

(3)

(Total 6 marks)

9 Trypsin is a protease. It is produced in an inactive form inside some of the cells of the pancreas.

(a) Name the part of a pancreatic cell that produces the inactive form of trypsin.

_____

(1)

(b) Suggest the advantage of producing trypsin in an inactive form inside cells in the pancreas.

_____

_____

_____

_____

_____

(2)

(c) After the inactive form of trypsin enters the small intestine, another enzyme removes a short chain of amino acids from the end of the inactive trypsin molecules. This leads to the formation of the active form of trypsin.

(i) Name the type of bond hydrolysed when the short chain of amino acids is removed.

_____

(1)

(ii) Sometimes trypsin can become activated inside a pancreatic cell. A competitive inhibitor in the cell then binds to the trypsin and stops it working.
Explain how the competitive inhibitor stops trypsin working.

_____

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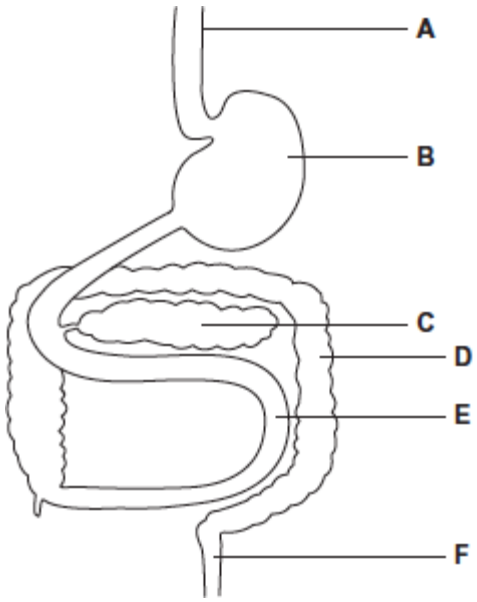
(3)

(Total 7 marks)

10 The diagram represents part of the human digestive system. The organs are labelled **A–F**.



(a) Give the letter of the organ that produces amylase.

(1)

(b) Give the letter of the organ that produces maltase.

(1)

(c) Maltose is hydrolysed by the enzyme maltase.

Explain why maltase catalyses only this reaction.

[Extra space]

(3)

(Total 5 marks)

11 (a) Describe how you would test a sample of food for the presence of starch.

(2)

(b) The concentration of glucose in the blood rises after eating a meal containing carbohydrates.

The rise is slower if the carbohydrate is starch rather than sucrose. Explain why.

(Extra space)

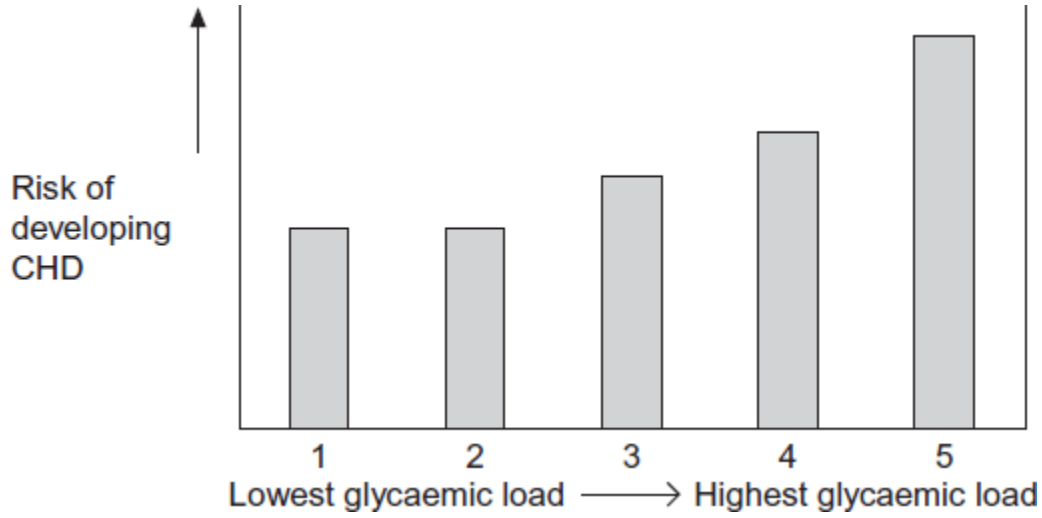
(3)

The glycaemic load (GL) of a diet is a measure of how much digestible carbohydrate it contains. The higher the GL of a diet the more quickly it raises the blood glucose concentration after a meal. A diet with a high GL also increases the concentration of harmful lipids in the blood.

Scientists investigated the relationship between diets with different glycaemic loads and the risk of developing coronary heart disease (CHD) in women.

The scientists determined the glycaemic loads of the diets of a large number of women. They then divided the women into 5 groups. Group 1 had diets with the lowest glycaemic load and group 5 had diets with the highest glycaemic load. The scientists determined the risk of developing CHD in each group.

The graph shows their results.



(c) The scientists excluded women who smoked from the study. Explain why.

_____

_____

_____

(1)

(d) (i) What do these data show about the effect that glycaemic load of the diet has on the risk of developing CHD?

_____

_____

_____

(1)

(ii) Use the information provided to explain the effect that glycaemic load of the diet has on the risk of developing CHD.

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(2)

(Total 9 marks)

12 Some people have a medical condition called pancreatitis. This can lead to their pancreatic duct becoming blocked. As a result, a high concentration of amylase is found in their blood.

At 12-hour intervals, a doctor measured the concentration of amylase in the blood of a person suffering from a blocked pancreatic duct. He also measured the concentration of amylase in the blood of a healthy person.

The figure below shows his results.

	Concentration of amylase in the blood / arbitrary units	
Time / hours	**Person with blocked pancreatic duct**	**Healthy person**
0	1800	800
12	2200	750
24	2500	700
36	2000	750
48	1400	800

(a) (i) The changes in concentration of amylase in the blood of a person with a blocked pancreatic duct are different from those of a healthy person during the period shown in the figure above.

Describe **two** of these differences.

1. _____

_____

_____

2. _____

_____

_____

(2)

(ii) In a person with a blocked pancreatic duct, starch digestion is affected.
Explain how.

_____

_____

_____

_____

_____

(2)

(b) Healthy people have amylase in their blood. This does not cause any harmful effects in the body.
Explain why.

_____

_____

_____

_____

_____

(2)

(c) Pancreatitis can lead to the release of protein-digesting enzymes into the blood. This is harmful to the body.
Suggest **one** reason why.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

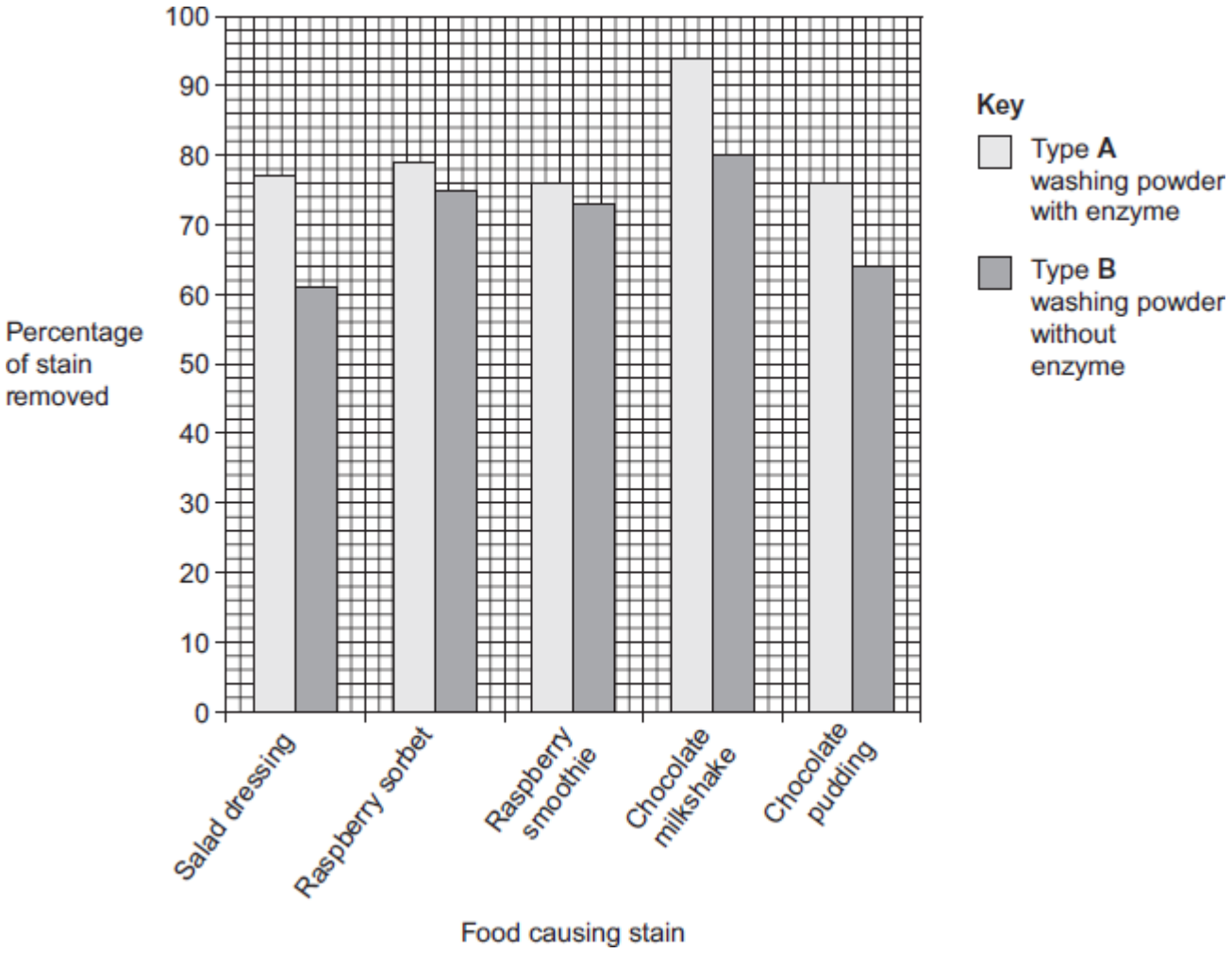
13 Biological washing powders contain enzymes which hydrolyse substances that cause stains on clothes.

A manufacturer tested the ability of two types of the same brand of washing powder to remove different food substances that stain clothes.

- Type **A** contained an enzyme.
- Type **B** was identical to **A** except it did **not** contain the enzyme.

Figure 1 shows the results.

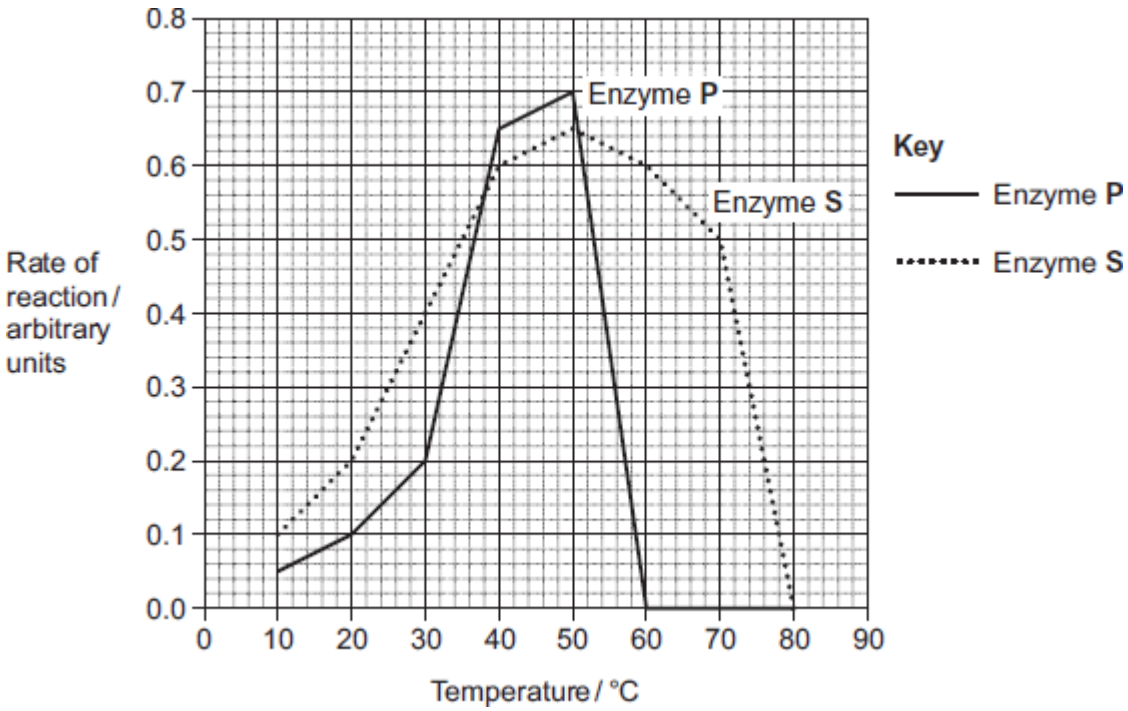
Figure 1



A scientist worked for a company that wanted to develop a biological washing powder that was effective over a range of temperatures. He investigated the effect of temperature on the rates of the reaction catalysed by two enzymes, **P** and **S** used in biological washing powders.

Figure 2 shows his results.

Figure 2



(a) Many of the substances causing the food stains are large, insoluble proteins.
Suggest how a biological washing powder removes this type of stain.

_____

_____

_____

_____

_____

(2)

(b) The manufacturer of type **A** and type **B** washing powder claimed that these results showed that biological washing powders are better at removing stains from clothes.

Use the information in **Figure 1** to evaluate this claim.

(Extra space)

(4)

(c) Most customers want a washing powder which removes stains from clothes over a range of temperatures. After obtaining the results shown in **Figure 2**, which enzyme should the scientist recommend for use in a biological powder?

Give reasons for your answer.

(Extra space)

(3)

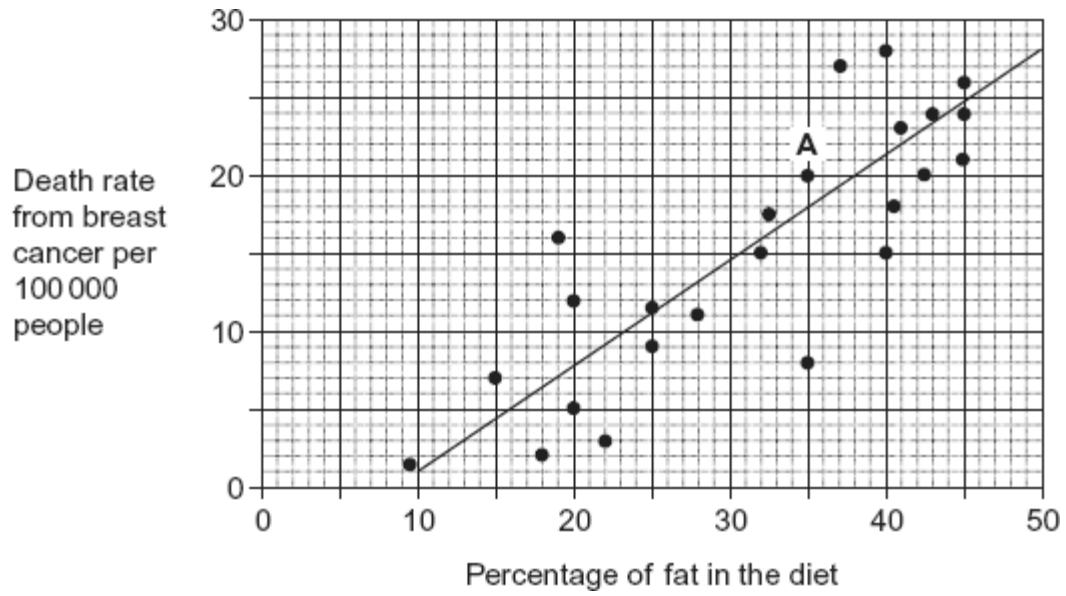
(d) Biological washing powders often contain a number of different enzymes. This enables them to remove a wider range of stains from clothes.
Explain why a number of enzymes are required to remove a wider range of stains.

(Extra space)

(3)

(Total 12 marks)

14 Scientists investigated the relationship between the percentage of fat in the diet and the death rate from breast cancer in 24 different countries. They plotted the data from each country on the graph below.



(a) Describe the information given by point **A** on the graph.

(1)

(b) Describe how the scientists calculated the death rate from breast cancer for each country.

(1)

(c) Some people have used the graph to conclude that a high percentage of fat in the diet causes breast cancer. Evaluate this conclusion.

(Extra space)

(3)

(Total 5 marks)

15 Different cells in the body have different functions.

(a) Some white blood cells are phagocytic. Describe how these phagocytic white blood cells destroy bacteria.

(Extra space)

(4)

(b) The epithelial cells that line the small intestine are adapted for the absorption of glucose. Explain how.

(Extra space)

(6)

(Total 10 marks)

16 Some people are lactose intolerant. The lactose in milk and milk products, such as cheese, causes digestive discomfort in these people.
Scientists gave 159 adult volunteers, who had dia gnosed themselves as lactose intolerant, a questionnaire to complete. The volunteers were asked,

- do you eat the food?
- if you eat the food, do you feel discomfor t after eating it?

The results are shown in the table.

Food	**Typical lactose content / g per serving**	**Percentage of people who**			
		A do not eat the food	**B** feel discomfort after eating the food	**C (= A + B)** do not eat the food or feel discomfort after eating the food	**D** feel no discomfort after eating the food
Hard cheese	1.2	11.1	39.9	51.0	49.0
Pizza	3.0	10.4	57.8	68.2	31.8
Soft cheese	3.6	25.1	53.0	78.1	21.9
Ice cream	6.0	14.6	68.2	82.8	17.2
Milk	9.9	27.0	67.1	94.1	5.9

(a) The scientists investigated the relationship between the lactose content of the food and the amount of digestive discomfort.

(i) The figures in columns **A** and **B** were used to produce those in column **C**.
The scientists used column **C** rather than column **B** in their analysis. Suggest why.

_____

_____

(1)

(ii) Describe the relationship between the lactose content of the food and the data in column **C**.

_____

_____

(1)

(iii) The scientists could **not** conclude that the discomfort was caused by the increase in lactose content of the food. Explain why.

_____

_____

_____

_____

_____

(2)

(b) Suggest **two** reasons why the data in this table may be unreliable.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

17 Doctors compared two tests for lactase deficiency.

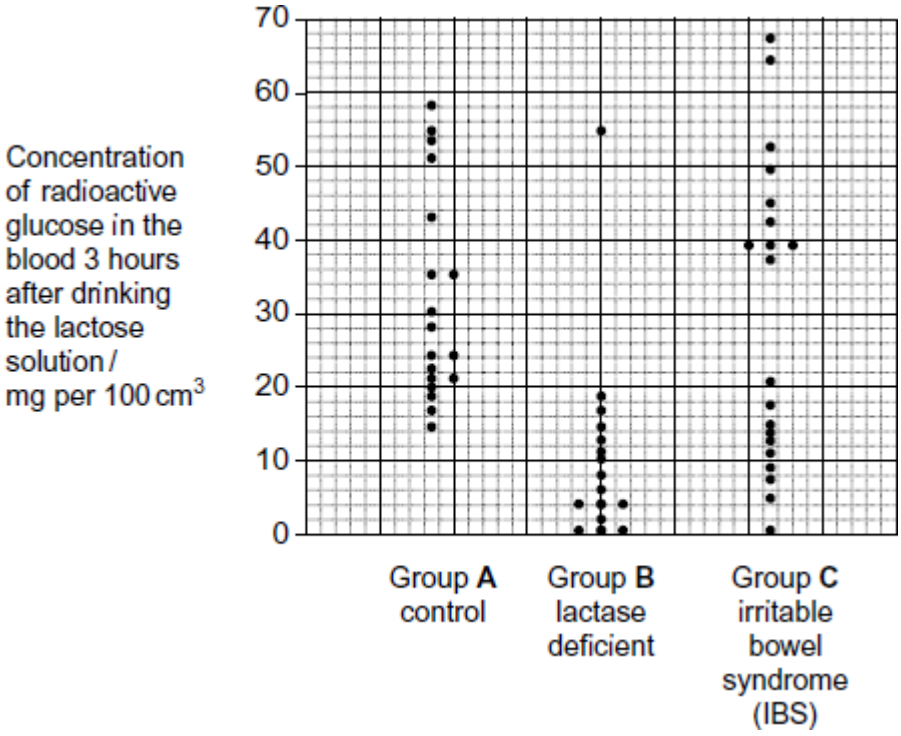
Doctors investigated three groups of people. The people in all three groups were not allowed to eat or drink for 8 hours before the test. They each then drank a solution containing 50 g of lactose made with a radioactive form of carbon called ^{14}C.

- Group **A** were the control group
- Group **B** were lactase deficient
- Group **C** had irritable bowel syndrome (IBS)

Both lactase deficieny and irritable bowel syndrome have similar symptoms.

The lactose tolerance test

The doctors measured the concentration of radioactive glucose in the blood of each person. The figure below shows the results. Each point shows the result for one person 3 hours after drinking the lactose solution.



(a) (i) Give the range of results for the control group (group **A**)

_____

(1)

(ii) Each person in the control group was given 50 g of lactose containing the same amount of radioactive carbon. All the products of lactose digestion were absorbed into their blood. The concentration of glucose was measured in mg per 100 cm^3 of blood.

Explain why the variation in the results may be due to differences in body mass.

_____

_____

_____

_____

(2)

(b) In the test the doctors obtained different results for the three groups.

Would this test be useful to identify people who were lactase deficient? Use the data from all three groups to explain your answer.

(Extra space)

(3)

(Total 6 marks)

18 Biologists divided new-born rats randomly into four groups.

They fed the rats in each group on a standard diet which only differed in the carbohydrate content. When these rats were adult, the biologists measured the activity of lactase in the digestive system of the rats. The following table shows the mean results for each group.

Diet	Mean lactase activity / μ mol of lactose digested per hour (± standard deviation)
Low sucrose	57.9 (± 14.5)
High sucrose	184.2 (± 30.8)
Low starch	86.9 (± 13.3)
High starch	221.4 (± 25.4)

(a) Give **one** piece of evidence from the table that indicates lactase activity is affected by diet.

(1)

(b) Some students suggested from these data that increasing starch in the diet was the most effective way to increase lactase activity in lactase deficient people. Is this conclusion valid? Explain your answer.

_____

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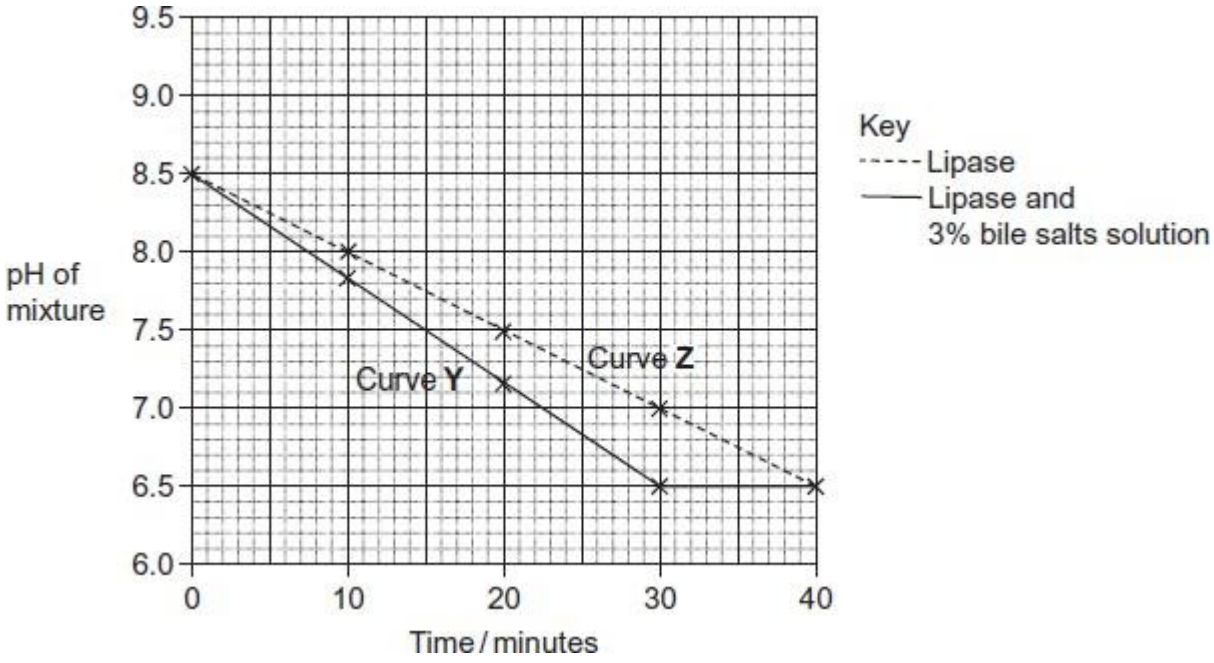
(2)

(Total 3 marks)

19 Scientists investigated the effect of lipase and a 3% bile salts solution on the digestion of triglycerides. The graph below shows their results.



The scientists also incubated triglycerides with different concentrations of bile salts. After 30 minutes they measured the diameter of the triglyceride droplets. They used the results to calculate the mean radius of the droplets at each concentration. The table below shows their results.

Concentration of bile salts /%	0	1	2	3	4	5
Mean radius of triglyceride droplet / μm	6	5	4	3	2	1

(a) Describe how you would use a microscope to find the mean diameter of triglyceride droplets on a slide.

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_____

_____

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_____

*(Extra space)*_____

_____

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(3)

(b) (i) The ratio of mean radius of triglyceride droplets in bile salts at a concentration of 0% to the mean radius in bile salts at a concentration of 3% is 2 : 1.

What is the ratio of their surface areas? Show your working.

You can calculate the surface area of a droplet from the formula

$$A = 4\pi r^2$$

Where A = surface area
r = radius
π = 3.14

(2)

(ii) Use the data in the table to explain the difference between curves **Y** and **Z** in the graph.

_____

_____

_____

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_____

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*(Extra space)*_____

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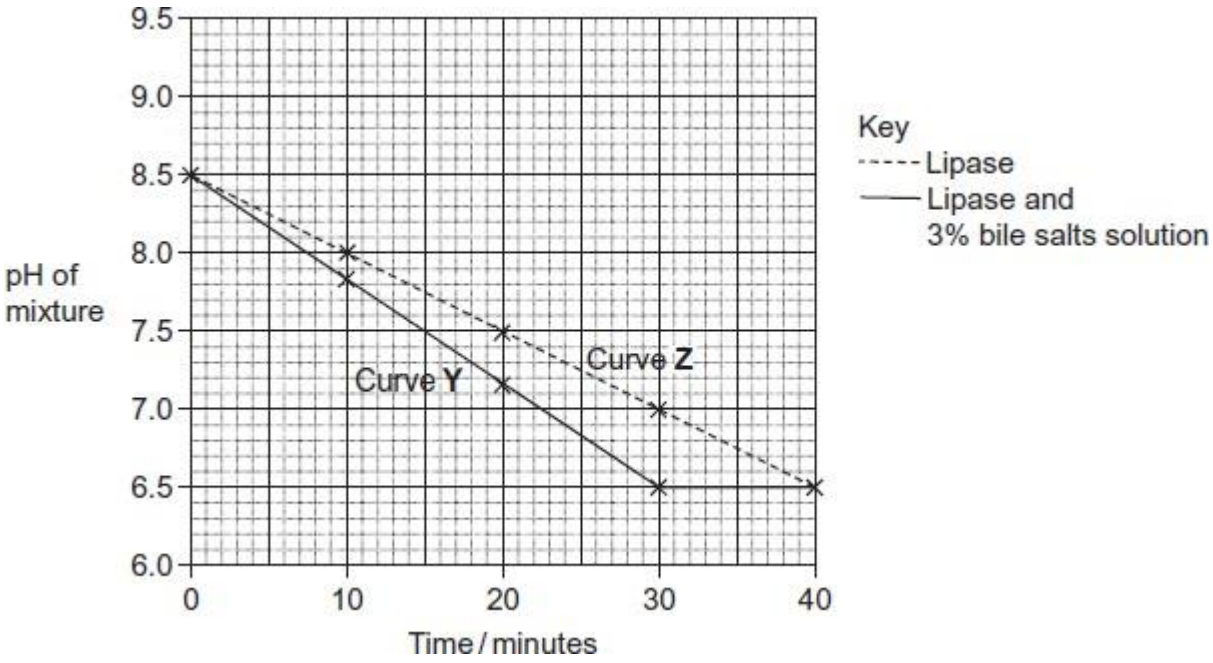
(3)

(Total 8 marks)

20 Scientists investigated the effect of lipase and a 3% bile salts solution on the digestion of triglycerides. The graph below shows their results.



(a) Describe what curve **Y** shows about the effect of lipase and bile salts on the pH of the mixture.

_____

_____

_____

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_____

(2)

(b) The concentration of lipase did not change during the course of the investigation. Explain why.

_____

_____

_____

(1)

(c) One of the scientists decided to repeat the investigation at a temperature 10°C below the original temperature.
Describe how you would expect his plotted curve to be different from curve **Z**.

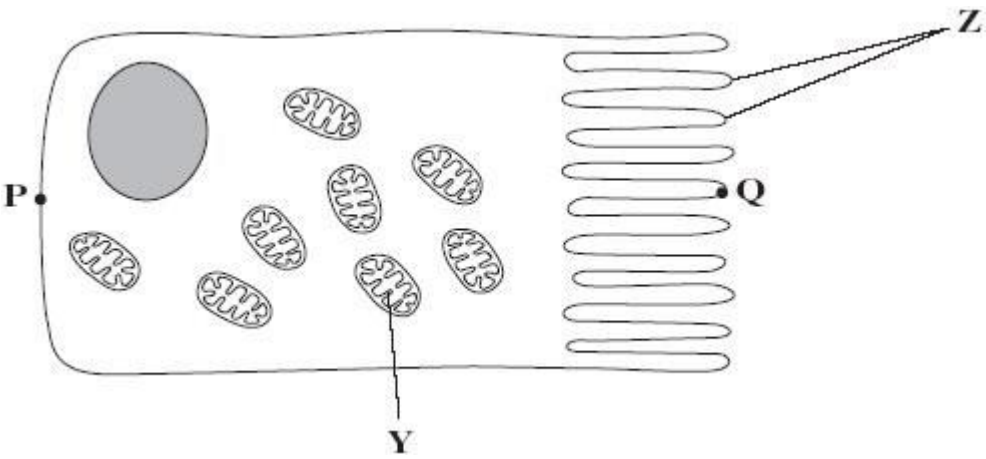
_____

_____

(1)

(Total 4 marks)

21 The diagram shows an epithelial cell from the small intestine.



(a) (i) Name organelle **Y**.

_____

(1)

(ii) There are large numbers of organelle **Y** in this cell. Explain how these organelles help the cell to absorb the products of digestion.

_____

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_____

_____

_____

(2)

(b) This diagram shows the cell magnified 1000 times. Calculate the actual length of the cell between points **P** and **Q**. Give your answer in µm. Show your working.

Answer_____µm

(2)

(c) Coeliac disease is a disease of the human digestive system. In coeliac disease, the structures labelled **Z** are damaged.

Although people with coeliac disease can digest proteins they have low concentrations of amino acids in their blood.

Explain why they have low concentrations of amino acids in their blood.

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_____

_____

_____

_____

(2)

(Total 7 marks)

22 Scientists fed different diets to three groups of monkeys of different ages. They fed half the monkeys in each age group a diet in which all the triglycerides were saturated and half on a diet in which all the triglycerides were unsaturated. All other aspects of the diets and living conditions were kept as similar as possible. The scientists measured the plasma cholesterol concentration of the monkeys. The table below shows their results.

Age group / months	Type of triglyceride in diet	Number of monkeys in group	Mean plasma cholesterol concentration /mmol dm^{-3} (± standard deviation)
16	Saturated	10	8.45 (± 1.96)
32	Saturated	8	9.75 (± 2.60)
60	Saturated	12	10.42 (± 4.12)
16	Unsaturated	9	6.59 (± 1.56)
32	Unsaturated	8	7.24 (± 2.60)
60	Unsaturated	11	8.84 (± 2.32)

(a) The scientists concluded that a diet high in saturated triglyceride raises the concentration of blood plasma cholesterol. Evaluate their conclusion.

(Extra space)

(3)

(b) The monkeys in this investigation were all of the same sex.
Explain how selecting monkeys of the same sex would help the scientists to draw reliable conclusions.

(2)

(c) Is the research described relevant to human health? Explain your answer.

_____

_____

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_____

(Extra space) _____

_____

_____

(3)

(Total 8 marks)

23 Bromelain is a protein-digesting enzyme found in pineapples. Some people claim that bromelain tablets have benefitial effect on health. These effects include reducing swelling and pain after surgery and reducing growth of cancers.

Bromelain is absorbed from the gut into the blood. Scientists gave a group of volunteers 3 g of bromelain in tablets each day for three days. They then measured the maximum mass of bromelain in the blood of each volunteer. The mean value for the maximum mass of bromelain in the blood of the volunteers was 0.025 mg.

(a) There is a difference between the mass of bromelain that the volunteers were given and the maximum mass of bromelain in their blood. Suggest **one** explanation for this difference.

_____

_____

(1)

(b) The scientists measured the concentration of bromelain in the blood. What else did they need to measure to calculate the total mass of the bromelain in the blood of a volunteer?

_____

_____

(1)

(Total 2 marks)

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

(5)

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

(5)

(Total 10 marks)

25 (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.

_____

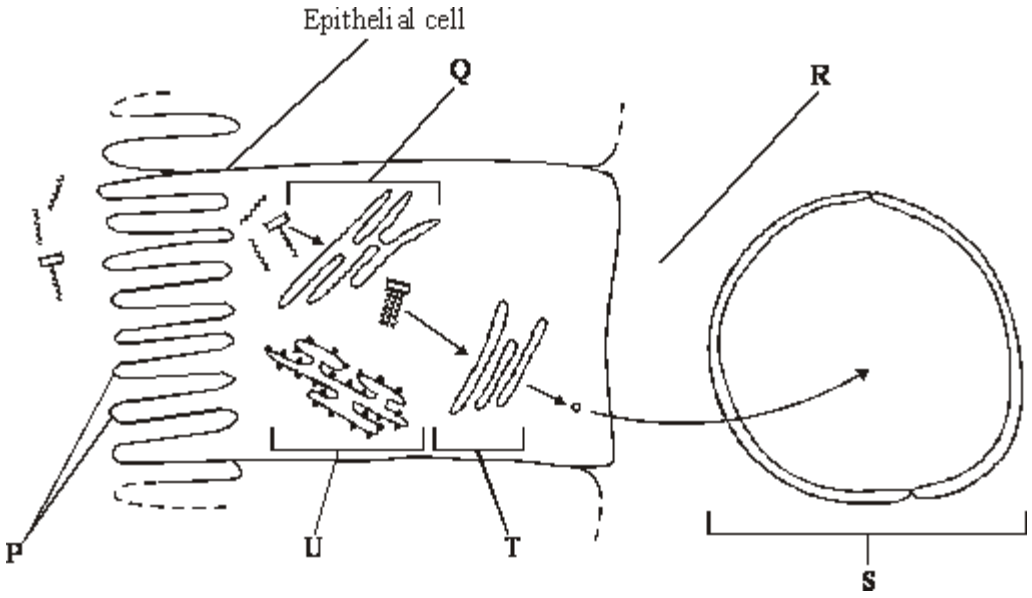
_____

_____

_____

(2)

(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**.

_____

_____

(1)

(ii) Name

R; _____

S. _____

(2)

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

_____

_____

_____

_____

(2)

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

_____

_____

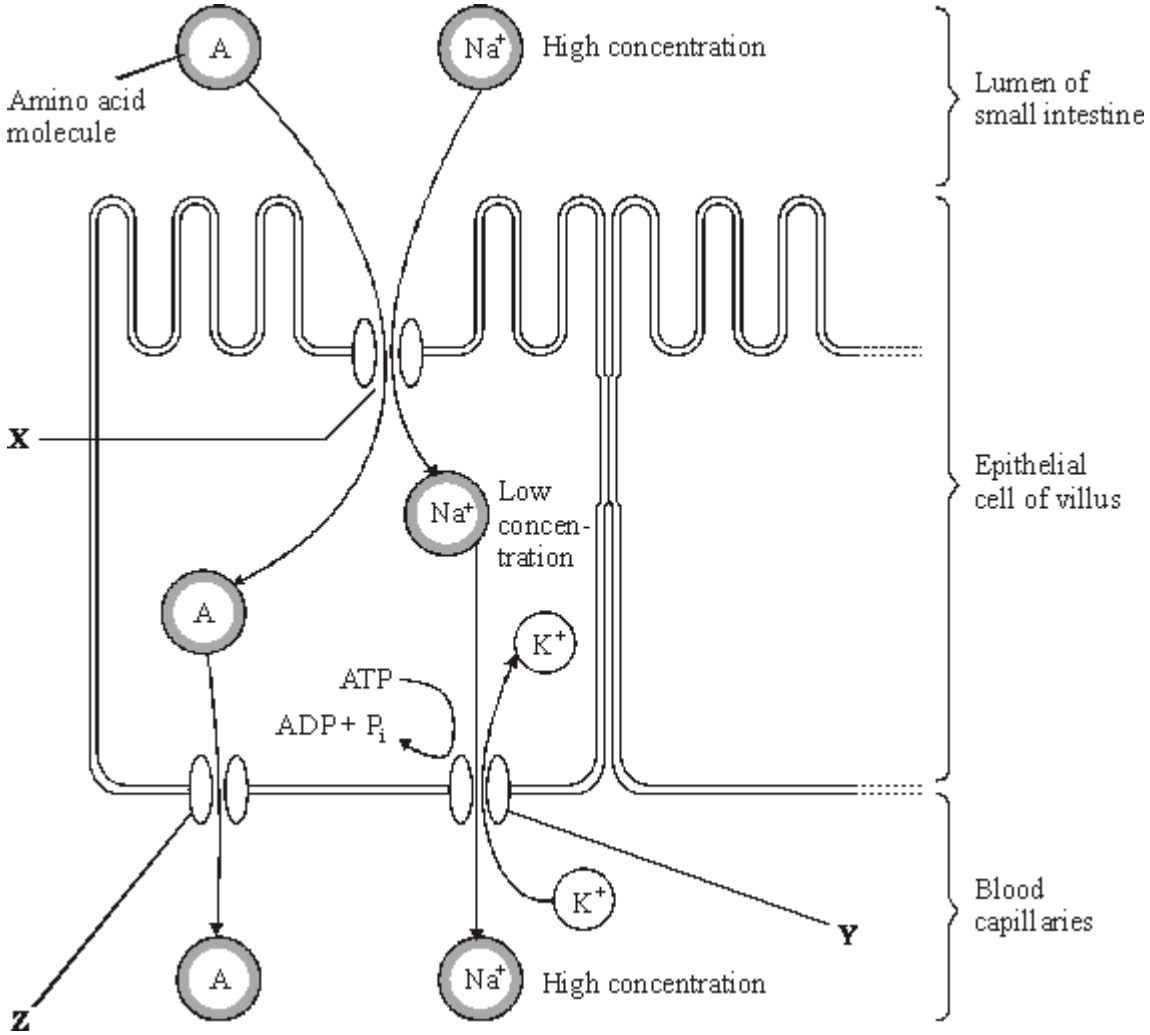
_____

_____

(2)

(Total 11 marks)

26 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.

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

(2)

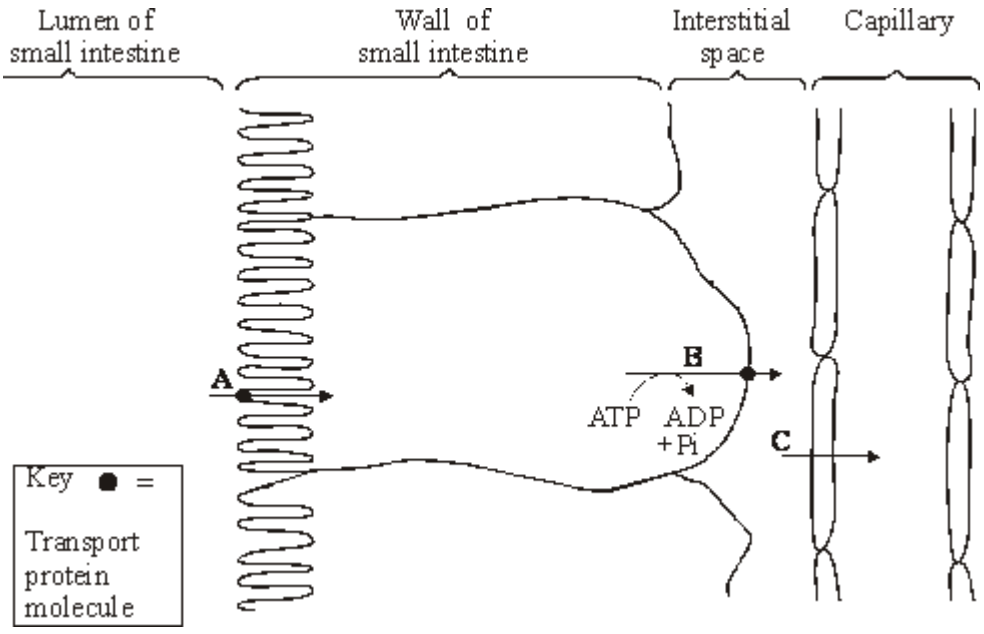
(iii) By what mechanism would amino acids leave the epithelial cell at point **Z**?

_____

(1)

(Total 5 marks)

27 **S** The figure below shows the processes involved in absorbing amino acids into a capillary from the small intestine.



(i) Name processes **A**, **B** and **C**. In each case, give the evidence for your answer.

A Process _____

Evidence _____

_____

B Process _____

Evidence _____

_____

C Process _____

Evidence _____

_____

(3)

(ii) Explain how process **B** creates the conditions for process **A** to occur.

_____

_____

_____

_____

(2)

(Total 5 marks)

28 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?

_____

_____

(1)

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

_____

(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.

_____

_____

(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.

_____

_____

_____

_____

(2)

(Total 5 marks)

Mark schemes

1

(a) Lactase hydrolyses lactose in to glucose (and galactose);

1

(b) No lactase in the milk
OR
Enzyme can be reused.

1

(c) 100 cm^3 $minute^{-1}$ is too fast to bind to active site / converse for 50 cm^3 $minute^{-1}$;

1

(d) 14.1(4);

1

(e) 1. Galactose is a competitive inhibitor / attaches to the active site (of lactase);

2. Fewer enzyme substrate complexes formed.

2

[6]

2

(a) 1. Sodium ions actively transported from ileum cell to blood;

2. Maintains / forms diffusion gradient for sodium to enter cells from gut (and with it, glucose);

3. Glucose enters by facilitated diffusion with sodium ions;

3

(b)

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		✓
I_2/KI		✓ or blank
Benedict's	✓	✓

1 mark for each correct row

3

(c) 1. Biuret: protein molecules too large to pass through tubing;

Neutral: enzyme molecules

2. Iodine in potassium iodide solution: starch molecules too large to pass through tubing;

If no tick in 04.2, allow no starch hydrolysed

3. Benedict's: starch hydrolysed to maltose, which is able to pass through tubing. **2**

Reject: glucose

3

3

(a) 1. Helicase;
2. Breaks hydrogen bonds;
3. Only one DNA strand acts as template;
4. RNA nucleotides attracted to exposed bases;
5. (Attraction) according to base pairing rule;
6. RNA polymerase joins (RNA) nucleotides together;
7. Pre-mRNA spliced to remove introns.

6 max

(b) 1. Polymer of amino acids;
2. Joined by peptide bonds;
3. Formed by condensation;
4. Primary structure is order of amino acids;
5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;

Accept alpha helix / pleated sheet

6. Tertiary structure is 3-D folding due to hydrogen bonding and ionic / disulfide bonds;
7. Quaternary structure is two or more polypeptide chains.

5 max

(c) 1. Hydrolysis of peptide bonds;
2. Endopeptidases break polypeptides into smaller peptide chains;
3. Exopeptidases remove terminal amino acids;
4. Dipeptidases hydrolyse / break down dipeptides into amino acids.

4

4

(a) 1. Maltose;
2. Salivary amylase breaks down starch.

2

(b) Maltase.

1

(c) (Mimics / reproduces) effect of stomach.

1

(d) 1. Add boiled saliva;
2. Everything same as experiment but salivary amylase denatured.

[9]

[15]

(e) 1. Some starch already digested when chewing / in mouth;
2. Faster digestion of chewed starch;
3. Same amount of digestion without chewing at end.

Accept use of values from graph

3

[9]

5

(a) 1. Add iodine / potassium iodide <u>solution</u>;

Reject if heated

2. Blue-black colour (with starch);

Accept black

Ignore purple

2

(b) 1. <u>Hydrolysed</u> by enzymes / <u>hydrolysed</u> by amylase / maltase;

If named enzyme given, it must relate to the correct substrate

2. Produces glucose (in the gut);

3. Small enough to cross the gut wall (into the blood) / monomers / monosaccharides (can) cross the gut wall (into the blood);

Accept cell membrane<u>s</u> / epithelium / cells for 'gut wall'

3

(c) 1. Time how long it takes to go brick red;

2. Weigh precipitate;

3. Dilute glucose samples / use smaller volume of glucose samples / use greater volume of Benedict's reagent;

Ignore references to colorimeter

1 max

[6]

6

(a) 1. In phospholipid, one fatty acid replaced by a phosphate;

Ignore references to saturated and unsaturated

Accept Pi/PO_4^{3-} / (P)

Reject P/Phosphorus

Accept annotated diagrams

1

(b) 1. Add ethanol, then add water;

Reject ethanal/ethonal

Accept 'Alcohol/named alcohol'

2. White (emulsion shows lipid);

Accept milky – Ignore 'cloudy'

Sequence must be correct

If heated then DQ point 1

Reject precipitate

2

(c) Saturated single/no double bonds (between carbons)

OR

Unsaturated has (at least one) double bond (between carbons);

Accept hydrocarbon chain/R group for 'between carbons' for either

Accept Sat = max number of H atoms bound

'It' refers to saturated

1

(d) 1. (Fat substitute) is a different/wrong shape/not complementary;

OR

Bond between glycerol/fatty acid and propylene glycol different (to that between glycerol and fatty acid)/no ester bond;

2. Unable to fit/bind to (active site of) lipase/no ES complex formed;

If wrong bond name given (e.g. peptide/glycosidic), then penalise once

2

(e) It is hydrophilic/is polar/is too large/is too big;

Ignore 'Is not lipid soluble'

1

[7]

7

(a) Any **one** from:

1. Numerical readings / not subjective / colour change subjective / gives quantitative data / not qualitative / gives continuous data;
2. Greater accuracy;

Accept greater precision

1 max

(b) Fatty acids produced;

1

(c)
1. No more (fatty) acids produced;
2. All triglycerides/fat//lipids/substrate used up / enzyme denatured;

2

(d)
1. Line starting at same point and falling above original line;
2. Levels off at same pH, but later;

Accept the line still falling at 4 minutes

Do not credit if levels off at higher pH

2

[6]

8

(a) Dipeptidase/s;

Accept: membrane bound dipeptidase/s.

1

(b)
1. Endopeptidases hydrolyse internal (peptide bonds)
OR
Exopeptidases remove amino acids/hydrolyse (bonds) at end(s);

Accept: break for hydrolyse.

Accept: endopeptidases break (proteins) into shorter chains.

2. More ends or increase in surface area (for exopeptidases);

2

(c)
1. No/less ATP produced
OR
No active transport;
2. Sodium (ions) not moved (into/out of cell);

Accept: sodium (ions) increase in cell.

Accept: sodium (ions) cannot diffuse into cell.

3. No diffusion gradient for sodium (to move into cell with amino acid)
OR
No concentration gradient for sodium (to move into cell with amino acid);

Accept: converse for all three points.

Note: no active transport of sodium (ions) equals 2 marks.

3

[6]

9

(a) Ribosome/rough endoplasmic reticulum;

Ignore RER or endoplasmic reticulum unqualified

1

(b) 1. Does not digest protein inside cells;

Accept named examples

2. So (pancreatic) cell/tissue/function not destroyed/damaged;

2

(c) (i) Peptide (bond);

1

(ii) 1. Inhibitor is a similar shape to the substrate;

2. (Inhibitor) blocks active site/is complementary to the active site/binds to the active site (of trypsin);

3. Substrate can't bind to active site / no/fewer ES complexes formed;

3

[7]

10

(a) C.

Ignore name of organ

1

(b) E.

Ignore name of organ

1

(c) 1. Active site (of enzyme) has (specific) shape / tertiary structure / active site complementary to substrate / maltose;

Reject active site on substrate.
Must have idea of shape
Assume "it" = maltase
Accept (specific) 3D active site
Reject has same shape

2. (Only) maltose can bind / fit;

Accept "substrate" for "malt ose"

3. To form enzyme substrate complex.

Accept E−S complex

3

[5]

11

(a) 1. Add iodine / potassium iodide solution to the food sample;

1. Allow 'iodine'
2. Must be in the context of the correct reagent

2. Blue / black / purple indicates starch is present;

2

(b) 1. Starch digested to maltose / by amylase;
Ignore 'hard to digest / easily digested'

2. Maltose digested to glucose / by maltase;

3. Digestion of sucrose is a single step / only one enzyme / sucrase;
3. Accept converse for starch
3. Do not accept digestion of sucrose is faster

3

(c) 1. Smoking increases risk of CHD / introduces another variable;

1

(d) (i) 1. No effect on risk with diet group 1 and 2 / lowest glycaemic load;
Simple statement of correlation is not enough for this mark

2. Above diet group 2 / in higher groups, risk increases as glycaemic load increases;

1 max

(ii) 1. (Higher GL diets lead to) more (harmful) lipids (in blood), so greater risk of atheroma;
Ignore reference to lipids in diet

2. Atheroma leads to blockage of coronary artery / increased risk of blood clot in coronary artery;
Ignore references to myocardial infarction / heart attack

2

2

12

(a) (i) For person with pancreatitis / blocked pancreatic duct:

1. At 0 h / start higher than healthy person / higher than healthy person throughout;

2. Rises then falls whereas healthy person falls then rises;

3. At 48 h / end, below the starting value whereas healthy person is the same (as at start);
Differences required for all points

2 max

(ii) 1. Little / less / no amylase can enter small intestine;
Accept gut or intestine but reject wrong locations e.g. stomach

2. Little / less / no starch digested (in intestine);

2

(b) 1. Amylase is specific (to starch);

2. No starch in human blood / cells / tissues / starch only in plants;

[9]

(c) 1. Could digest own body / own proteins;

e.g. 'could digest carrier proteins in body cells' would score 2 marks

e.g. 'could digest antibodies in blood' would also score 2 marks

2. Example of protein digested e.g. membrane protein, antibody, named protein in blood;

Do not credit unsuitable example such as muscle proteins

2

[8]

13 (a) 1. Enzyme hydrolyses / breaks down protein to amino acids;

2. Products are soluble / can be washed away;

2

(b) Arguments for biological washing powder:

3 max if only arguments against biological washing powder are referred to

1. More effective with all stains;

Accept different ways of expressing 'effective' e.g. higher % of stain removed

2. Greater improvement with salad dressing / chocolate milkshake / chocolate pudding;

Arguments against biological washing powder:

3. Little / less improvement with raspberry sorbet / raspberry smoothie;

4. Only tested 5 / a small number of stains;

5. Only chose stains that would work / didn't select stains that wouldn't work;

6. Only included results that did work / didn't show results that didn't work;

7. Only one set of results / not repeated;

8. Only compared against one washing powder / may not be true for other washing powders;

Ignore references to unknown masses of powder, temperature of washes or other aspects of technique or different fabrics

4 max

(c) 1. Enzyme **S** effective across a wider range of temperatures;

2. Enzyme **S** *more* active above 50 °C / active up to 80 °C / active above 60 °C;

3. Enzyme **S** more active below (about) 37 °C temperature;

4. (Although) Enzyme **P** has higher rate of reaction at optimum / 40 – 50 °C;

5. Enzyme **P** denatured above 50 °C;

*Answers should be in the context of choosing enzyme **S** but, if **P** is chosen, points 4 and 5 may still be awarded, if described*

In points 2 and 3, a temperature must be stated. Allow ± 5 degrees of values shown

3 max

(d) 1. Stains caused by different substances;

2. Enzymes are specific;

3. Active site specific to substrate / other substrates cannot fit active site;

This could be expressed in other ways e.g. 'other substrates are not complementary to the active site'

3

[12]

14 (a) In one country where the percentage of fat (in the diet) is 35%, the death rate (from breast cancer) is 20 per 100 000;

Must have reference to country

Accept … 1 per 5 000 / 0.02%

1

(b) 1. No. of deaths from breast cancer divided by total population × 100 000;

2. No. of deaths from breast cancer divided by all deaths × 100 000;

3. Sample and count deaths from breast cancer in 100 000 people;

If sample not 100 000 then must scale appropriately

(c) 1. Positive correlation;

2. But correlation does not show causation / some other (named) factor may be involved;

3. Evidence against positive correlation e.g. different death rates at same % fat / similar death rates at different % fat / some countries with higher death rate have lower fat intake;

1. Accept description of positive correlation / directly proportional.

Accept positive relationship.

2. Do not accept casual in place of causal.

nsistent with data.

1 max

3

[5]

15 (a) 1. Phagocyte attracted to bacteria by chemicals / recognise antigens on bacteria as foreign;

2. Engulf / ingest bacteria;

3. Bacteria in vacuole / vesicle;

4. Lysosome fuses with / empties enzymes into vacuole;

5. Bacteria digested / hydrolysed;

1. Accept names chemical e.g. toxin
2. Allow description of engulfing
3. Accept: bacteria in phagosome
5. Neutral: Break down
5. Accept digestive enzymes destroy bacteria
5. Do not accept ''destroy bacteria'' as it is in question stem

4 max

(b) 1. Microvilli provide a large / increased surface area;

2. Many mitochondria produce ATP / release or provide energy (for active transport);

3. Carrier proteins for active transport;

4. Channel / carrier proteins for facilitated diffusion;

5. Co-transport of sodium (ions) and glucose or symport / carrier protein for sodium (ions) and glucose;

6. Membrane-bound enzymes digest disaccharides / produce glucose;

1. Reject villi on epithelial cells
1. Accept brush border
2. Accept large SA:vol ratio
3. Need idea of ''lots''
4. Reject: energy produced
5. Accept Na^+K^+ pump
6. Neutral: Channel proteins
7. Accept named example

6

[10]

16 (a) (i) Assumed that did not eat due to discomfort in the past;

1

(ii) Positive correlation / as lactose concentration increases the data in column C increases / percentage who do not eat the food or feel discomfort after eating the food increases;

1

(iii) Correlation does not mean that there is a causal relationship;

May be due to some other factor / example of factor;

Do not accept casual

2

(b) 1. People self-diagnosed lactose intolerant condition;

2. Discomfort may be due to other factor / infection / other component of diet / is subjective;

3. Large variation in lactose content of specific food items / e.g. variation in lactose content of different soft cheeses;

4. Amount in a serving may vary;

5. Untruthful responses / demand characteristics;

Sample size = neutral.

2 max

[6]

17 (a) (i) 14 / 15 – 58 / 59 or 43 – 45 (mg per 100cm^3);

Wrong calculation does not disqualify

1

(ii) The larger the person the more blood they would have so have a lower concentration of blood glucose;

as same amount of glucose absorbed / all / 50g absorbed;

2

(b) 1. Any reference to overlap between all 3 groups;

2. One lactase deficient subject had high blood glucose / similar to control;

3. Some control / Group A subjects had the similar blood glucose to LD / Group B subjects / some IBS subjects had similar results to lactase deficient subjects;

3

[6]

18 (a) High sucrose / starch diet leads to increase in lactase activity;

1

(b) Not valid / cannot be certain because overlap in SD between high sucrose and high starch;

Study based on rats (not human) so may not apply to human;

2

[3]

19

(a) Measure with eyepiece graticule / scale;
Calibrate with stage micrometer / scale on slide / object of known size;
Repeats and calculate the mean;
OR
Use a ruler to estimate the field diameter under microscope;
How many droplets go across the field;
Repeats and calculate mean;

Accept references to radius

3

(b) (i) Two mark for correct answer of 4 : 1;;
One mark for incorrect answer but working shows that candidate has clearly attempted to compare values of r^2 / 6^2 and 3^2 / 36 and 9;

Idea of comparing ratios
A ratio of 1 : 4 should gain 1 mark

2

(ii) Small droplets have a larger surface area to volume ratio;
More surface for lipase (to act), leading to faster digestion of triglycerides;
Fatty acids are produced more quickly so pH will drop more quickly in curve Y / with bile salts / less fatty acids in curve Z / without bile salts so pH drop more slowly;

3

[8]

20

(a) pH goes down and levels out;
after 30 min / pH 6.5;

2

(b) Enzyme not used up in reaction;

1

(c) Curve will be less steep:

*Only accept answers relating to curve **not** rate of reaction*

1

[4]

21

(a) (i) Mitochondrion;

Neutral: cristae

1

(ii) (Site of aerobic) respiration / ATP production / energy release;

***Q** Reject: anaerobic respiration*

***Q** Reject: energy produced*

Active transport / transport against the concentration gradient;

Accept: energy produced in the form of ATP

2

(b) 89 – 91 gains 2 marks;

Correct answer gains 2 marks outright

Principle of:

$\frac{\text{correct measured length}}{\text{magnification}}$ gains 1 mark;

89-91 (mm) / 1000 or 8.9-9.1 (cm) / 1000 gains 1 mark

2

(c) Suitable explanation given e.g.

Accept: converse arguments

Reduced surface area; (So) less absorption;

*Neutral: structure **Z** incorrectly named*

(Membrane-bound) enzymes less effective;
(So) proteins / polypeptides not digested;

Reduced surface area for absorption gains 2 marks

Cell membranes damaged;
(So) Fewer / less effective carrier / channel proteins;

Accept: references to diffusion and active transport for 'absorption'

Carrier / channel proteins damaged;
(So) less absorption;

Reject: active transport if linked to channel proteins

2

[7]

22 (a) Diet including saturated fats leads to higher plasma cholesterol concentrations;
Higher in all age groups;
But sample size is very small;
Standard deviations overlap / suggest wide variation;

3 max

(b) The sex of individual is a risk factor for high cholesterol;
To remove a / one variable / to establish a fair test;

2

(c) Monkeys and humans closely related therefore similar conclusions might be drawn;
High concentrations of plasma cholesterol lead to an increased risk of cardiovascular disease in humans;
Don't know if diet has the same effect in monkeys (as in humans) / could have different effects because not the same species;

3

[8]

23 (a) (Most of) bromelain is digested / not absorbed / broken down in blood;

1

(b) Total volume of blood; **2**

1

24 (a) Amylase;

(Starch) to maltose:

Maltase;

Maltose to glucose;

Hydrolysis;

(Of) glycosidic bond;

Q *Do not penalise incorrect site for digestion or incorrect site of enzyme production.*

5 max

(b) Glucose moves in with sodium (into epithelial cell);

Via (carrier / channel) protein / symport;

Sodium removed (from epithelial cell) by active transport / sodium- potassium pump;

Into blood;

Maintaining low concentration of sodium (in epithelial cell) / maintaining sodium concentration gradient (between lumen and epithelial cell);

Glucose moves into blood;

By (facilitated) diffusion;

Q *Only allow diffusion mark in context of movement of glucose into the blood.*

5 max

25 (a) Two marks for correct answer of 64.285 / 64.3 / 64;

(allow 1 mark for (8100 / 100 × 30) / 37.8)

2

(b) dissolve in / add ethanol then mix with water;
emulsion / white colour indicates triglycerides present;

2

(c) (i) increase the surface area for absorption;

(ignore wrong ref. to name)

1

(ii) **R** = tissue fluid / interstitial fluid / extracellular fluid / intercellular space;
S = lymph(atic) vessel / lymph capillary / lacteal;

[2]

[10]

(iii) proteins are synthesised by **U**;
involvement of ribosomes;
protein isolation / transport (inside RER);
vesicle formation;

2 max

(iv) exocytosis / description of;
because of size / too large to leave by other methods;

2

[11]

26

(i) Lack of ATP;
Pump = <u>active</u> transport / requires <u>energy</u> / ATP provides <u>energy</u> / transport is up
concentration gradient;

2

(ii) Concentration of Na^+ inside cell no longer less than concentration in gut lumen / no longer a concentration gradient;
No (facilitated) diffusion of NA^+ ions possible / amino acid absorption requires diffusion of Na^+ ions into cell;

2

(iii) Diffusion / facilitated diffusion;

1

[5]

27

(i) In all cases reject 'energy' unless qualified

A – <u>facilitated</u> diffusion as transport protein needed but ATP not needed;
B – active transport 'energy' unless as (transport protein and) ATP needed; qualified
C – (simple) diffusion as neither ATP nor transport protein needed;
(Ignore all references to concentration gradients)

3

(ii) creates low concentration of amino acids / Na^+ in cell concentration gradient established between lumen and cell (of amino acids or Na^+)

2

[5]

28

(a) Digestion / hydrolysis / breakdown of a disaccharide into monosaccharides;
OR
(glucose and galactose form lactose) glucose is a monosaccharide;

max 1

(b) (i) Dipeptidase / disaccharidase / named disaccharidase;

1

(ii) Enzymes not lost (with gut contents) / more effective absorption of products formed by these enzymes;

1

(c) No ATP formed / no energy released by respiration;

[reject "making" energy]

Link ATP to active transport (of galactose) into cells;

2

[5]