BIOLOGICAL MOLECULES

Carbohydrates Part 2 EXAM Q&A

Q1.

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)

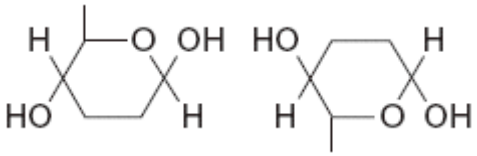
Q2.

(a) The table shows some substances found in cells. Complete the table to show the properties of these substances. Put a tick in the box if the statement is correct.

Statement	**Substance**			
	Starch	Glycogen	Deoxyribose	DNA helicase
Substance contains only the elements carbon, hydrogen and oxygen				
Substance is made from amino acid monomers				
Substance is found in both animal cells and plant cells				

(4)

(b) The diagram shows two molecules of β-glucose.



On the diagram, draw a box around the atoms that are removed when the two β-glucose molecules are joined by condensation.

(2)

(c) (i) Hydrogen bonds are important in cellulose molecules. Explain why.

_____

_____

_____

_____

(2)

(ii) A starch molecule has a spiral shape. Explain why this shape is important to its function in cells.

_____

_____

_____

(1)

(Total 9 marks)

Q3.

(a) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature _____

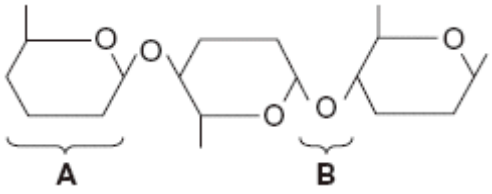
Explanation _____

_____

_____

(2)

(b) The diagram shows part of a cellulose molecule.



(i) Name part **A**.

_____

(1)

(ii) Name bond **B**.

_____

(1)

(c) The structure of cellulose is related to its role in plant cell walls. Explain how.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q4.

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)

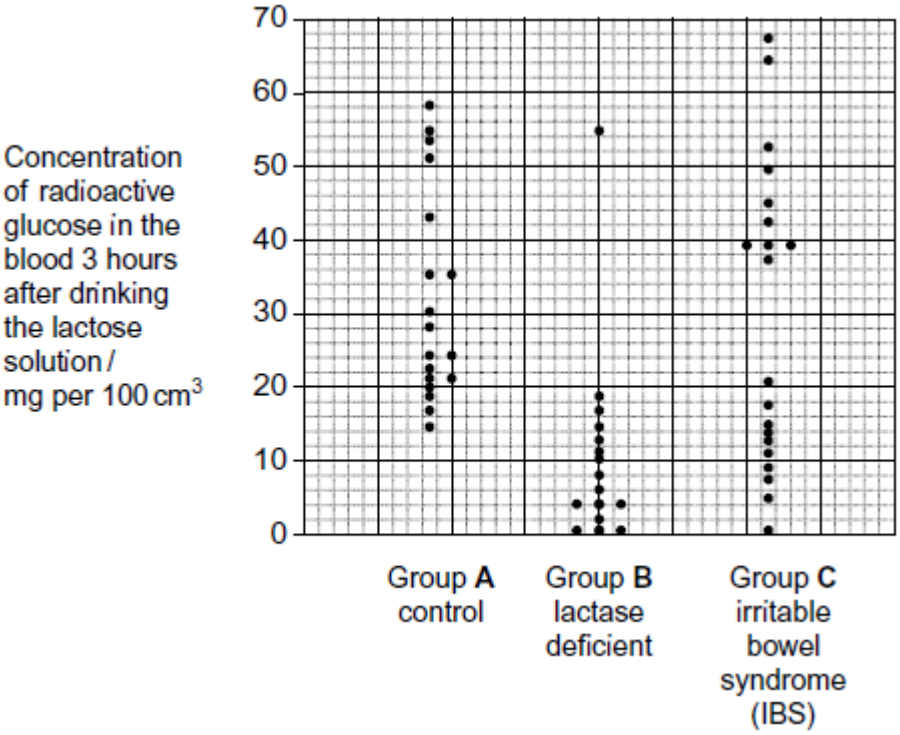
Both lactase deficiency and irritable bowel syndrome have similar symptoms.

The doctors carried out two measurements on the people in each group.

Test 1 – The lactose tolerance test

The doctors measured the concentration of radioactive glucose in the blood of each person. **Figure 1** shows the results. Each point shows the result for one person 3 hours after drinking the lactose solution.

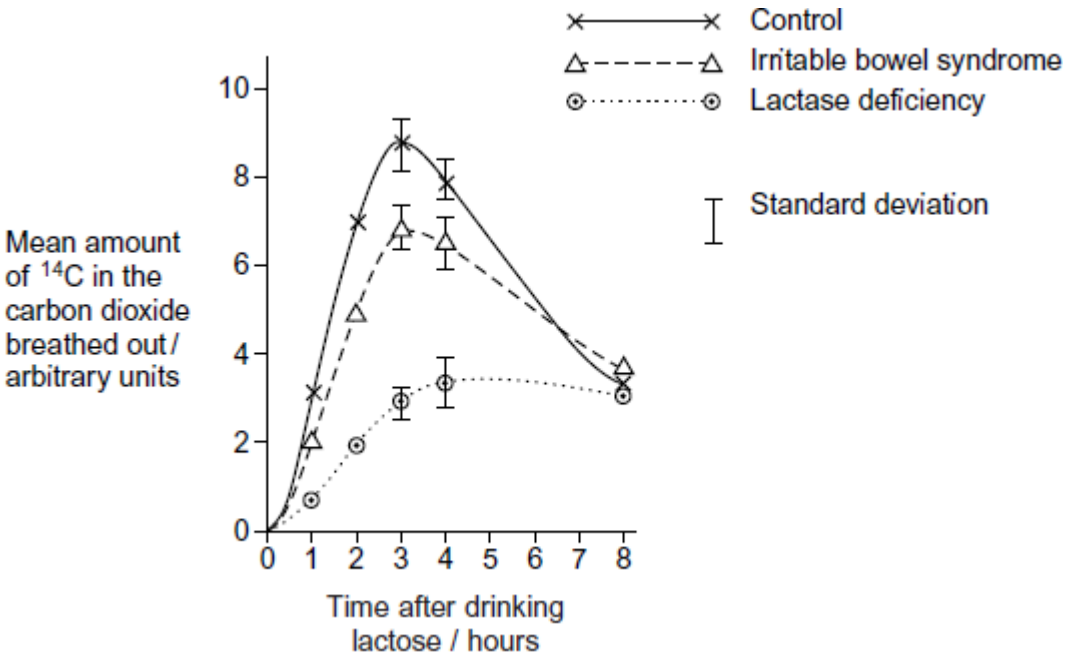
Figure 1



Test 2 – The carbon dioxide breath test

In this test the doctors measured the amount of ^{14}C in the carbon dioxide breathed out. The doctors took measurements at intervals for 8 hours after each volunteer had drunk the lactose solution. **Figure 2** shows the mean results for each group.

Figure 2



The people who took part in these tests were not allowed to eat or drink for 8 hours before the test. Explain why.

_____

_____

_____

_____

(Total 2 marks)

Q5.

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
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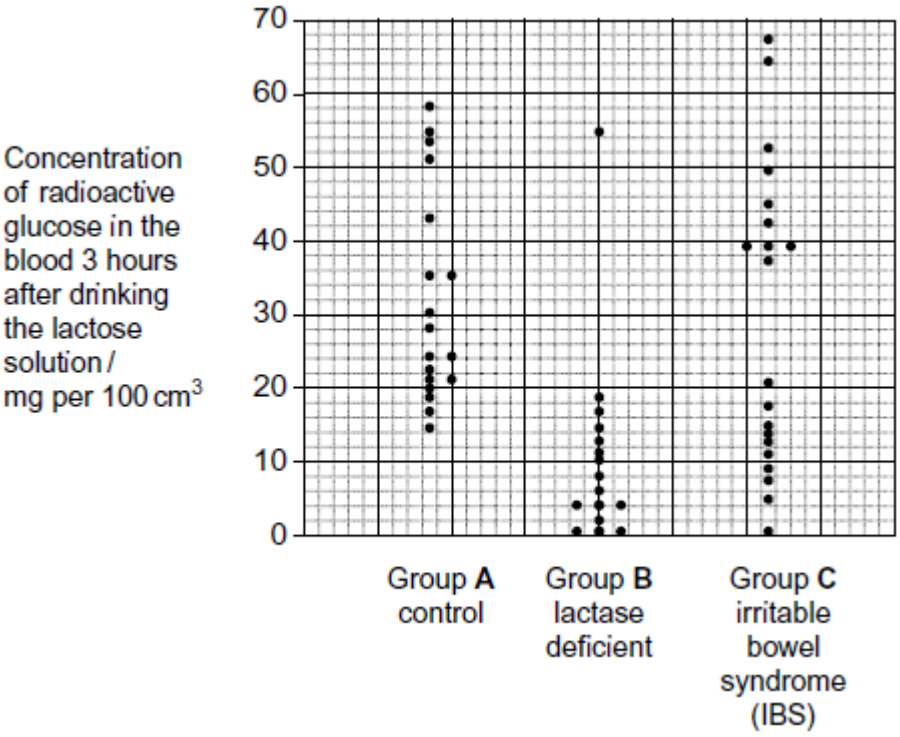
Both lactase deficiency and irritable bowel syndrome have similar symptoms.

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.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q6.

Doctors compared two tests for lactase deficiency.

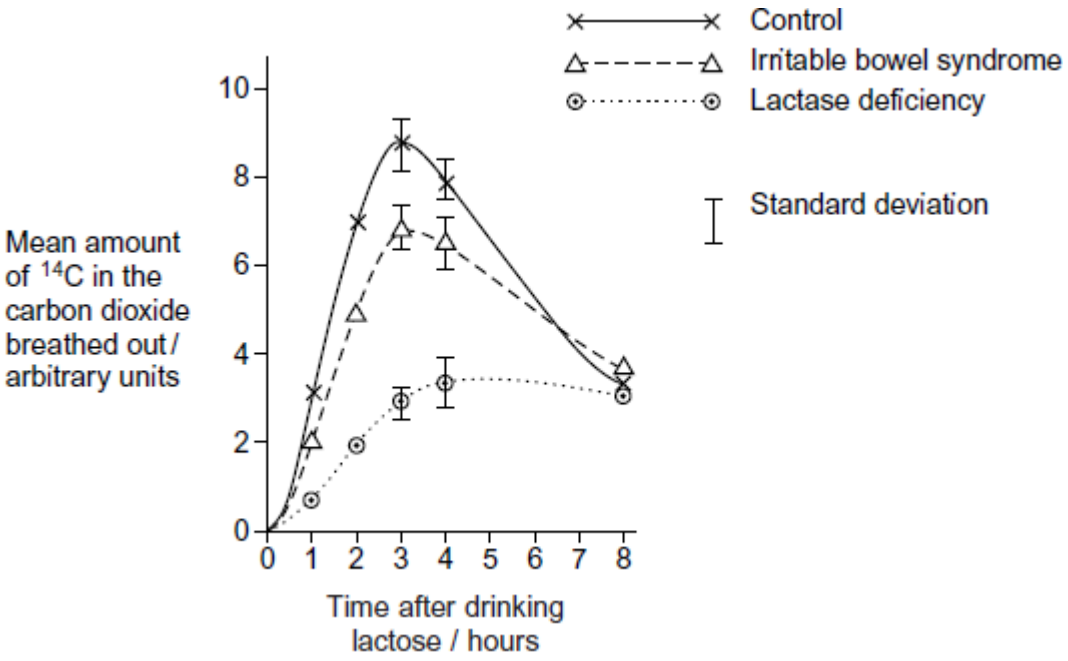
Doctors investigated three groups of people. The people in all three groups were not allowed to eat or drink for 8 hours before the test. They each then drank a solution containing 50 g of lactose made with a radioactive form of carbon called ^{14}C.

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

Both lactase deficiency and irritable bowel syndrome have similar symptoms.

The carbon dioxide breath test

In this test the doctors measured the amount of ^{14}C in the carbon dioxide breathed out. The doctors took measurements at intervals for 8 hours after each volunteer had drunk the lactose solution. The following figure shows the mean results for each group.



(a) Describe the common trend shown by **all** the curves in the figure.

_____

_____

_____

(1)

(b) Explain why the doctors stopped measuring the amounts of ^{14}C in the carbon dioxide breathed out after 8 hours.

_____

_____

_____

_____

(2)

(c) Carbon dioxide in the breath contained the radioactive form of carbon, ^{14}C. Explain how ^{14}C in carbon dioxide came from ^{14}C in glucose in the blood.

_____

_____

_____

_____

(2)

(d) The doctors concluded that measuring the amount of ^{14}C in the carbon dioxide in the breath after 3 hours was a better way of diagnosing lactase deficiency than the lactose tolerance test. Do you agree with the doctors' conclusion? Give the reasons for your answer.

(2)

(Total 7 marks)

Q7.

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)

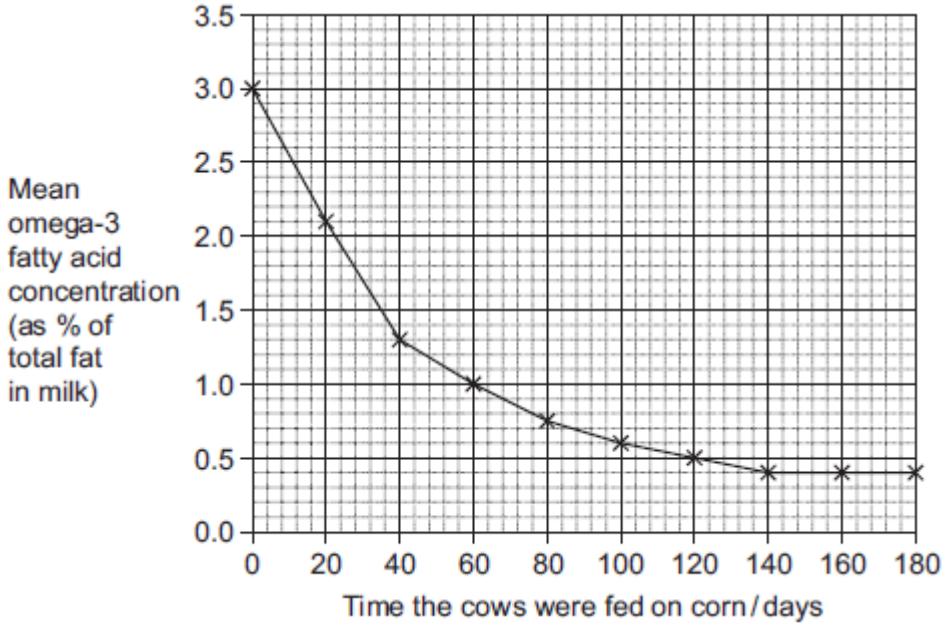
(b) Some students suggested from these data that increasing starch in the diet was the most effective way to increase lactase activity in lactase deficient people. Is this conclusion valid? Explain your answer.

(2)

(Total 3 marks)

Q8.

Omega-3 fatty acids are found in cows' milk. Scientists investigated changes in the concentration of omega-3 fatty acids in milk when cows were moved from eating grass in fields to eating corn in cattle sheds. The following figure shows the results of one investigation.



(a) The concentration of omega-3 fatty acids in milk changed when cows were fed on corn instead of grass. Describe how.

_____

_____

_____

_____

(2)

(b) (i) Calculate the rate of decrease in the mean omega-3 fatty acid concentration between 0 and 40 days.
Show your working.

Answer_____% per day

(2)

(ii) The omega-3 fatty acid concentration is expressed as a percentage of total fat. Explain the advantage of this.

_____

_____

_____

_____

(2)

(iii) One farmer concluded from the graph that feeding cows on corn reduces the omega-3 fatty acid content in milk. Evaluate this conclusion.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q9.

(a) (i) The equation shows the reaction catalysed by the enzyme lactase. Complete this equation.

Lactose + _____ ⟶ Glucose + _____

(2)

(ii) Name the type of chemical reaction shown in this equation.

_____

(1)

(b) Lactase is an enzyme. Lactose is a reducing sugar.

(i) Describe how you could use the biuret test to distinguish a solution of the enzyme, lactase from a solution of lactose.

_____

_____

(1)

(ii) Explain the result you would expect with the enzyme.

_____

_____

(1)

(Total 5 marks)

Q10.

A glucose biosensor is an instrument used to measure glucose concentration. It contains an enzyme called glucose oxidase.

(a) A glucose biosensor detects only glucose. Use your knowledge of the way in which enzymes work to explain why.

_____

_____

_____

_____

_____

_____

(3)

(b) It is better to use a biosensor than the Benedict's test to measure the concentration of glucose in a sample of blood. Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) (i) Diabetes mellitus is a disease that can lead to an increase in blood glucose concentration. Some diabetics need insulin injections. Insulin is a protein so it cannot be taken orally. Suggest why insulin cannot be taken orally.

_____

_____

_____

(1)

(ii) A drug company produced a new type of insulin. Scientists from the company carried out a trial in which they gave this new type of insulin to rats. They reported that the results of this trial on rats were positive. A newspaper stated that diabetics would benefit from this new drug. Suggest **two** reasons why this statement should be viewed with caution.

1. _____

_____

2. _____

(2)

(Total 8 marks)

Q11.

(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)

Q12.

(a) What is a tissue?

_____

_____

(1)

(b) A student cut a thin section of tissue from a potato and examined it with an optical microscope.

(i) Starch was present in the cells of this tissue. Describe how the student could find out where in the cells the starch was present.

_____

_____

_____

_____

_____

(2)

(ii) The student cut a thin section of the tissue. Explain why it was important that the section was thin.

_____

_____

_____

_____

_____

(2)

(c) The cell walls of potato cells contain cellulose. Cellulose and starch are both carbohydrates. Describe **two** ways in which molecules of cellulose are similar to molecules of starch.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q13.

(a) Sucrose, maltose and lactose are disaccharides.

(i) Sucrase is an enzyme. It hydrolyses sucrose during digestion. Name the

products of this reaction.

_____ and _____

(2)

(ii) Sucrase does **not** hydrolyse lactose. Use your knowledge of the way in which enzymes work to explain why.

_____

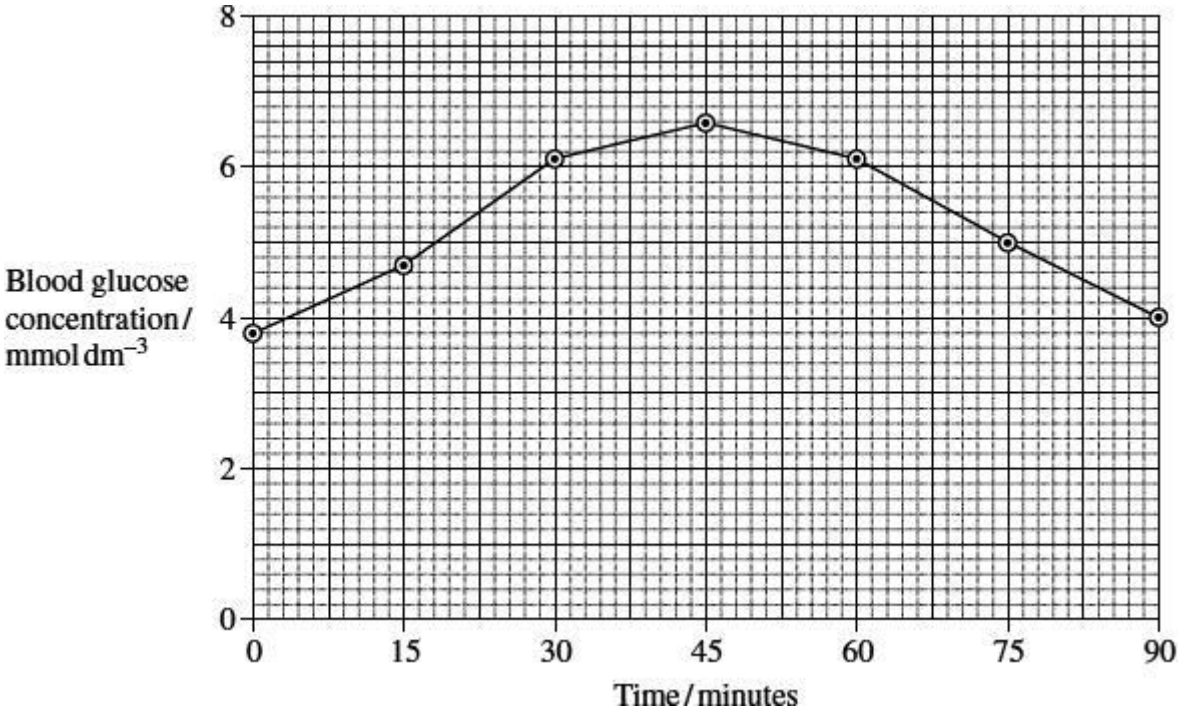
_____

_____

_____

(2)

(b) A woman was given a solution of sucrose to drink. Her blood glucose concentration was measured over the next 90 minutes. The results are shown on the graph.



(i) Describe how the woman's blood glucose concentration changed in the period shown in the graph.

_____

_____

_____

_____

(2)

(ii) Explain the results shown on the graph.

_____

_____

_____

_____

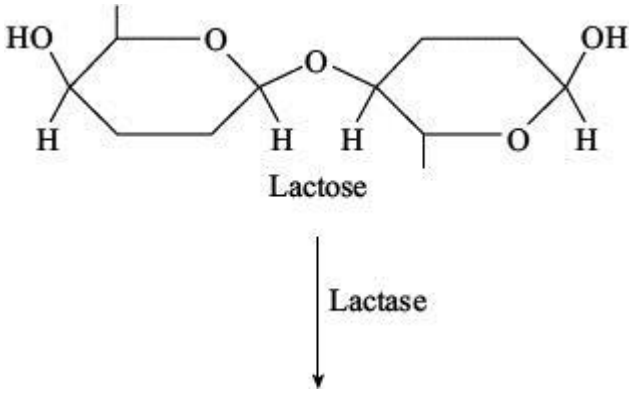
(2)

(Total 8 marks)

Q14.

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.

Complete the diagram to show the hydrolysis of lactose to galactose and glucose.

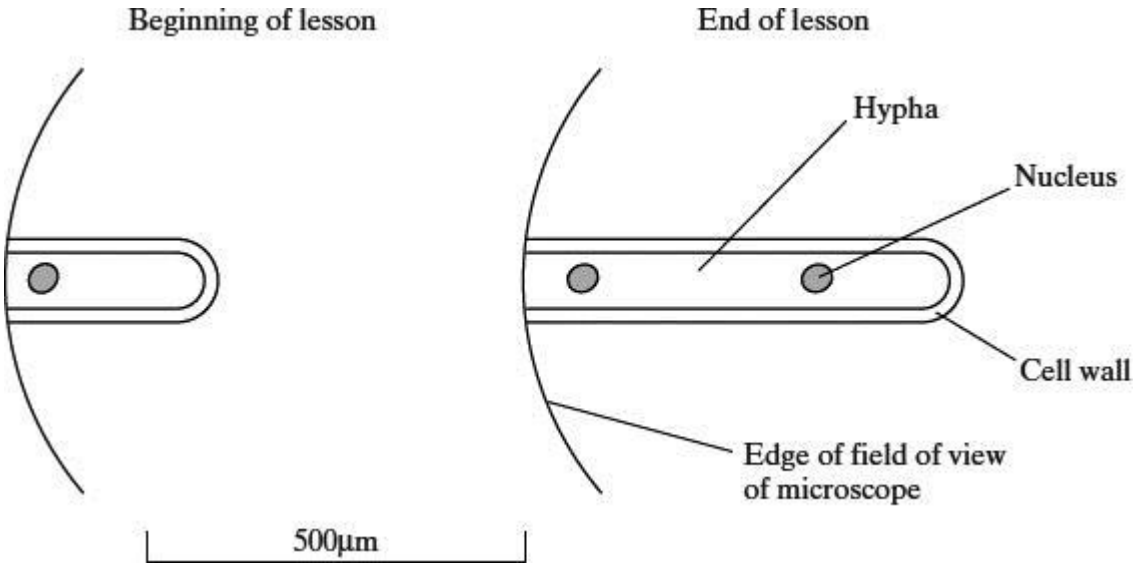


(Total 2 marks)

Q15.

Moulds belong to a group of organisms called fungi. When mould is examined with a microscope it is seen to consist of long, colourless threads called hyphae.

A student investigated the growth of fungal hyphae. The diagram shows part of a hypha seen under a microscope at the beginning of a lesson and again at the end of the lesson.



(a) Give **one** piece of evidence from the diagram that fungi are eukaryotic.

_____

_____

(1)

(b) (i) By how much had the hypha grown during the lesson? Show your working.

Answer: _____ µm

(2)

(ii) Explain how you could use your answer to calculate the rate of growth of this hypha.

_____

_____

(1)

(c) Under the microscope, small granules were seen in the hypha. Describe how you could show that these granules consisted of starch.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q16.

Read the following passage.

Straw consists of three main organic substances – cellulose, hemicellulose and lignin. Cellulose molecules form chains which pack together into fibres. Hemicellulose is a small molecule formed mainly from five-carbon (pentose) sugar monomers. It acts as a cement holding cellulose fibres together. Like hemicellulose, lignin is a polymer, but it is not a carbohydrate. It covers the cellulose in the cell wall and supplies additional strength. In addition to these three substances, there are small amounts of other biologically important polymers present.

The other main component of straw is water. Water content is variable but may be determined by heating a known mass of straw at between 80 and 90°C until it reaches a constant mass. The loss in mass is the water content.

Since straw is plentiful, it is possible that it could be used for the production of a range of organic substances. The first step is the conversion of cellulose to glucose. It has been suggested that an enzyme could be used for this process. There is a difficulty here, however. The lignin which covers the cellulose protects the cellulose from enzyme attack.

Use information from the passage and your own knowledge to answer the following questions.

(a) (i) Give **one** way in which the structure of a hemicellulose molecule is similar to the structure of a cellulose molecule.

_____

_____

(1)

(ii) Complete the table to show **two** ways in which the structure of a hemicellulose molecule differs from the structure of a cellulose molecule.

Hemicellulose	Cellulose
_____ _____	_____ _____
_____ _____	_____ _____

(2)

(b) Name **one** biologically important polymer, other than those mentioned in the passage, which would be found in straw.

_____

(1)

(c) Explain why the following steps were necessary in finding the water content of straw:

(i) heating the straw *until it reaches constant mass* (line 9);

(1)

(ii) not heating the straw above 90°C (line 9).

(2)

(d) A covering of lignin protects cellulose from enzyme attack (line 14). Use your knowledge of the way in which enzymes work to explain why cellulose-digesting enzymes do not digest lignin.

(2)

(e) Describe the structure of a cellulose molecule and explain how cellulose is adapted for its function in cells.

_____

_____

_____

(6)

(Total 15 marks)

Q17.

(a) Starch and protein are biologically important polymers.

(i) Explain what is meant by a polymer.

_____

_____

(1)

(ii) Give **one** example of a biologically important polymer other than starch or protein.

_____

(1)

(b) In an investigation, the enzyme amylase was mixed in a test tube with a buffer solution and a suspension of starch. The amylase broke down the starch to maltose. When all the starch had been broken down, a sample was removed from the test tube and tested with biuret reagent.

(i) Explain why a buffer solution was added to the amylase-starch mixture.

_____

_____

_____

(2)

(ii) What colour would you expect the sample to go when tested with biuret reagent?

_____

(1)

(iii) Give an explanation for your answer to part (ii)

_____

_____

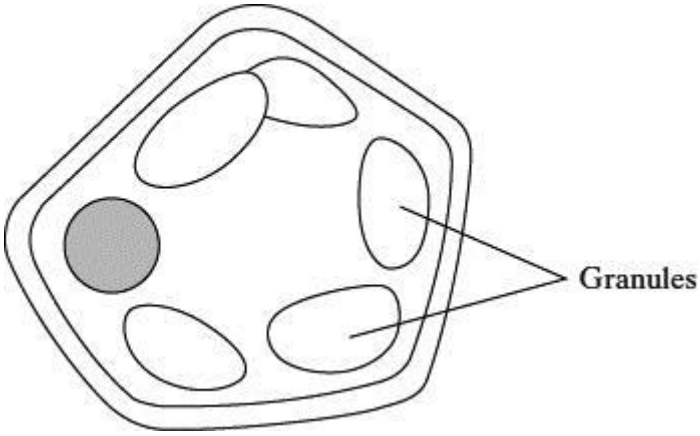
_____

(2)

(Total 7 marks)

Q18.

The diagram shows a cell from a potato.



(a) Give **two** features which may be found in a prokaryotic cell which would not be found in this cell.

1. _____

2. _____

(2)

(b) (i) Describe how you could confirm that the granules contained starch.

_____

_____

(1)

_____

(ii) Name **one** polysaccharide other than starch that would be found in this cell.

_____

(1)

(c) Explain **one** advantage of storing starch rather than glucose in potato cells.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q19.

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)

Q20.

Read the following passage.

Human milk contains all the nutrients a young baby needs in exactly the right proportions. It is formed in the mammary glands by small groups of milk-producing cells. These cells absorb substances from the blood and use them to synthesise the lipids, carbohydrates and proteins found in milk. Milk-producing cells are roughly cube-shaped and have a height to breadth ratio of approximately 1.2 : 1.

The main carbohydrate in milk is lactose. Lactose is a disaccharide formed by the condensation of two monosaccharides, glucose and galactose. (A molecule of galactose has the same formula as a molecule of glucose – the atoms are just arranged in a different way.)

Lactose is synthesised in the Golgi apparatus and transported in vesicles through the cytoplasm. Because lactose is unable to escape from these vesicles, they increase in diameter as they move towards the plasma membrane. The vesicle membranes fuse with the plasma membrane and the vesicles empty their contents out of the cell.

Use the information from the passage and your own knowledge to answer the following questions.

(a) (i) The breadth of a milk-producing cell is 26 µm. Calculate the height of this cell.

Height = _____ µm

(1)

(ii) Describe and explain how you would expect the height to breadth ratio of an epithelial cell from a lung alveolus to differ from the height to breadth ratio of a milk-producing cell.

_____

_____

_____

_____

(2)

(b) How many oxygen atoms are there in a molecule of

(i) galactose;

_____

(1)

(ii) lactose?

_____

(1)

(c) The lactose-containing vesicles increase in diameter as they move towards the plasma membrane of the milk-producing cell (lines 11-12). Use your knowledge of water potential to explain why.

_____

_____

_____

_____

(2)

(d) Suggest **one** advantage of milk-producing cells containing large numbers of mitochondria.

_____

_____

_____

(2)

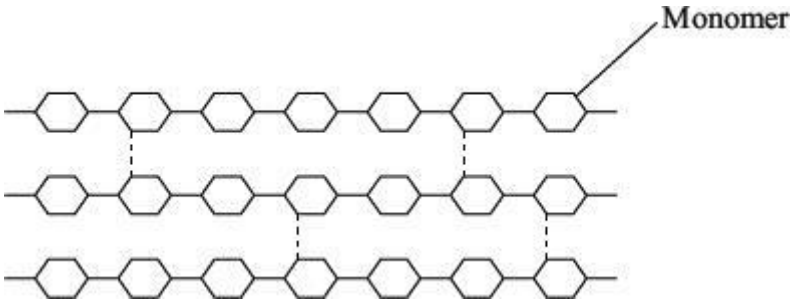
(e) Some substances pass through the plasma membrane of a milk-producing cell by diffusion. Describe the structure of a plasma membrane and explain how different substances are able to pass through the membrane by diffusion.

(6)

(Total 15 marks)

Q21.

Cellulose is made from one type of monomer. The monomers are held together by bonds. The diagram shows parts of three cellulose molecules in a cell wall.



(a) Name the monomer present in cellulose.

(1)

(b) Name the type of reaction that converts cellulose to its monomers.

(1)

(c) Cotton is a plant fibre used to make cloth. Explain how cellulose gives cotton its

strength.

_____

_____

_____

_____

_____

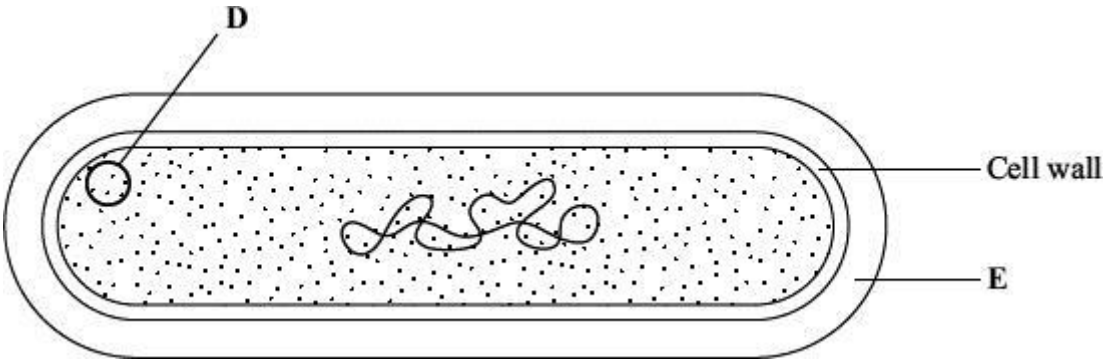
_____

(3)

(Total 5 marks)

Q22.

(a) The diagram shows a bacterial cell.



(i) Name the parts labelled **D** and **E.**

D _____

E _____

(2)

(ii) Give **one** function of the cell wall.

_____

_____

(1)

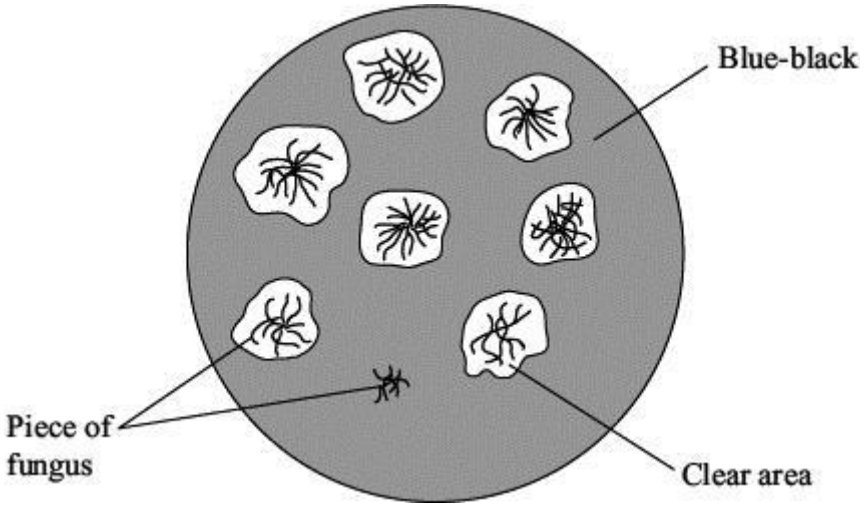
(b) Name **two** structures present in eukaryotic cells that are not present in the cells of prokaryotes.

1. _____

2. _____

(2)

(c) Several small pieces of a saprophytic fungus were placed on a starch agar plate. After 48 hours the iodine solution was poured over the starch agar. The result is shown in the diagram below.



(i) Explain why there is a clear area around most of the pieces of fungus.

_____

_____

_____

_____

(2)

(ii) Suggest why one piece of fungus has no clear area round it.

_____

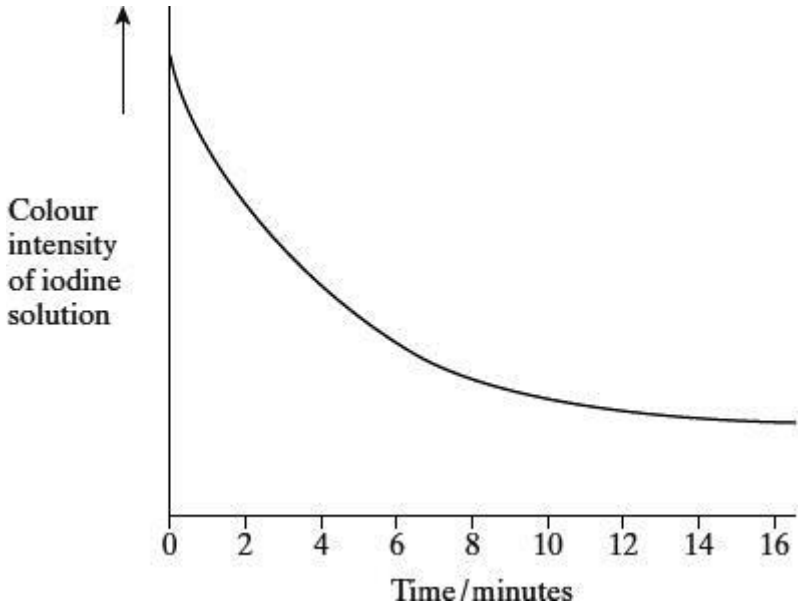
_____

(1)

(Total 8 marks)

Q23.

In an investigation into carbohydrase activity, the contents from part of the gut of a small animal were collected. The contents were added to starch solution at pH 7 and kept in a water bath at 25°C. At one-minute intervals, samples were removed and added to different test tubes containing dilute iodine solution. The colour intensity of each sample was determined. The graph shows the results.



(a) Explain the change in colour intensity.

_____

_____

_____

_____

(2)

(b) Draw clearly labelled curves on the graph to show the expected result if the experiment was repeated

(i) at 35 °C;

(ii) at pH 2.

(2)

(c) Explain how

(i) raising the temperature to 35 °C affects carbohydrase activity;

_____

_____

_____

_____

_____

_____

_____

_____

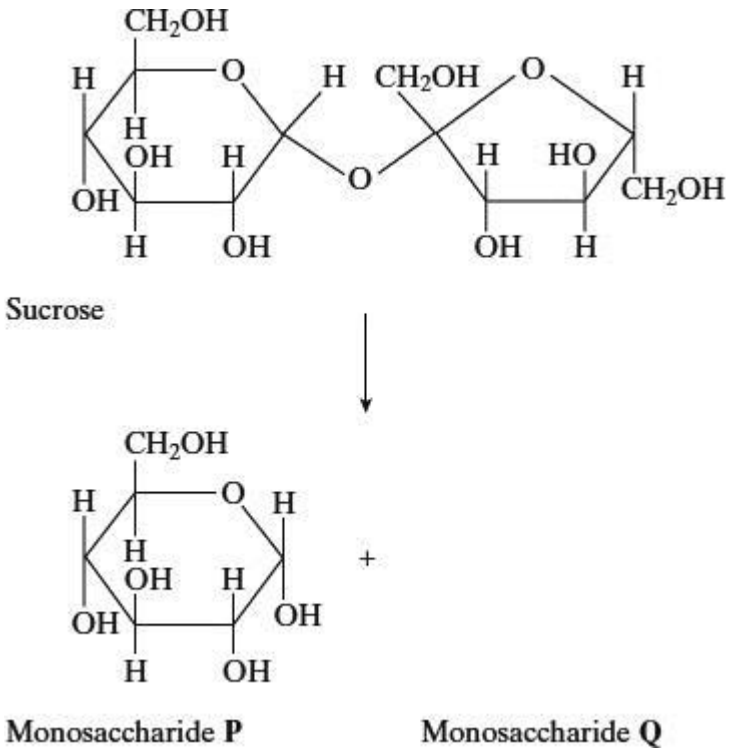
(ii) decreasing the pH affects carbohydrase activity.

(7)

(Total 11 marks)

Q24.

Sucrose is a disaccharide. It is formed from two monosaccharides **P** and **Q**. The diagram shows the structure of molecules of sucrose and monosaccharide **P**.



(a) (i) Name monosaccharide **Q**.

(1)

(ii) Draw the structure of a molecule of monosaccharide **Q** in the space above.

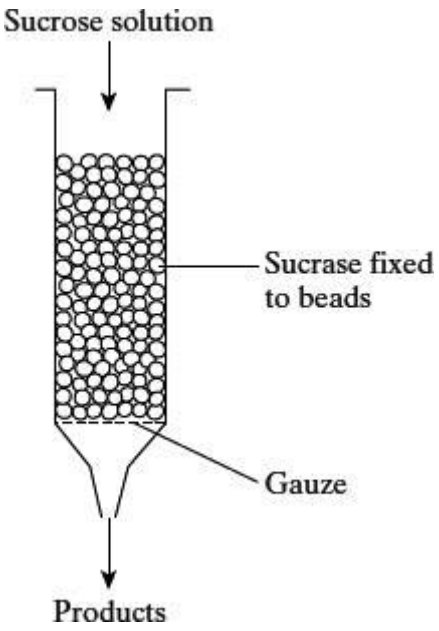
(1)

(b) The enzyme sucrase catalyses the breakdown of sucrose into monosaccharides. What type of reaction is this breakdown?

_____

(1)

(c) The diagram shows apparatus used in breaking down sucrose. The enzyme sucrase is fixed to inert beads. Sucrose solution is then passed through the column.



Describe a biochemical test to find out if the solution collected from the apparatus contains

(i) the products;

_____

_____

_____

_____

(2)

(ii) the enzyme.

_____

_____

_____

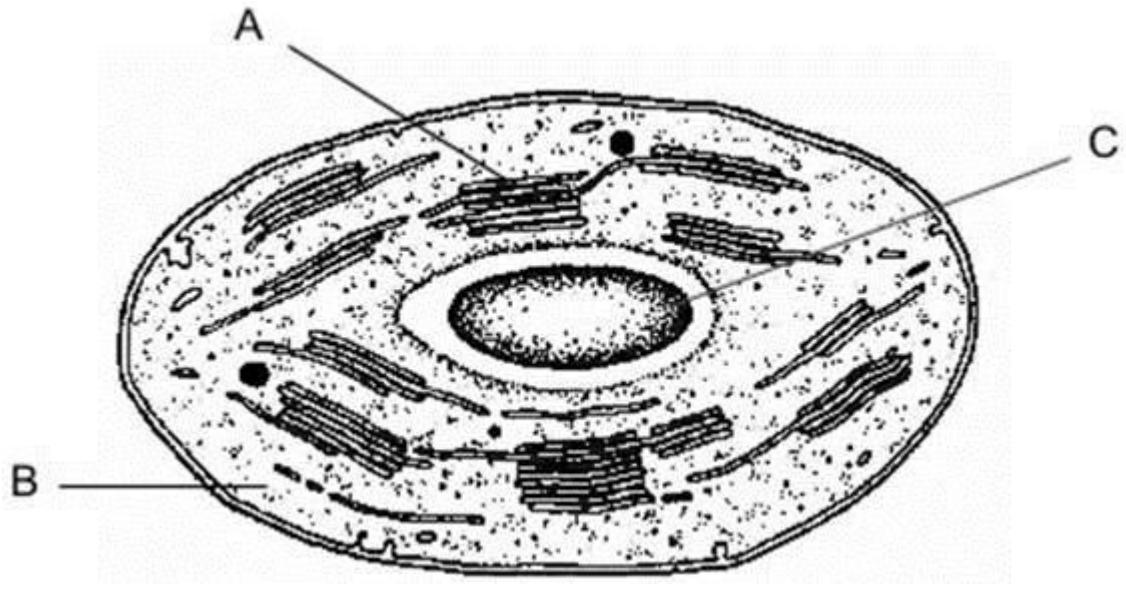
_____

(2)

(Total 7 marks)

Q25.

The electron micrograph shows part of a chloroplast.



(a) Name the parts labelled **A** and **B** and, for each, describe **one** role in the process of photosynthesis.

A Name _____

Role _____

B Name _____

Role _____

(4)

(b) (i) Name the main substance present in the part labelled **C**.

_____

(1)

(ii) How is this substance formed?

_____

_____

(1)

(Total 6 marks)

Q26.

In an investigation, the effects of caffeine on performance during exercise were measured. One group of athletes (**A**) was given a drink of decaffeinated coffee. Another group (**B**) was given a drink of decaffeinated coffee with caffeine added. One hour later the athletes started riding an exercise bike and continued until too exhausted to carry on. Three days later the same athletes repeated the experiment, with the drinks exchanged.

(a) (i) The researchers added caffeine to decaffeinated coffee. Explain why they did not just use normal coffee.

_____

_____

(1)

(ii) The performance of the athletes might have been influenced by how they expected the caffeine to affect them. How could the researchers avoid this possibility?

_____

_____

(1)

During the exercise the concentrations of glycerol and fatty acids in the blood plasma were measured. The results are shown in the table.

Drink	**Mean time to exhaustion /minutes**	**Mean concentration of blood glycerol/ mmol dm^{-3}**	**Mean concentration of blood fatty acids/ mmol dm^{-3}**
With caffeine	90.2	0.20	0.53
Without caffeine	75.5	0.09	0.31

(b) (i) Describe the effect of caffeine on exercise performance.

_____

_____

(1)

(ii) Suggest **one** explanation for the higher glycerol and fatty acid concentrations in the blood plasma of the athletes after they were given caffeine.

_____

_____

_____

_____

(2)

(c) The researchers measured the volumes of carbon dioxide exhaled and oxygen inhaled during the exercise. From the results they calculated the respiratory quotient (RQ), using the formula

$$RQ = \frac{\text{volume of carbon dioxide exhaled per minute}}{\text{volume of oxygen inhaled per minute}}$$

When a person is respiring carbohydrate only, RQ = 1.0

When a person is respiring fatty acids only, RQ = 0.7

(i) The basic equation for the respiration of glucose is

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Explain why the RQ for glucose is 1.0.

_____

_____

_____

_____

(2)

(ii) The researchers found that, when the athletes were given the drink containing caffeine, their mean RQ was 0.85. When given the drink without caffeine their mean RQ was 0.92.

The researchers concluded that when the athletes had caffeine they used glycogen more slowly than when they did not have caffeine, and that the store of glycogen in their muscles was used up less quickly during the exercise.

Explain the evidence from the information above and from the table which supports these conclusions.

_____

_____

_____

_____

_____

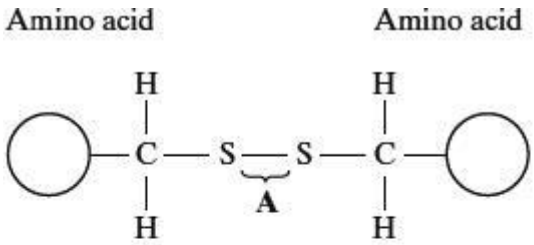
_____

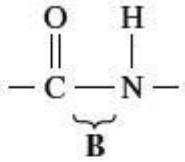
(3)

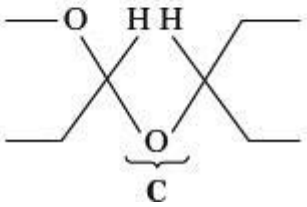
(Total 10 marks)

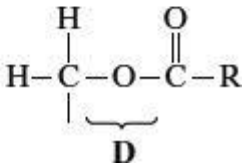
Q27.

The diagrams show four types of linkage, **A** to **D**, which occur in biological molecules.









(a) Name the chemical process involved in the formation of linkage **B**.

_____

(1)

(b) Give the letter of the linkage which

(i) occurs in a triglyceride molecule;

_____

(1)

(ii) might be broken down by the enzyme amylase;

_____

(1)

(iii) may occur in the tertiary, but not the primary structure of protein.

_____

(1)

(c) Describe how a saturated fatty acid differs in molecular structure from an unsaturated fatty acid.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q28.

Lactose is a disaccharide sugar which can be broken down by the enzyme lactase into

two monosaccharides, glucose and galactose.

$$\text{lactose + water} \xrightarrow{\text{lactase}} \text{glucose + galactose}$$

(a) The formula for galactose is $C_6H_{12}O_6$. What is the formula for lactose?

_____

(2)

(b) A solution containing the enzyme lactase was added to a lactose solution. The solution was incubated at 40 °C for one hour. Sample **A** was removed from the tube before incubation. Sample **B** was removed after one hour.

(i) Describe a chemical test you could carry out on sample **A** to show that lactose is a reducing sugar.

_____

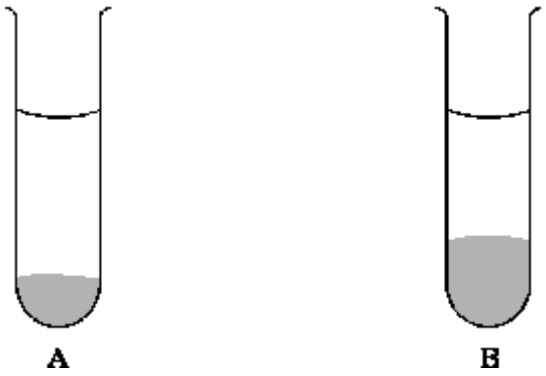
_____

_____

_____

(2)

(ii) This chemical test was carried out on samples **A** and **B**. All experimental variables were the same in the testing of the two samples. Both tubes were left for ten minutes to allow the precipitate to settle. The diagram shows the result.



Is galactose a reducing sugar? _____

Explain how the results in the diagram support your answer.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q29.

(a) Name the substance that muscles use as their immediate energy source.

_____

(1)

(b) Sports scientists investigated the change in energy sources used during exercise. They measured the percentage of energy obtained from carbohydrate and the percentage of energy obtained from fat in two groups of athletes.

- **Group A** exercised at different intensities for the same time.
- **Group B** exercised at the same intensity for different times.

They calculated the intensity of the exercise as a percentage of VO_2 max.
VO_2 max is the maximum volume of oxygen the athletes can take in per minute.

The results for **Group A** are shown in **Figure 1** and the results for **Group B** are shown in **Figure 2**.

Figure 1

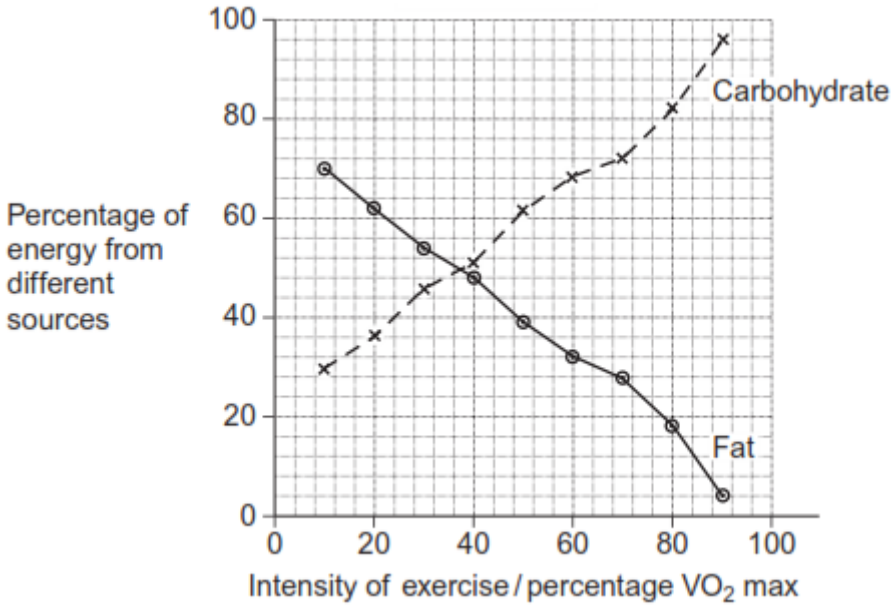
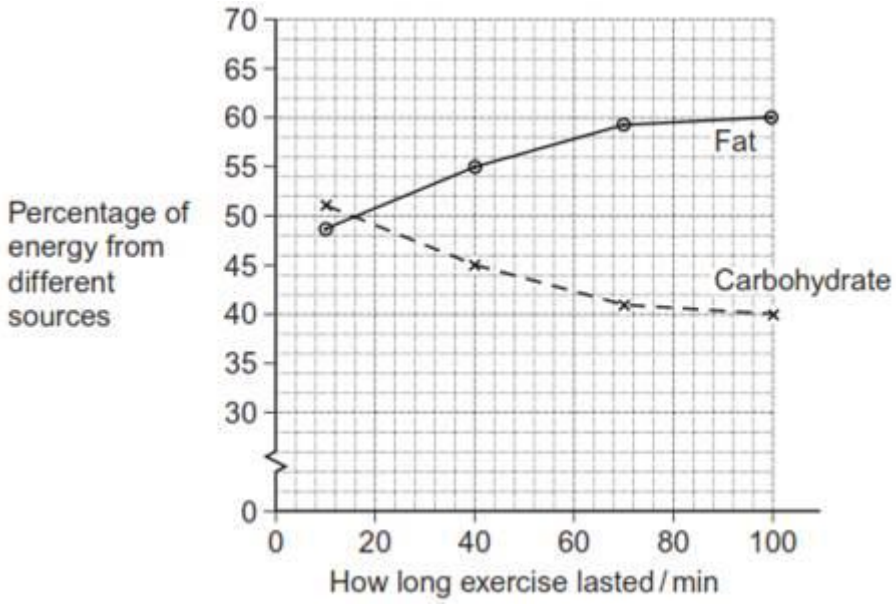


Figure 2



(i) Calculate the ratio of the percentage of energy from carbohydrate to the percentage of energy from fat when the intensity of exercise is 70% VO_2 max. Show your working.

Answer _____

(2)

(ii) A person wishes to lose some body fat by exercising. What sort of exercise would be most effective? Use the information in **Figures 1** and **2** to explain your answer.

_____

_____

_____

_____

_____

_____

(*Extra space*) _____

_____

_____

(3)

(Total 6 marks)

Q1.

(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]

Q2.

(a)

✓	✓	✓	
			✓
		✓	✓

One mark for each correct column

Mark ticks only and ignore crosses

4

(b) 1. Two marks for box round two hydrogens and one of the oxygens from OH groups on carbons 1 and 4;;

2. One mark from incorrect answer involving any two hydrogens and an oxygen from carbons 1 and 4;

Do not award marks if all atoms concerned are on same carbon atom or are on carbon atoms other than 1 and 4 or where the answer does not have two hydrogen and one oxygen

2

(c) (i) 1. Holds chains / cellulose molecules together / forms cross links between chains / cellulose molecules / forms microfibrils, providing strength / rigidity (to cellulose / cell wall);

2. Hydrogen bonds strong in large numbers;x

Principles here are first mark for where hydrogen bonds are formed and second for a consequence of this.

Accept microfibres

2

(ii) Compact / occupies small space / tightly packed;

Answer indicates depth required. Answers such as "good for storage", "easily stored" or "small" are insufficient.

1

[9]

Q3.

(a) Helical / spiral / coiled;
Compact / description e.g. 'tightly packed';

Feature = one mark
Explanation = one mark

Insoluble;
Prevents osmosis / uptake of water / does not affect water potential / (starch) does not leave cell;

These must be related for both marks but can be in reverse order.

Large molecule / long chain;
Does not leave cell;

Allow idea of compact / helical / spiral / coiled due to bonding for two marks.

2 max

(b) (i) β / beta Glucose;

***Q** Reject alpha glucose*

1

(ii) Glycosidic;

1

(c) Long / straight / unbranched chains (of glucose joined by) hydrogen bonds;

***Q** Ignore reference to alpha glucose*

Form (micro)fibrils / (macro)fibrils;

Provide rigidity / strength / support;

Allow suitable descriptions for last point e.g. 'prevents bursting';

3

[7]

Q4.

So there is no / less food in digestive system;

Which could affect the absorption of glucose;

[2]

Q5.

(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]

Q6.

(a) Increase in the first 3 – 4 hours and then decrease;

1

(b) Little / no difference (at 8 hours);

Between all groups;

2

(c) Respiration (produce CO_2);

By cells / tissues;

2

(d) Clear differences between the lactose deficient and IBS / control group;

No overlap in SD;

Accept between all groups

2

[7]

Q7.

(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]

Q8.

(a) (Omega-3 concentration) falls more rapidly at first;
Levels out at 140 days / concentration of 0.4%;

2

(b) (i) Two marks for correct answer of 0.04 or 0.043;;

One mark for incorrect answer which clearly identifies total fall of 1.7;

2

(ii) To take into account variation in fat content of milk / fat content varies from cow to cow;
Allows comparison;

2

(iii) The graph shows a decrease with time feeding on corn;
No control group;
Might have fallen anyway / might decrease with time rather than with time spend feeding on corn;
Other factors / other named factor might also have changed;
Only one investigation so might not be representative;

4 max

[10]

Q9.

(a) (i) (Lactose +) Water; → (Glucose +) Galactose;
Accept: H_2O for water

2

(ii) Hydrolysis;
Accept: if phonetically correct

1

(b) (i) (Add Biuret reagent to both solutions) – no mark;
Neutral: positive / negative result

Lactase / enzyme will give purple / lilac / mauve;
Neutral: incorrect reference to the method

OR

Lactose / reducing sugar will not give purple / lilac / mauve / will remain blue;

1

(ii) Lactase / enzyme is a protein;
Accept: lactase / enzyme contains peptide bonds

1

[5]

Q10.

(a) Enzyme / active site has a (specific) tertiary structure;

Only glucose has correct shape / is complementary / will bind / fit to active site;

(Forming) enzyme-substrate complex;

Q *Allow second mark if candidate refers to correct shape or complementary in terms of the enzyme. Do not allow 'same' shape*

Q *Do not allow third mark if active site is described as being on substrate.*

3

(b) (Only detects glucose whereas) Benedict's detects (all) reducing sugars / named examples;

Provides a reading / is quantitative / Benedict's only provides a colour / doesn't measure concentration / is qualitative / semiquantitative;

Is more sensitive / detects low concentration;

Red colour / colour of blood masks result;

Can monitor blood glucose concentration continuously;

Q *Do not credit quicker / more accurate unless qualified.*

Q *Allow Benedict's detects monosaccharides for first mark point.*

2 max

(c) (i) Broken down by enzymes / digested / denatured (by pH) too large to be absorbed;

1

(ii) Study not carried out on humans / only carried out on rats;
Long-term / side effects not known;
Scientists have vested interest;
Study should be repeated / further studies / sample size not known;

2 max

[8]

Q11.

(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

[10]

Q12.

(a) (Group of) similar / identical cells / cells with a common origin;

Q *Ignore references to function*

1

(b) (i) Add iodine / stain specific for starch to the slide / cells / tissue / add iodine / stain specific for starch and examine under microscope;

Blue-black / blue / black / purple;

Reject sample

2

(ii) Need a single layer of cells / only a few cells thick / not too many layers / detail obscured by cells underneath;

Light must be able to pass through;

2

(c) Both are polymers / made of monomers;

Joined by condensation / molecules can be broken down by hydrolysis;

Both have 1-4 links;

Contain C(arbon), H(ydrogen) and O(xygen) / both made up of glucose;

Both insoluble;

Both contain glycosidic bonds;

Accept other valid answers.
Ignore ref to unbranched.

2 max

[7]

Q13.

(a) (i) Glucose;

Fructose;

Any order.

2

(ii) Lactose has a different shape / structure;

Does not fit / bind to active site of enzyme / sucrase;

Only allow a second mark if reference is made to the active site.
Max 1 mark if active site is described as being on the substrate.

OR

Active site of enzyme / sucrase has a specific shape / structure; Does not fit / bind to lactose;

Do not accept same shape.

2

(b) (i) Rose and fell;

Peak at 45 (minutes) / concentration of 6.6 (mmol dm^{-3});

2

(ii) Glucose (produced by digestion) is absorbed / enters blood;

Decrease as used up / stored;

2

[8]

Q14.

use of water;

must be above arrowhead
OH drawn correctly in place of glycosidic bond on each monosaccharide;

[2]

Q15.

(a) presence of nuclei;

1

(b) (i) 1 mark growth clearly calculated from difference between lengths at beginning and end of lesson

2 marks correct answer of 300 µm

2

(Allow for slight measurement errors)

(ii) <u>divide</u> by time (between measurements);

1

(c) blue-black / dark blue / purple / black;
iodine added to slide / specimen / granules;

2

[6]

Q16.

(a) (i) both are polymers / polysaccharides / built up from many sugar units / both contain glycosidic bonds / contain (C)arbon, (H)ydrogen and (O)xygen;

1

(ii) hemicellulose shorter / smaller than cellulose / fewer carbons;
hemicellulose from pentose / five-carbon sugars and cellulose from hexose / glucose / six-carbon sugars;

(only credit answers which compare like with like.)

2

(b) protein / nucleic acid / enzyme / RNA / DNA / starch / amylose / amylopectin polypeptide;

1

(c) (i) to make sure that all the water has been lost;

1

(ii) only water given off below 90 °C;
(above 90°C) other substances straw burnt / oxidised / broken down;
and lost as gas / produce loss in mass;

2

(d) enzymes are specific;
shape of lignin molecules will not fit active site (of enzyme);
OR
shape of active site (of enzyme);
will not fit molecule;

2 max

(e) 1. made from β-glucose;
2. joined by condensation / removing molecule of water / glycosidic bond;
3. 1 : 4 link specified or described;
4. "flipping over" of alternate molecules;
5. hydrogen bonds linking chains / long straight chains;
6. cellulose makes cell walls strong / cellulose fibres are strong;
7. can resist turgor pressure / osmotic pressure / pulling forces;
8. bond difficult to break;
9. resists digestion / action of microorganisms / enzymes;

(allow maximum of 4 marks for structural features)

6 max

[15]

Q17.

(a) (i) (Molecule) made up of many identical / similar molecules / monomers / subunits;

Not necessary to refer to similarity with monomers.

1

(ii) Cellulose / glycogen / nucleic acid / DNA / RNA;

1

(b) (i) To keep pH constant;
A change in pH will slow the rate of the reaction / denature the amylase / optimum for reaction;

2

(ii) Purple / lilac / mauve / violet;
Do not allow blue or pink.

1

(iii) Protein present / the enzyme / amylase is a protein;
Not used up in the reaction / still present at the end of the reaction;

2

[7]

Q18.

(a) Any two from:

Loop of DNA;	Non-cellulose cell wall;
Plasmid;	Capsule;
Flagellum;	Mesosome;

Accept small ribosomes

2

(b) (i) (Granules) turn blue-black / dark blue / black / purple with iodine;

1

(ii) Cellulose / pectin;

1

(c) Use principle:
Feature of starch;
Consequence in terms of storage;
e.g.
Insoluble;
Therefore will not "wash" out of cell / affect water potential / affect osmosis;
OR
Molecule coiled / branched;
Therefore large amount stored in small space / compact
OR
Does not affect water potential;
So no effect on entry of water (into cell);

2

[6]

Q19.

(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]

Q20.

(a) (i) 31 / 31.2;

1

(ii) Ratio would be less / smaller;
Cell is thin / has large surface area / (adapted) for diffusion;

Accept converse. Must relate to concept of ratio.

2

(b) (i) 6;

1

(ii) 11;

1

(c) Water potential inside vesicle more negative / lower;
Water moves into vesicle by osmosis / diffusion;

2

(d) Mitochondria supply energy / ATP;
For active transport / absorption against concentration gradient / synthesis / anabolism / exocytosis / pinocytosis;

Do not credit references to making, creating or producing energy.

2

(e) 1 Phospholipids forming bilayer / two layers;
2 Details of arrangement with "heads" on the outside;
3 Two types of protein specified;
e.g. passing right through or confined to one layer /
extrinsic or intrinsic /
channel proteins and carrier proteins /
two functional types
4 Reference to other molecule e.g. cholesterol or glycoprotein;
5 Substances move down concentration gradient / from high to low concentration;

Reject references to across or along a gradient

6 Water / ions through channel proteins / pores;
7 Small / lipid soluble molecules / examples pass between phospholipids / through phospholipid layer;
8 Carrier proteins involved with facilitated diffusion;

Ignore references to active transport.

Credit information in diagrams.

max 6

[15]

Q21.

(a) glucose;

(reject alpha glucose)

1

(b) hydrolysis;

(accept catabolic)

1

(c) (long) straight / unbranched chains;
(idea of more than 1) chains lie side by side / form (micro)fibrils;
idea of H bonds holding chains together;

3

[5]

Q22.

(a) (i) **D** plasmid / ribosome(s) / cytoplasm / storage granules;

(accept any sensible structure)

E (slime / mucous) capsule

OR

slime / mucous layer;

2

(ii) protection / maintain shape / prevent lysis / strength / support;

1

(b) two of the following:
nucleus;

OR

nuclear envelope / mitochondria / chloroplasts / sER / rER /
golgi apparatus / 80s ribosomes

linear DNA / chromosomes / lysosomes / vacuole / vescicles /
cellulose cell wall;

2 max

(c) (i) starch digested / broken down;
by amylase / carbohydrase;

2

(ii) any sensible suggestion e.g. no secretion of amylase /
functional amylase /
piece of fungus might have died;

(accept carbohydrase / enzyme for amylase)

(reject "no digestion" without qualification)

1

[8]

Q23.

(a) colour results from starch-iodine reaction;
decrease due to breakdown of starch by carbohydrase / enzyme;

2

(b) (i) curve drawn below curve on graph and starting at same point;

1

(ii) curve drawn above curve on graph and starting at same point but finishing above;

(allow curve or horizontal line)

(allow alternative curve for pH if explanation in (ii) is consistent)

1

(c) (i) 1. increase in temperature increases kinetic energy;
2. increases collisions (between enzyme / active site and substrate) / increases formation of enzyme / substrate complexes;
3. increases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(ii) 4. (decrease in pH) increases H^+ ions / protons which attach / attracted to amino acids;
5. hydrogen / ionic bonds disrupted / broken which denatures enzyme / changes tertiary structure;
6. changes shape / charge of active site so active site / enzyme unable to combine / fit with starch / enzyme-substrate complex no longer able to form;
7. decreases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(allow alternative explanation for pH if consistent with line drawn in (ii))

7

[11]

Q24.

(a) (i) fructose;

1

(ii) correctly drawn (OH group at bottom left);

1

(b) hydrolysis;

1

(c) (i) heat with Benedict's solution (*disqualify if HCl added*);
orange / brown / brick red / green / yellow colour or precipitate;

2

(ii) biuret test / NaOH + $CuSO_4$;
purple / violet / lilac / mauve;

2

[7]

Q25.

(a) A – granum / thylakoid;
chlorophyll molecules to trap light / light absorbing pigments / light dependent reaction / part of light dependent reaction;

2

B – stroma;
(contains enzymes for) carbon dioxide fixation / light-independent reaction / part of light-independent reaction;

(allow ribosome role of protein in photosynthesis)

2

(b) (i) C – starch;

1

(ii) from glucose in a condensation / polymerisation reaction / many glucose molecules joined together;

1

[6]

Q26.

(a) (i) in case normal coffee differs in some other way / to control concentration of caffeine;

1

(ii) not telling them what the drink contained / purpose of experiment;

1

(b) (i) able to continue for longer; *(not just increases performance) (disqualify if also refers to fatty acids and glycerol)*

1

(ii) breakdown of fats;
at increased rate / by mobilisation of fat stores;

2

(c) (i) idea that volumes of oxygen and carbon dioxide the same;
reference to equal moles, or quotient as 1 divided by 1 / or 6 by 6;

2

(ii) glycogen is a carbohydrate / broken down to glucose, linked to RQ;
with no caffeine, RQ nearer 1.0 / less carbon dioxide exhaled and more oxygen inhaled (or vice versa) / with caffeine higher proportion of fats / fatty acids respired;
increased time to exhaustion suggests slower use of glycogen:

3

[10]

Q27.

(a) (i) condensation;

1

(b) (i) **D**;

1

(ii) **C**;

1

(iii) **A**;

1

(c) absence of a double bond;
in the (hydrocarbon) chain;
unable to accept more <u>hydrogen</u> / saturated with hydrogen;

2 max

[6]

Q28.

(a) C_{12} ; $H_{22}O_{11}$;

2

(b) (i) heat with Benedict's;
yellow / brown / orange / red;

2

(ii) (yes)
(may appear on second line)

more precipitate in sample **B**;
both sugars are reducing sugars / give a positive test;

2

[6]

Q29.

(a) ATP

1

(b) (i) 2.57:1/2.6:1/18:7;
Correct answer however derived scores two marks
72:28 scores one mark
Correct working from wrong figures scores 1 mark
Accept
0.4 / 0.39 / 0.389 / 0.3889

2 max

(ii) Low intensity;
At low intensity/below 40% mainly fat used / at high intensity/ above 40% mainly carbohydrate used;
Long duration exercise;
Percentage fat used increases with time / percentage carbohydrate used decreases with time;

3

[6]