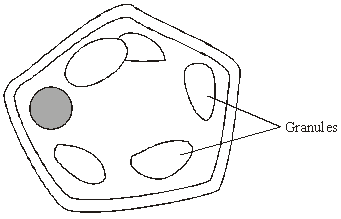
**Q1.**          The diagram shows a cell from a potato.



(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.

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**(1)**

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

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**(1)**

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

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**(2)**

**(Total 6 marks)**

**Q2.**          Lactose is a disaccharide sugar which can be broken down by the enzyme lactase into two monosaccharides, glucose and galactose.

lactase

lactose+ water  glucose + galactose

(a)     The formula for galactose is C6H12O6. What is the formula for lactose?

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**(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.

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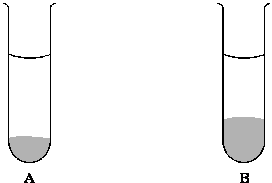
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**(2)**

(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.

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**(2) (Total 6 marks)**

**Q3.**          (a)     Name the substance that muscles use as their immediate energy source.

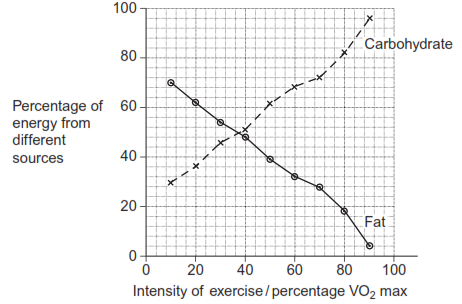
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**(1)**

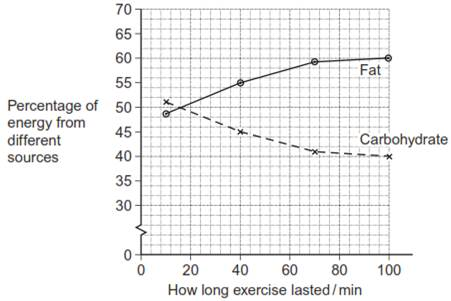
(b)     Sports scientists investigated the change in energy sources used during exercise.  
They measured the percentage of energy obtained from carbohydrate and the percentage of energy obtained from fat in two groups of athletes.  
•    **Group A** exercised at different intensities for the same time.  
•    **Group B** exercised at the same intensity for different times.  
They calculated the intensity of the exercise as a percentage of VO2 max.  
VO2 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**

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**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% VO2 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.

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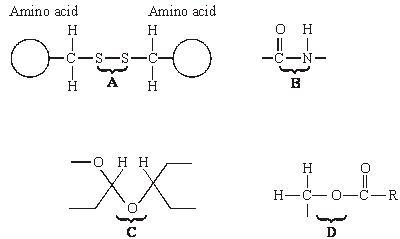
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**(3) (Total 6 marks)**

**Q4.**          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**.

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**(1)**

(b)     Give the letter of the linkage which

(i)      occurs in a triglyceride molecule;

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**(1)**

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

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**(1)**

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

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**(1)**

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

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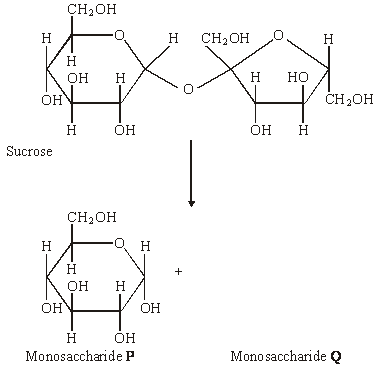
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**(2)**

**(Total 6 marks)**

**Q5.**          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**.

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**(1)**

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

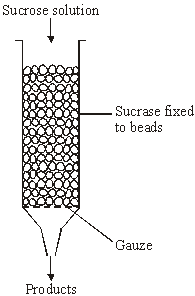
**(1)**

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

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**(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;

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**(2)**

(ii)     the enzyme.

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**(2)**

**(Total 7 marks)**

**Q6.**          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.

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**(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?

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**(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.

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**(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.

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**(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



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

C6H12O6 + 6O2 → 6CO2 + 6H2O

Explain why the RQ for glucose is 1.0.

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**(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.

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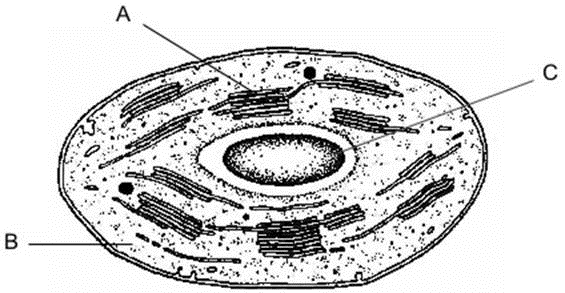
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**(3)**

**(Total 10 marks)**

**Q7.**          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 ...........................................................................................................

**(2)**

**B** Name ........................................................................................................

   Role ...........................................................................................................

**(2)**

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

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**(1)**

(ii)     How is this substance formed?

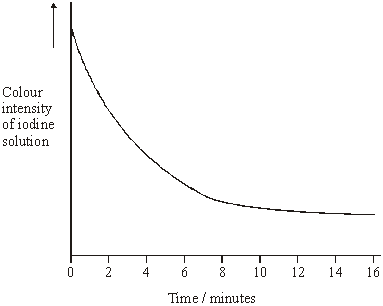
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**(1)**

**(Total 6 marks)**

**Q8.**          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.

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**(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;

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(ii)     decreasing the pH affects carbohydrase activity.

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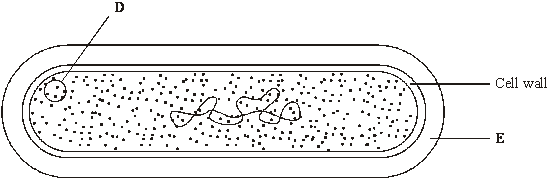
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**(7)**

**(Total 11 marks)**

**Q9.**          (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.

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**(1)**

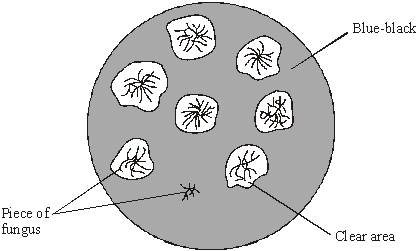
(b)     Name **two** structures present in eukaryotic cells that are not present in the cells of prokaryotes.

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.

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**(2)**

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

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**(1)**

**(Total 8 marks)**

**Q10.**          Lactose is a disaccharide found in milk. In the small intestine, it is digested into glucose and galactose by the enzyme lactase. Molecules of lactase are located in the plasma membranes of cells lining the small intestine.

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

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**(1)**

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

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**(1)**

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

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**(1)**

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

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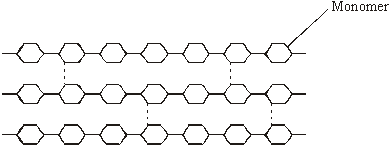
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**(2)**

**(Total 5 marks)**

**Q11.**          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.

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**(1)**

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

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**(1)**

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

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**(3)**

**(Total 5 marks)**

**Q12.** 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

5     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.)

10   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.

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**(2)**

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

(i)      galactose;

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**(1)**

(ii)     lactose?

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**(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.

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**(2)**

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

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**(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.

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**(6)**

**(Total 15 marks)**

**Q13.** 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 14C.

•        Group **A** were the control group

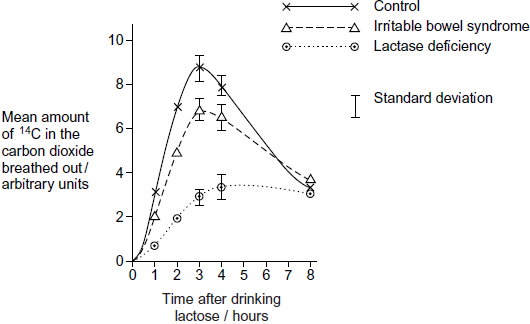
•        Group **B** were lactase deficient

•        Group **C** had irritable bowel syndrome (IBS)

Both lactase deficieny and irritable bowel syndrome have similar symptoms.

**The carbon dioxide breath test**

In this test the doctors measured the amount of 14C 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.

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**(1)**

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

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**(2)**

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

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**(2)**

(d)     The doctors concluded that measuring the amount of 14C 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.

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**(2)  
(Total 7 marks)**

**Q14.**          (a)     Starch and protein are biologically important polymers.

(i)      Explain what is meant by a polymer.

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**(1)**

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

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**(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.

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**(2)**

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

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**(1)**

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

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**(2)**

**Total 7 marks)**

**Q15.**          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

 5      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.

10     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.

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**(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.

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**(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);

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**(1)**

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

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**(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.

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**(2)**

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

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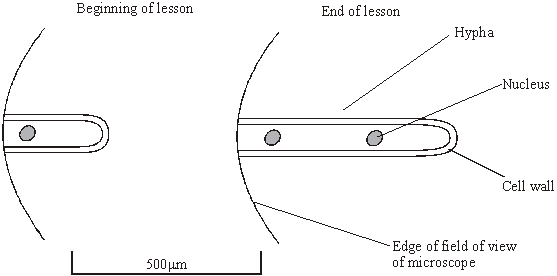
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**(6)**

**(Total 15 marks)**

**Q16.**          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.

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**(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.

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**(1)**

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

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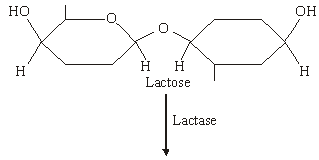
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**(2)**

**(Total 6 marks)**

**Q17.**Lactose is a disaccharide found in milk. In the human small intestine, the enzyme lactase catalyses the hydrolysis of lactose to the monosaccharides, galactose and glucose. These monosaccharides are then absorbed into the blood.

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



**(Total 2 marks)**

**Q18.**          (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.

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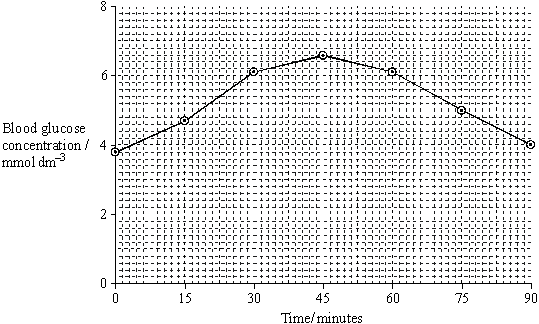
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**(2)**

(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.

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**(2)**

(ii)     Explain the results shown on the graph.

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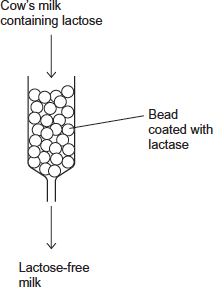
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**(2)**

**(Total 8 marks)**

**Q19.**Cow’s milk contains the sugar lactose. Many cats are unable to digest cow’s milk because they are lactose intolerant.

Cow’s milk can be made suitable for these cats by treating it with the enzyme lactase to hydrolyse lactose. This makes the cow’s milk lactose-free. Beads are coated with lactase and placed in a tube, as shown in the diagram below. Cow’s milk flows over the beads and the lactose is hydrolysed.



(a)     Attaching lactase to the beads is a more efficient use of lactase than adding the lactase directly to cow’s milk.

Suggest **three** reasons why it is more efficient to attach lactase to the beads.

1 .....................................................................................................................

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2 .....................................................................................................................

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3 .....................................................................................................................

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**(3)**

(b)     Monosaccharides and disaccharides taste sweet.  
The lactose-free milk made after hydrolysis with lactase tastes sweeter than the cow’s milk containing lactose.  
Suggest why.

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........................................................................................................**(2) (Total 5 marks)**

**Q20.**          (a)     What is a tissue?

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**(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.

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**(2)**

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

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**(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.

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**(2)**

**(Total 7 marks)**

**Q21.**          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.

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**(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 ...................................................................................................................

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2 ...................................................................................................................

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**(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.

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**(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 ..........................................................................................................

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2 ..........................................................................................................

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**(2)**

**(Total 8 marks)**

**Q22.**(a)     Describe the role of the enzymes of the digestive system in the complete breakdown of starch.

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**(5)**

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

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**(5)**

**(Total 10 marks)**

**Q23.**(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.

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**(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.

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**(1)**

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

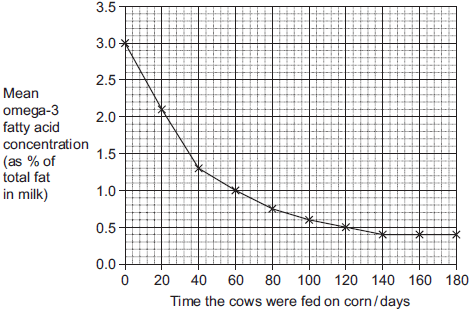
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**(1)**

**(Total 5 marks)**

**Q24.**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.

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**(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.

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**(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.

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**(4)**

**(Total 10 marks)**

**Q25.**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.

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**(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)**

**Q26.**         The equation shows the breakdown of lactose by the enzyme lactase.

Lactose + water   galactose + monosaccharide **X**

(a)     (i)      Name the type of reaction catalysed by the enzyme lactase.

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**(1)**

(ii)     Name monosaccharide **X**.

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**(1)**

(b)     (i)      Describe how you would use a biochemical test to show that a reducing sugar is present.

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**(2)**

(ii)     Lactose, galactose and monosaccharide **X** are all reducing sugars.  
After the lactose has been broken down there is a higher concentration of reducing sugar. Explain why.

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**(1)**

(c)A high concentration of galactose slows down the breakdown of lactose by lactase.  
Use your knowledge of competitive inhibition to suggest why.

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**(2)**

**(Total 7 marks)**

**Q27.**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 14C.

•        Group **A** were the control group

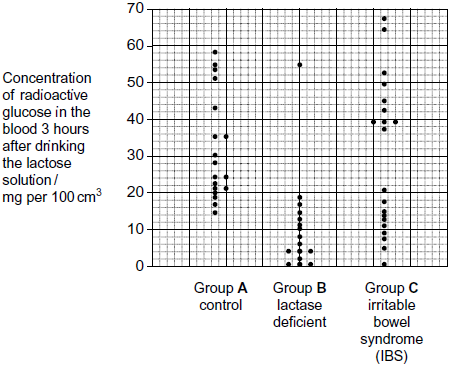
•        Group **B** were lactase deficient

•        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**)

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**(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 cm3 of blood.

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

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**(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.

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**(3)**

**(Total 6 marks)**

**Q29.**          (a)     Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature ........................................................................................................

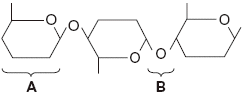
Explanation ..................................................................................................

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**(2)**

b)     The diagram shows part of a cellulose molecule.



(i)      Name part **A**.

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**(1)**

(ii)     Name bond **B**.

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**(1)**

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

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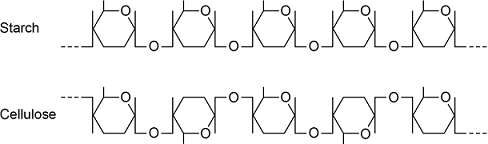
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**(3)**

**(Total 7 marks)**

**Q30.**Starch and cellulose are two important plant polysaccharides.

The following diagram shows part of a starch molecule and part of a cellulose molecule.



(a)     Explain the difference in the structure of the starch molecule and the cellulose molecule shown in the diagram above.

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**(2)**

(b)     Starch molecules and cellulose molecules have different functions in plant cells. Each molecule is adapted for its function.

Explain **one** way in which starch molecules are adapted for their function in plant cells.

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**(2)**

(c)     Explain how cellulose molecules are adapted for their function in plant cells.

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**(3)**

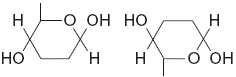
**(Total 7 marks)**

**Q31.**(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.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Substance** | | | |
|  | **Statement** | 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.

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**(2)**

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

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**(1)**

**(Total 9 marks)**

**Q32.**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 diagnosed 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 discomfort 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.

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**(1)**

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

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**(1)**

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

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**(2)**

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

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2 .....................................................................................................................

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**(2)**

**(Total 6 marks)**

**Q33.**(a)    The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Statement** | **Starch** | **Cellulose** | **Glycogen** |
|  | Found in plant cells |  |  |  |
|  | Contains glycosidic bonds |  |  |  |
|  | Contains β-glucose |  |  |  |

**(3)**

(b)     Name the type of reaction that would break down these carbohydrates into their monomers.

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**(1)**

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

Feature...........................................................................................................

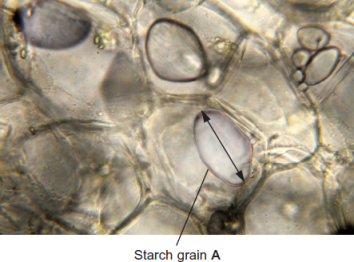
Explanation.....................................................................................................

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**(2)**

(d)     The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 μm. Use this information and the arrow line to calculate the magnification of the picture. Show your working.

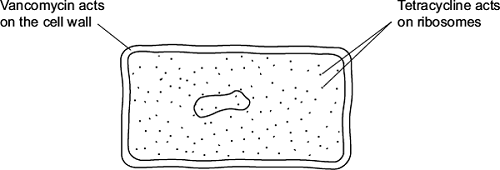
  
                                                                               © iStock/Thinkstock

Magnification ...................................... times

**(2)**

**(Total 8 marks)**

**Q34.**The diagram shows the structure of a bacterium and the sites of action of two antibiotics.



(a)     (i)      Use information in the diagram to explain why vancomycin does **not** affect human cells.

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**(1)**

(ii)     Use information in the diagram to explain how tetracycline prevents bacterial growth.

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**(1)**

(b)     Frequent treatment with vancomycin can result in resistant strains of bacteria. Explain how.

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**(2)**

**(Total 4 marks)**

**Q35.**(a)    Name the monosaccharides of which the following disaccharides are composed.

(i)      Sucrose

monosaccharides.....................................and.......................................

**(1)**

(ii)     Lactose

monosaccharides.....................................and.......................................

**(1)**

(b)     Amylase and maltase are involved in the digestion of starch in the small intestine.

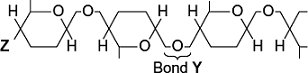
Complete the table by identifying where these enzymes are produced and the product of the reaction they catalyse.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Name of enzyme** | **Where the enzyme is produced** | **Product of the reaction catalysed by the enzyme** |
|  | Amylase |  |  |
|  | Maltase |  |  |

**(2)**

**(Total 4 marks)**

**Q36.**          The diagram shows one end of a cellulose molecule.



(a)     (i)      Name the monomers that form a cellulose molecule.

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**(1)**

(ii)     Name bond **Y**.

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**(1)**

(iii)    What chemical group is at position **Z**?

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**(1)**

b)     (i)      Complete the table to show **two** ways in which the structure of cellulose is different from the structure of starch.

|  |  |  |
| --- | --- | --- |
|  | **Starch** | **Cellulose** |
|  |  |  |
|  |  |  |

**(2)**

(ii)     Explain **one** way in which the structure of cellulose is linked to its function.

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**(2)**

**(Total 7 marks)**

**Q37.**(a)    Describe how you would test a sample of food for the presence of starch.

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**(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.

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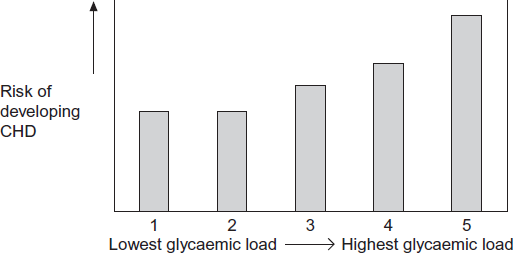
**(3)**

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.



Diet group

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

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**(1)**

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

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**(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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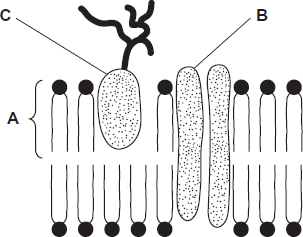
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**(2)**

**(Total 9 marks)**

**Q38.**The diagram shows the structure of the cell-surface membrane of a cell.



(a)     Name **A** and **B.**

**A**.....................................................................................................................

**B**.....................................................................................................................

**(2)**

(b)     (i)      **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

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**(1)**

(ii)     Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle...............................................................................................

Description of role..................................................................................

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**(2)**

**(Total 5 marks)**

**Q39.**(a)     In humans, the enzyme maltase breaks down maltose to glucose.  
This takes place at normal body temperature.

Explain why maltase:

•        only breaks down maltose

•        allows this reaction to take place at normal body temperature.

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**(5)**

(b)     Scientists have investigated the effects of competitive and non-competitive inhibitors of the enzyme maltase.

Describe competitive and non-competitive inhibition of an enzyme.

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**(5)**

**(Total 10 marks)**

**Q40.**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.

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**(2)**

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

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**(1)**

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

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**(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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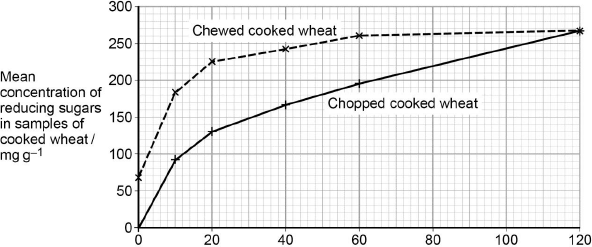
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**(2)**

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

  
                               Incubation time / minutes

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

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**(3)**

**(Total 9 marks)**

**Q41.**Many sports drinks contain water, sodium chloride and carbohydrates. The manufacturers of the sports drinks claim that carbohydrates provide an energy boost. The sodium chloride is used to increase absorption of glucose in the small intestine.

Scientists investigated the effect of a sports drink on the performance of runners in 5 km races.

They recruited 100 runners who had previously run a 5 km race in similar times. During this race, Race 1, they had water they could drink.

The scientists divided the runners into two equal groups, **P** and **Q**. Both groups ran a second 5 km race, Race 2. During this race:

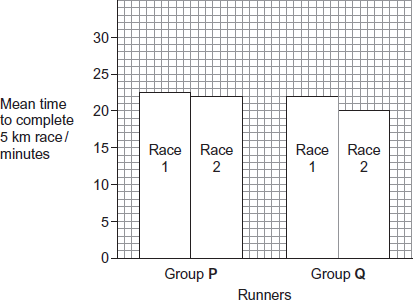
•        group **P** had water available

•        group **Q** had the sports drink available.

The scientists recorded the mean time for each group to complete this race.

**Figure 1** shows their results.

**Figure 1**

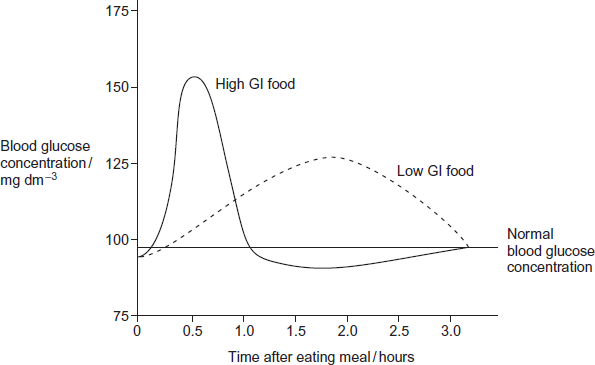


The glycaemic index (GI) is a measure of the increase in blood glucose concentration after eating a given mass of a food compared with eating the same mass of pure glucose. The GI of pure glucose has a value of 100.

The GI of a food depends on several factors such as how much starch and sugars it contains. High GI foods include those containing lots of simple sugars or white flour. The carbohydrates in these foods are rapidly digested and absorbed. Low GI foods include wholegrain bread and breakfast cereals that contain a lot of fibre. The carbohydrates in these foods are digested and absorbed more slowly.

**Figure 2** shows changes in blood glucose concentration after eating meals of high GI food and meals of low GI food.

**Figure 2**

****

Explain how a sports drink could provide an energy boost when running.

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(Extra space) ..........................................................................................................

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**(3)**

**(Total 3 marks)**

**Q42.**(a)     (i)      Give **two** ways in which the structure of starch is **similar** to cellulose.

1 ................................................................................................................

2 ................................................................................................................

**(2)**

(ii)     Give **two** ways in which the structure of starch is **different** from cellulose.

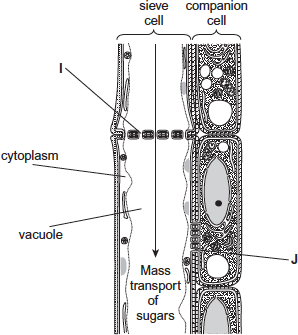
1 ................................................................................................................

2 ................................................................................................................

**(2)**

(b)     In plants, mass transport of sugars takes place through columns of sieve cells in the phloem. Other cells, called companion cells, transport sugars into, and out of, the sieve cells.

The diagram shows the structure of phloem.



Structures **I** and **J** allow the transport of sugars between cells.

(i)      Using the diagram, suggest and explain **one** other way in which sieve cells are adapted for mass transport.

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**(2)**

(ii)     Using the diagram, suggest and explain **one** other way in which companion cells are adapted for the transport of sugars between cells.

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**(2)**

**(Total 8 marks)**

**M1.**          (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]**

**M2.**          (a)     C12 ; H22O11 ;

**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]**

**M3.**          (a)     ATP

**1**

(b)     (i)      2.57:1/2.6:1/18:7;Correct answer however derived scores two marks72:28 scores one markCorrect 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]**

**M4.**          (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 hydrogen / saturated with hydrogen;

**2 max**

**[6]**

**M5.**          (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 + CuSO4;  
purple / violet / lilac / mauve;

**2**

**[7]**

**M6.**          (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]**

**M7.**          (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]**

**M8.**          (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]**

**M9.**          (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]**

**M10.**          (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]**

**M11.**          (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]**

**M12.**          (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]**

**M13.**(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 CO2);

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]**

**M14.**          (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]**

**M15.**          (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]**

**M16.**          (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)     divide by time (between measurements);

**1**

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

**2**

**[6]**

**M17.**          use of water;

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

**[2]**

**M18.**          (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]**

**M19.**(a)     Accept **three** suitable suggestions:

1.      (Lactase / beads) can be reused / not washed away;

*1. Accept lactase / beads not wasted*

*1. Less lactase used is insufficient*

2.      No need to remove from milk;

*2. Accept lactase not present in milk.*

3.      Allows continuous process;

4.      The enzyme is more stable;

5.      Avoid end-product inhibition.

*Ignore ref to SA*

**3 max**

(b)     1.      (Lactose hydrolysed to) galactose and glucose;

2.      (So) more sugar molecules;

*2. Idea of* ***more*** *sugars essential*

3.      (So) more / different receptors stimulated / sugars produced are sweeter (than lactose).

**2 max**

**[5]**

**M20.**          (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]**

**M21.**          (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]**

**M22.**(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]**

**M23.**(a)     (i)      (Lactose +) Water; → (Glucose +) Galactose;

*Accept: H2O 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]**

**M24.**(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]**

**M25.**(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]**

**M26.**          (a)     (i)      Hydrolysis;

*Accept phonetic spelling.*

*Ignore reaction.*

**1**

(ii)     (Alpha) glucose;

*Accept α glucose.*

*Reject β glucose / beta glucose*

**1**

(b)     (i)      Add Benedict’s (reagent) and heat / warm;

Red / orange / yellow / green (colour);

*Reject Add HCl*

*Accept brown, reject other colours*

**2**

(ii)     2 products / 2 sugars produced;

*Look for idea of* ***two***

*Accept named monosaccharides produced.*

*“More” insufficient for mark*

*Neutral if incorrect products named*

*Neutral “lactose is a polysaccharide”*

*Neutral “lactose is not a reducing sugar”*

*Neutral: Reference to surface area.*

**1**

(c)     1.      Galactose is a similar shape / structure to lactose / both complementary;

*Q Reject: Same shape / structure*

2.      (Inhibitor / Galactose) fits into / enters / binds with active site (of enzyme);

*Accept blocks active site*

3.      Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

*Look for principles:*

*1. Shape*

*2. Binding to active site*

*3. Consequence*

**2 max**

**[7]**

**M27.**(a)     (i)      14 / 15 – 58 / 59 or 43 – 45 (mg per 100cm3);

*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]**

**M28.**So there is no / less food in digestive system;

Which could affect the absorption of glucose;

**[2]**

**M29.**          (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]**

**M30.**(a)     1.      Starch formed from α-glucose but cellulose formed from β-glucose;

2.      Position of hydrogen and hydroxyl groups on carbon atom 1 inverted.

**2**

(b)     1.      Insoluble;

2.      Don’t affect water potential;

***OR***

3.      Helical;

*Accept form spirals*

4.      Compact;

***OR***

5.      Large molecule;

6.      Cannot leave cell.

**2**

(c)     1.      Long and straight chains;

2.      Become linked together by many hydrogen bonds to form fibrils;

3.      Provide strength (to cell wall).

**3**

**[7]**

**M31.**(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]**

**M32.**(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]**

**M33.**(a)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Statement | Starch | Cellulose | Glycogen |
|  | Found in  plant cells |  |  |  |
|  | Contains glycosidic bonds |  |  |  |
|  | Contains β-glucose |  |  |  |

*One mark for each correct row*

**3**

(b)     Hydrolysis;

*Accept: if phonetically correct*

*Do not accept: ‘hydration’*

**1**

(c)     1.      Coiled / helical / spiral;

*Feature = one mark*

*Explanation = one mark*

*Note: these are independent marking points*

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

2.      (So) compact / tightly packed / can fit (lots) into a small space;

3.      Insoluble;

4.      (So) no osmotic effect / does not leave cell / does not affect water potential;

*Accept: prevents osmosis*

5.      Large molecule / long chain;

6.      (So) does not leave cell / contains large number of glucose units;

*4. and 6. Accept: can’ t cross membranes*

7.     Branched chains;

8.     (So) easy to remove glucose;

**2 max**

(d)     Two marks for correct answer of 479 - 521;

*Accept: measured and actual lengths in different but correct units for 1 mark*

One mark for incorrect answers in which candidate clearly divides measured length by actual length;

*The actual range is 23 - 25mm, If they just divide this by 48 they gain 1 mark*

*Just writing the formula is insufficient, numbers must be used*

**2**

**[8]**

**M34.**(a)     (i)      (Human cells) don't have a cell wall;

*Accept "they" refers to human cells.*

**1**

(ii)     (Affects) protein synthesis;

*Allow description e.g. 'amino acids not joined together / translation.*

*Reject: affects transcription.*

**1**

(b)     1.      Mutation present / occurs;

*Ignore antibiotic causes mutation.*

2.      Resistance gene / allele;

*1. or 2.*

*Reference to immunity disqualifies first credited marking point.*

3.      Resistant bacteria (survive and) reproduce;

*Reference to mitosis negates marking point 3.*

**2**

**[4]**

**M35.**(a)     (i)      Glucose and fructose;

*Ignore reference to alpha and beta*

*Either way around*

**1**

(ii)     Glucose and galactose;

*Ignore reference to alpha and beta*

*Either way around*

**1**

(b)     1.      (Amylase) pancreas, produces maltose;

*Place and product = 1 mark*

*(mark horizontally)*

2.      (Maltase) in / on epithelium (of small intestine), produces glucose;

*Ignore references to salivary glands or saliva*

*Accept wall / lining of small intestine*

*Ignore reference to cells alone*

*Ignore reference to ribosomes / rER*

**2**

**[4]**

**M36.**         (a)     (i)     β / Beta glucose;

*Accept b / B*

*Reject any reference to alpha /* ***α***

**1**

(ii)     Glycosidic;

*Reject references to* ***α****(1-4) glycosidic bond, but allow beta 1-4, or unspecified reference to 1-4 (1,4)*

**1**

(iii)    OH / hydroxyl / HO;

*Reject hydroxide*

*Reject OH / HO molecule*

*Ignore alcohol*

**1**

|  |  |  |
| --- | --- | --- |
| (b)     (i) | **Starch** | **Cellulose** |
|  | 1. (1,4 and) 1,6     bonds / contains 1,6     bonds / branching | 1. 1,4 bonds / no 1,6     bonds /      unbranched /      straight; |
|  | 2. All glucoses /      monomers same     way up | 2. Alternate     glucoses /     monomers     upside down; |
|  | 3. Helix /     coiled / compact | 3. Straight; |
|  | 4. Alpha glucose | 4. Beta glucose; |
|  | 5. No (micro / macro)     fibrils / fibres | 5. Micro / macro     fibrils / fibres; |

*1 mark per pair of contrasts, both starch and cellulose required*

*Accept other comparable differences eg hydrogen bonds* ***within*** *starch but* ***between*** *cellulose molecules*

**2 max**

(ii)     1.      H-bonds / micro / macro fibrils / fibres;

*Reject strong hydrogen bonds*

2.      Strength / rigidity / inelasticity;

*‘Strong hydrogen bonds’ = 0 but ‘Strong hydrogen bonds give strength (to the molecule)’ = 1*

**2**

**[7]**

**M37.**(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**

**[9]**

**M38.**(a)     1.       **A**: phospholipid (layer);

*1. Reject hydrophobic / hydrophilic phospholipid*

2.      **B**: pore / channel / pump / carrier / transmembrane / intrinsic / transport protein;

*2. Ignore unqualified reference to protein*

**2**

(b)     (i)      Condensation (reaction);

**1**

(ii)     Organelle named; Function in protein production / secretion;

*Function must be for organelle named*

*Incorrect organelle = 0*

eg

1.      Golgi (apparatus);

*1. Accept smooth endoplasmic reticulum*

2.      Package / process proteins;

***OR***

3.      Rough endoplasmic reticulum / ribosomes;

*3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient*

*3. Accept folding polypeptide / protein*

4.      Make polypeptide / protein / forming peptide bonds;

***OR***

5.      Mitochondria;

6.      Release of energy / make ATP;

*6. Reject produce / make energy*

*6. Accept produce energy in the form of ATP*

***OR***

7.      Vesicles;

8.      Secretion / transport of protein;

**2**

**[5]**

**M39.**(a)     1.      Tertiary structure / 3D shape of enzyme (means);

*Accept references to active site*

2.      Active site complementary to maltose / substrate / maltose fits into active site / active site and substrate fit like a lock and key;

*Idea of shapes fitting together*

3.      Description of induced fit;

4.      Enzyme is a catalyst / lowers activation energy / energy required for reaction;

*Accept “provides alternative pathway for the reaction at a lower energy level”*

5.      By forming enzyme-substrate complex;

*Accept idea that binding stresses the bonds so more easily broken*

***Do not award point 5 simply for any reference to E-S complex***

**5**

(b)     1.      Inhibitors reduce binding of enzyme to substrate / prevent formation of ES complex;

*Max 3 if only one type of inhibition dealt with. Accept maltase and maltose as examples of enzyme and substrate (and others)*

*Only once, for either inhibitor*

**(Competitive inhibition),**

2.      Inhibitor similar shape (idea) to substrate;

3.      (Binds) in to active site (of enzyme);

*Accept allows max rate of reaction to be reached / max product will eventually be formed*

*Accept complementary to active site*

4.      (Inhibition) can be overcome by more substrate;

**(Non-competitive inhibition),**

5.      Inhibitor binds to site on enzyme other than active site;

6.      Prevents formation of active site / changes (shape of) active site;

*Accept does not allow max rate of reaction to be reached / max product will not be formed*

7.      Cannot be overcome by adding more substrate;

**5 max**

**[10]**

**M40.**(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.

**2**

(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]**

**M41.**1.      (Drink) contains carbohydrates / sugars **so** High GI / (drink) contains carbohydrates / sugars **so** raises blood glucose concentration quickly;

*Each alternative requires both aspects for credit*

*The second alternative requires a reference to speed eg ‘quickly’ or ‘immediately’*

2.      Contains salt so glucose more rapidly absorbed;

3.      Increases glucose to muscles for respiration;

4.      More / faster respiration so more / faster energy release;

*Reject reference to energy production*

*Accept more ATP produced*

**[3]**

**M42.**(a)     (i)      ***(Both)***

1.      Are polymers / polysaccharides / are made of monomers / of monosaccharides;

2.      Contain glucose / carbon, hydrogen and oxygen;

3.      Contain glycosidic bonds;

4.      Have 1−4 links;

*Neutral: references to ‘unbranched’, insoluble, formed by condensation, flexible and rigid*

*Are made of the monomer glucose = MP 1 and 2 = 2 marks*

5.      Hydrogen bonding (within structure).

*Ignore reference to H bonds between cellulose molecules*

**2 max**

(ii)     (Starch)

1.      Contains α / alpha glucose;

*Assume ‘it’ refers to starch*

*Accept: converse arguments only if linked directly to cellulose*

*Accept: forms α glycosidic bonds*

2.      Helical / coiled / compact / branched / not straight;

3.      1,6 bonds / 1,6 branching;

4.      Glucoses / monomers same way up;

5.      No H-bonds between molecules;

6.      No (micro / macro) fibres / fibrils.

**2 max**

(b)     (i)      1.      No / few organelles / very little cytoplasm / cytoplasm at  
         edge / more room / hollow / large vacuole / large space /  
         thick walls;

*Accept strong walls for thick walls*

2.      (So) easier / more flow / (thick / strong walls) resist pressure.

*Easier flow may be expressed in other ways e.g. lower resistance to flow*

**2**

(ii)     1.      Mitochondria release energy / ATP / site of respiration;

***Q*** *Reject: ‘produce energy’*

*but accept produce energy in form of ATP*

2.      For active transport / uptake against concentration gradient.

*Note: no mark is awarded for simply naming an organelle*

***OR***:

3.      Ribosomes / rough endoplasmic reticulum produce(s)  
         proteins;

*Concept of making proteins needed*

4.      (Proteins) linked to transport e.g. carrier proteins / enzymes.

**2**

**[8]**

**E1.**          (a)     The wording of the question made it clear that candidates were required to give features found in prokaryotic cells. Many of those who failed to gain credit for this very straightforward question ignored this instruction, and listed features of a eukaryotic cell which would not be found. Such answers failed to gain credit.

(b)     Among those candidates who clearly knew which test should be used, some identified the reagent as ‘potassium iodide’ while others limited their responses to ‘iodine test’. Credit was withheld in both these cases, in the first instance for the use of an incorrect reagent and in the second, for an inadequate answer. The instruction ‘Describe’ should have indicated that rather more was required. The most frequent error in part (ii) was to identify the polysaccharide concerned as protein, although there were also numerous references to glycogen.

(c)     Most candidates were able to give both a relevant aspect of starch molecules and a consequence of the feature described, and thus gained maximum credit. Those who failed to do so, either did not add significantly to information provided in the question with answers such as ‘It is insoluble, so can be stored’ or concentrated on aspects of glucose which were linked to its function as a respiratory substrate, clearly an inappropriate approach to this question.

**E2.**          (a)     Most candidates gained the idea of C12, but not the condensation of the two sugars involving the loss of the water molecule, C12H24O12 was therefore a common answer.

(b)     The Benedict’s test was well rehearsed, although heating was sometimes either omitted or just implied by use of a waterbath. Weaker candidates included the use of a hydrolysing agent as an initial stage in the test. The results of A and B were described by the better candidates in terms of amount of visible precipitate, but very few then attempted to explain the result.

**E3.**          In (a), nearly everyone knew ATP was the energy source, although a few did suggest glucose and one or two, rather disappointingly, suggested oxygen. In (b)(i), a surprising number of candidates were unaware of what is meant by a ratio and gave an answer based on percentage. Although some tolerance was allowed in reading the figures from the graph, too many were simply not careful enough in carrying out this task. Part (b)(ii) was a good discriminator. A good number noticed that fat usage was greatest at low intensity exercise and also after longer durations, but failed to put the two together to suggest low intensity, long- lasting exercise.

**E4.**          (a)     The vast majority of candidates gained the mark, with only a few confusing hydrolysis with condensation.

(b)     Most candidates scored full marks, the most common error occurring in (ii) where the substrate of amylase was identified as protein.

(c)     The difference between the types of fatty acids was well understood in terms of double bonds but very few candidates then went on to mention the location of the bonds or describe saturation with reference to hydrogen. Weaker candidates identified the bonds involved as hydrogen and therefore failed to obtain any marks.

**E5.**          (a)     (i)      This question was well answered. Glucose was the commonest incorrect response.

(ii)     A significant number of candidates failed to gain the mark on this question. The most frequent error was to change the glycosidic bond to an H group instead of an OH group. A number failed to use the information in the diagram, drawing a glucose molecule or six-carbon ring. Inaccurate drawing was also a cause of candidates failing to gain the mark.

(b)     Condensation was the most common mistake, but most candidates correctly stated hydrolysis. Hydrolysation was occasionally given.

(c)     The responses to this question were surprisingly varied. Many candidates were either unfamiliar with reducing and non-reducing sugars and their respective tests, or misunderstood the action of the enzyme. Many gained a mark for the correct colour change but gave muddled accounts incorrectly describing the use of hydrochloric acid or omitting heat. Many candidates gave the Biuret test or stated the correct reagents. Answers suggesting the mixture should be heated were not penalised. The correct colour was usually given. The weakest candidates confused the two tests, and in some cases the test for starch was given.

**E6.**          It was pleasing to find a higher proportion of candidates performing well on this question than had been anticipated, and a considerable number gained at least 6 or 7 marks. In particular, an encouraging number managed to get to grips with part (c), although often the weakest candidates made no attempt.

(a)     Most candidates answered both parts well.

(b)     (i)      The majority gained a mark, but a significant number merely stated that caffeine improved performance without describing how. Some recited all the results from the table, including the glycerol and fatty acid concentrations, and were disqualified from the mark.

(ii)     A good proportion recognised that the glycerol and fatty acids would have been derived from the breakdown of fats, for which they gained credit. Very few appreciated that the fats would be likely to have come from fat stores in the body rather than from, for example, the caffeine. A number proposed explanations in terms of more fats or fatty acids being ‘needed’ in order to be able to exercise for longer.

(c)     (i)      Many realised that the equation showed that the volume of oxygen absorbed was the same as the volume of carbon dioxide given out. Not all went on to explain how this ratio gave an RQ value of 1.0. It was encouraging, however, to see that many candidates explained their answer in terms of moles. Inevitably, a proportion of candidates ignored the equation altogether and suggested, for example, that a value of 1.0 was chosen because glucose is what is normally used in respiration.

(ii)     Many of the better candidates provided good explanations, citing the evidence that the RQ being closer to 0.7 when caffeine was taken, showed that fatty acids were being respired. Fewer actually pointed out that glycogen would be broken down to glucose, and that an RQ closer to 1.0 would suggest that the glycogen stores would be used more rapidly. Credit was awarded for those who pointed out that the longer time to exhaustion would in itself suggest that glycogen stores were being used more slowly. Weaker candidates often ignored reference to the data and tried to offer explanations based on time spent on anaerobic respiration, or the overall rate of respiration being slower after drinking coffee. Many confused glycerol and glycogen, or assumed they were the same substance.

**E7.**          (a)     This was answered well by the majority of candidates, with many scoring full marks. Part (i) was answered better than (ii), as a significant number identified **B** as the cytoplasm, even though they correctly gave its role in photosynthesis.

(b)     Many candidates identified the main substance in **C** as starch. Although some candidates mentioned glucose as the substrate, only a minority explained how starch was formed from the glucose. There was a wide range of incorrect answers including chlorophyll, water and protein.

**E8.**          (a)     This was a well answered question with a significant number achieving full marks.

Most candidates gained one mark by recognising that the fall in intensity was the result of the breakdown of starch. A frequent omission, which lost a mark, was a failure to give the reaction of the starch with iodine as the reason for the colour change.

(b)     The curves were generally well drawn with candidates achieving both marks. Marks were lost by careless drawing of the origin which should start at the same point on the *y* axis as the existing line. Another error was to draw the pH line to meet the original after 16 minutes. A minority of candidates seemed to misunderstand the graph, drawing and labelling the pH 2 line below the original line and the 35° C line above it, but then correctly explained the effect of these changes in part (c).

(c)     This was a very well-answered question with candidates well prepared and able to make the main points, particularly in part (i). Thorough answers were often produced in part (ii) but there were more candidates unable to explain fully the effect of pH. There was less understanding of how a decrease in pH, resulting in an increase in *Yt* ions, affects the shape of the active site. A number of candidates, having given very good explanations, omitted to state the effect on the rate of activity which lost a mark if insufficient of the other marking points had been gained.

**E9.**          (a)     There was evidence of some confusion concerning the drawing of the plasmid in this question. In order not to disadvantage the candidates, any reasonable structure was accepted. The most common answers were ribosomes and plasmid for **D**. Not many candidates knew capsule for **E**. Common incorrect answers were ‘cell wall’ and ‘membrane’.

(b)     Most candidates could give a function for the cell wall, but some gave vague statements such as ‘keeping the structure’.

(c)     Many candidates realised that starch had been digested, but few could name amylase as the specific enzyme. Many gave a credible explanation for the piece of fungus not having a clear area; the most common answer was that the fungus had died or was unable to secrete an enzyme to digest the starch. Answers stating the starch had not been digested were not accepted.

**E10.**          (a)     It was common to see answers that referred to galactose as the single breakdown product of ll lactose and answers of this nature did not gain credit.

(b)     Part (i) tended to be well answered by candidates though part (ii) did not elicit the desired response in many instances. Many candidates answered in terms of surface area. Some candidates realised the enzymes would pass out of the body but identified this as an example of excretion. Unfortunately these candidates often made the same error in 2 (a) (i).

(c)     The assertion that mitochondria *made* energy prevented a significant number of candidates scoring one of the marks available. Many candidates scored both the marks available.

**E11.**          (a)     Most of the candidates knew glucose as the monomer of cellulose.

(b)     Most candidates knew that the type of reaction converting cellulose to monomers was hydrolysis, but some candidates gave condensation instead.

(c)     Few candidates scored full marks in part (c) - many did not realise the significance of straight chains or were vague on the location of hydrogen bonds. Many referred to cell wall structure rather than cotton and significant numbers of candidates confused cellulose with the beta pleated sheet or helices of proteins. This question was, therefore, a good discriminator.

**E12.**          (a)     Although, in part (i), most candidates showed sufficient familiarity with the concept of a ratio to be able to calculate the answer correctly, part (ii) presented more difficulties. The few candidates who analysed the question with sufficient care and began their answers with wording along the lines of “The height to breadth ratio of an epithelial cell . . “ were usually able to obtain credit. The main problems which arose elsewhere were either a failure to make any reference to a ratio, or to answer in terms of the milk-producing cell. These approaches, coupled with confused explanation, severely limited the marks that could be awarded in many cases.

(b)     Most candidates recognised that a molecule of galactose would contain six oxygen atoms. Predictably, the most frequent incorrect answer in part (ii) was 12 and this appeared with considerable frequency.

(c)     This question required candidates to apply their knowledge of water potential to unfamiliar material. Most demonstrated that they understood the principles involved but gave the impression, yet again, of relying on their knowledge of seemingly similar, but very different, questions which had been set in the past. Those who related their answers to the vesicles usually gained full credit. Unfortunately many lost their way by attempting to describe water movement into the cell or, in some cases, the membrane.

(d)     Those candidates who avoided the obvious pitfall of describing mitochondria as “making” energy and referred to releasing energy or producing ATP were able to gain at least one mark. They were not always successful in gaining the second, however. Some of these less convincing answers were based on bland statements about the ATP or energy being “needed” by the cells. Others treated energy as a specific substance required by the baby.

(e)     There were some outstanding answers to this question and candidates from some centres demonstrated not only a good understanding of membrane structure but were able to relate this clearly to diffusion. Less able candidates showed that they understood the structure of a plasma membrane in terms of the phospholipid bilayer but were less certain of the role of proteins in diffusion, often failing to link them with facilitated diffusion.

**E13.**(a)     This was answered well with most candidates scoring the mark. Those who did not offered vague descriptions of trend, referring only to the shape of the curve. This should have been supported with data from the axes.

(b)     This was a very straightforward question and candidates scored well. The commonest error was to refer to curves levelling off without any reference to this happening at the *same* value.

(c)     There were some really good answers here with many candidates scoring the mark for respiration. Better candidates linked this idea to cells but others often confused ventilation and respiration. Statements such as glucose goes to the lungs and gets breathed out were not uncommon.

(d)     Many candidates score the first mark stating there was a clear difference between the lactose deficient group and the IBS or control group. Good candidates achieved the second marking point of there being no overlap between the standard deviations. Candidates appeared to understand that a small standard deviation indicated reliable data. However, they were often uncertain of the implications of overlapping values.

**E14.**          (a)     Imprecise expression frequently limited the marks awarded for part (i). Care clearly needed to be taken to avoid suggesting too few components, with answers such as that a polymer consisted of ‘two or more’ monomers. Those who did not make use of the term ‘monomer’ needed to indicate, in some way, the similarity of the constituents. They did not always do this. The most frequent reason for failing to gain credit for part (ii) was where candidates gave substances, such as haemoglobin and amylopectin, which were excluded by the wording of the question. Nevertheless, many candidates gave correct answers.

(b)     In part (i), most candidates recognised the importance of buffers in maintaining pH, although some associated them with temperature. Better candidates could generally develop the idea and usually gained a second mark through reference to denaturation. Unfortunately, some saw parts (ii) and (iii) as a trick and pointed out that since starch was not a protein, it would give a negative result. Others made the same error by simply failing to focus on the right component of the mixture. Perhaps more disturbing is the continued failure of so many candidates at this level to learn the relevant information relating to basic biochemical tests. There was again much confusion over test and result, apparent both here and in the answers to Question **4** (b).

**E15.**          (a)     (i)      Answers to parts of this question were not infrequently marred by lack of knowledge of the basic structure of cellulose as a polymer of β-glucose. Thus, although all that was required here was to note that both molecules were polymers, many disqualified their answers by referring to cellulose as also being a pentose.

(ii)     Limited question technique frequently restricted the credit available. Many candidates concentrated on functional rather than structural differences. As a consequence, the answer boxes were often so full that they rarely compared like with like and offered a valid comparison. Among the better, more focused, answers were some which unfortunately were a little too concise, referring to hemicellulose as a pentose and cellulose as a hexose. Questions requiring structural similarities are likely to remain a feature of BYA1. Candidates clearly need an effective strategy for answering them.

(b)     Starch and protein were correctly identified by many, but a range of incorrect responses included glycogen, phospholipid and various monosaccharides.

(c)     (i)      Answers suggested that, although candidates were clearly familiar with the term “constant mass”, they were by no means all conversant with the idea that it represented the point at which all water had been lost.

(ii)     There were many correct answers. Answers to this second part, such as “Going over 90 °C would start to boil the water so that we would be unable to calculate the water content” were frequent and suggested that candidates had failed to focus on the information provided in the second paragraph of the passage. The better candidates at whom this question was directed were generally able to point out, however, that high temperatures might lead to other substances being broken down and a consequent loss in mass.

(d)     Although most candidates were aware of the specific nature of enzyme action, they experienced varying degrees of difficulty in relating the general concepts involved to the context of this question. Those candidates who gained least credit were inclined to reword the question and offer an explanation in terms of the lignin covering. Others offered responses centred around lignin acting as an enzyme inhibitor. Better candidates clearly understood the concepts of molecular shape and fit and were able to apply them to this situation.

(e)     Answers to this part of the question ranged from those of the more able candidates who wrote clearly and logically about cellulose structure and function, often with a pleasing level of accuracy and detail, to those which did not gain credit. Among the latter were many who failed to attempt this part of the question and others who confused cellulose with other molecular components of plant cells such as starch and plasma membranes. There was much confusion between hydrogen bonds and glycosidic bonds, and between α-glucose and β-pleated sheets.

Other incorrect assertions which frequently arose were that cellulose is formed from alternating α- and β-glucose residues, and that it contains both 1-4 and 1-6 linkages. Many candidates correctly identified strength as one of the molecule’s properties and went further in discussing the importance of this in withstanding pressures resulting from osmosis. A frequent error, however, was to assign the function of energy storage to cellulose.

**E16.**          This question targeted grade E and most candidates revealed a sound knowledge of the principles and skills tested here.

(a)     The presence of a nucleus was usually correctly identified as being a eukaryotic feature, although there were occasional inappropriate references to cell walls.

(b)     (i)      The majority of candidates measured hypha length to an acceptable level of accuracy although errors of a centimetre or more were surprisingly frequent. Most completed the necessary subtraction to arrive at a value for growth but problems were frequently encountered with the use of the scale bar and conversion to micrometres.

(ii)     Candidates were expected to provide a method of calculation but a significant number, although identifying the key variables of growth and time, could not supply the necessary idea of growth divided by time.

(c)     It was expected that candidates would draw on their knowledge of the biochemical test for starch in their responses. While most were successful, many answers made no attempt to link this to the context of the question and wrote generally about “doing the iodine test” on “the food” or on “the solution”. There was occasional confusion with Benedict’s test and the biuret reaction. Some referred incorrectly to the reagent as potassium iodide and a few were rather more concerned about representing their findings than testing for starch.

**E17.**Many candidates copied the orientation of the two hexoses and gained one mark for the correct monosaccharides. However, several candidates inverted the second hexose and then failed to copy it correctly. It was more common to see water as a product rather than a reactant, although few candidates included this at all. A small but significant number of responses showed water being removed with the direct linking of carbons one and four.

**E18.**          (a)     Most candidates were able to identify glucose as one of the monomers from which a molecule of sucrose was formed, but there was less certainty about the other. Part (ii) was designed to be accessible to grade E candidates and, in view of this, it was disappointing to see so few gaining full credit. There were a number of predictable errors such as in describing the active site as being on the substrate, and in maintaining that active site and substrate were the same shape. Credit was generally lost however because of a lack of precision in the answers. There were many general references to specificity that were simply worded in terms of sucrose and lactose not being ‘specific to each other’ or enzymes being specific to a particular substrate. Good answers amplified the concepts of shape and fit with appropriate reference to complementarity and the active site of the enzyme.

(b)     It is encouraging to note that most candidates were able to describe the data in the graph with appropriate precision and gained full credit for their answers to part (i). There were, however, candidates who failed to distinguish between the terms ‘describe’ and ‘explain’ and offered inappropriate responses both here and in part (ii). In part (ii), better candidates generally identified the role of absorption in raising the glucose concentration and respiration or storage resulting in the fall after 45 minutes. Difficulties arose where candidates referred imprecisely to sugar, and there were many answers where the examiners were left unclear as to whether glucose or sucrose was being discussed. It was also apparent that many candidates considered the graph to be showing some aspect of enzyme activity and responded in terms of the effect of a particular parameter on substrate or product concentration.

**E19.**(a)     The question required students to apply their knowledge to an unfamiliar context and so learned responses about enzymes did not score well. Many students incorrectly suggested that the beads increased the surface area of the lactase - they did not think of the comparison in terms of adding a solution of the enzyme directly to the milk. However many students gained two marks, usually for stating that the enzyme remained on the beads and could be re-used and also that the enzyme did not have to be removed from the milk.

(b)     This question discriminated well and over half the students scored both marks. Many students could name the two monosaccharides produced when lactose is hydrolysed but it was surprising how many thought that lactose was a polysaccharide. Some students failed to gain the second marking point as they went no further than repeating the question stem in their answer.

**E20.**          (a)     In defining a tissue, care needs to be taken to produce a definition that excludes organs and other levels of organisation. Thus, it is essential to refer to the cells involved being similar or with a common origin. To say that a tissue consists of cells that carry out a particular function lacks the necessary precision.

(b)     In part (a)(i), most candidates appeared to appreciate that iodine solution could be used to locate starch but often failed to note the specific requirement of the question. There was a tendency to describe the test concerned without heeding the need to find out where in the cells the starch was present. On occasions, candidates failed to note that this question was directed towards what a student should do, and there were a number of inappropriate answers involving electron microscopes and ultracentrifugation. Most of the answers to part (b) (ii) identified the need to produce a section through which light could pass but seldom developed the arguments further to embrace the points made in the mark scheme. Some of the less able candidates confused optical and electron microscopes.

(c)     Although most candidates produced sound answers to part (c), some occasionally went far beyond the two differences required in the question. They should be aware that this approach is not without its drawbacks. Examiners cannot be expected to select correct answers from a mixture of correct and incorrect responses. In order to be fair to all, once the required number of responses has been exceeded, correct answers are disqualified by those that are clearly wrong. ***Guidance for Teachers Marking ISAs*** on the AQA Website has useful information about the application and interpretation of mark schemes.

**E21.**          (a)     This question proved to be an effective discriminator with only a third of candidates obtaining maximum marks. Most candidates gained at least one mark often for stating that glucose has a complementary shape to the enzyme in the biosensor. Although many candidates did gain a second mark for referring to the active site a significant number did not and often suggested that an active site is present on the substrate.  
There were, however, some excellent explanations of the way in which enzymes work including references to their tertiary structure and the formation of enzyme substrate complexes.

(b)     The majority of candidates gained at least one mark often by stating that the Benedict’s test only provides a colour or does not measure the concentration of blood glucose. Another common correct response was that the Benedict’s test detects not only glucose but all reducing sugars. However, a number of candidates incorrectly stated that the Benedict’s test detects all sugars. A few candidates indicated that the red colour produced during a positive Benedict’s test would be masked by the colour of the blood. Responses which simply referred to the biosensor being more accurate or quicker without any further details were not credited.

(c)     (i)      Most candidates obtained this mark by suggesting that insulin would be digested or broken down by enzymes. A few candidates did suggest that it may be too large to be absorbed or that it could be denatured by acid in the stomach.  
Candidates who failed to gain the mark often suggested that it would be broken down by amylase.

(ii)     This was very well answered. Almost every candidate obtained at least one mark often by indicating that the study had not been carried out on humans.  
Many candidates then linked this to unknown long term or side effects to gain a second marking point. It was also pleasing to note the number of responses which displayed an understanding of ‘How Science works’ including references to the vested interests of scientists, unknown sample size and the need for further or repeat studies.

**E22.**(a)     This question proved to be an effective discriminator. Most candidates gained at least one mark by mentioning the enzyme amylase. Many of these candidates gained a second mark for naming maltose as the product of the action of amylase on starch.  
However, it was not uncommon to see starch being broken down directly into glucose by amylase. There were also a significant number of answers which included irrelevant references to bile, lipase and a range of proteases. A few candidates confused maltose and maltase but others had little difficulty in quickly accumulating maximum marks by describing the hydrolytic action of maltase in breaking maltose down into glucose.  
Fortunately, the mark scheme did not penalise candidates for incorrect sites of enzyme production or incorrect sites of digestion. The action of enzymes on glycosidic bonds was infrequently mentioned by candidates. Almost twenty percent of candidates obtained maximum marks often displaying impressive use of terminology and understanding of this topic.

(b)     This proved to be much more demanding that part (a) with a much lower mean mark being obtained. A number of candidates simply repeated their answer to part (a) or provided details on the digestion of other carbohydrates such as lactose and sucrose.  
There were also a number of blank or very brief answers. The most accessible marking points related to the movement of glucose from the epithelial cells into the blood by (facilitated) diffusion. The process by which glucose entered the epithelial cells was less well understood. Many candidates had some idea that sodium ions are involved but it was not always clear where they were moving to or from. The role of active transport caused similar confusion for a number of candidates and there were also some references to osmosis. However, despite this there were some outstanding responses demonstrating a thorough understanding of co-transport.

**E23.**(a)     (i)      It was disappointing that only one third of candidates scored full marks on this question, given that it was targeted at grade E and involved straightforward recall. However, most candidates gained at least one mark for correctly naming water as the reactant or galactose as the product. A common incorrect response for the missing reactant was ‘lactase’, despite this being given in the stem of the question. There was a wide variety of suggestions for the missing product. These included water, fructose, maltose and sucrose.

(ii)     Over 70% of candidates correctly named the reaction as hydrolysis. The most common incorrect responses seen were ‘digestion’ and ‘condensation’.

(b)     There was widespread failure to read the stem of each question part, which resulted in only a minority of candidates gaining full credit. It was also clear that many candidates had failed to distinguish between the terms ‘describe’ and ‘explain’ for part (i) and (ii) respectively.

(i)      There were numerous references to the Benedict’s test for reducing sugars and, to a lesser extent, iodine solution and universal indicator. It was also clear from the colour changes given that many candidates were not familiar with basic food tests. Candidates who did refer to the biuret test often limited their answer to describing the method and naming the reagents involved. For those who did mention a purple colour, it was not often clear if they were referring to lactose or lactase.

(ii)     Many candidates gave the answer to (b)(i) here but failed to explain why this result would be achieved.

**E24.**(a)     Many centres gave credit to descriptions which only indicated that the omega-3 concentration fell but made no reference to the rapidity of fall. Similarly credit was given to any answer which stated that the concentration reached 0.4% at 140 days, even if there was no mention of the concentration levelling out.

(b)     (i)      The calculation was carried out correctly by many, and two marks were scored. A large number gained one mark for correctly identifying a fall of 1.7.

(ii)     It was rare to see more than one mark awarded. This was almost universally for the idea of being able to make comparisons between the cattle or milk. Often any reference to a comparison was awarded credit.

(iii)    A large majority of candidates recognised that the graph showed the omega-3 concentration decreasing with time. A variety of suggestions was offered to account for the decrease, but few suggested that the concentration might have fallen anyway.

**E25.**(a)     This question was well answered with most candidates making the required connection.

(b)     This question was not well answered. The commonest response was that it is not possible to generalise from rats to humans. Only the very best candidates grasped the concept of overlapping standard deviation. Although the concept of standard deviation was understood, only the best candidates were clear about an overlap in the standard deviation suggesting an uncertain conclusion.

**E26.**          (a)     (i)      Most candidates correctly named the type of reaction as hydrolysis.

(ii)     Most candidates correctly named glucose.

(b)     (i)      Most candidates gained full marks for describing the test for reducing sugars accurately. Some did not mention the need for heat, and a few could not recall the correct test – the biuret test being the most common error. A few candidates lost credit because they described the non-reducing sugar test and hydrolysed with hydrochloric acid first.

(ii)     The majority of the candidates could explain the idea that one molecule of lactose was being hydrolysed to give two molecules of product, both of which were reducing sugars. The commonest reason for missing the mark was when students paraphrased the stem of the question, stating that the reason there was a higher concentration of reducing sugar was because there was more reducing sugar present. A surprising number of candidates gave answers relating to an increase in surface area.

(c)     Although many candidates gained full marks on this question there was a significant number who were confused about the position of the active site, placing it on the sugar rather than the enzyme. A number of candidates thought that galactose would bind to lactose rather than lactase.

**E27.**(a)     (i)      Most candidates scored this mark. Those who did not had usually misread the graph.

(ii)     Many candidates made the link that a larger person would have more blood but the second marking point, that therefore there would be a lower concentration of glucose, was less frequently seen. Candidates frequently described the glucose as being more spread out. This was not given credit. A common misconception was that diffusion distances in larger people were greater. As in question 10, candidates who referred simply to different masses, rather than to masses being high or low, did not gain credit.

(b)     Better candidates realised that there was considerable overlap between the groups and scored at least two marks. Less able candidates decided that in many cases the test was fine and ignored the overlap.

**E28.**Many generalisations were seen here with candidates using “valid” “reliable” and “fair test” interchangeably. These terms gained no credit when used without further explanation. Better candidates realised that the digestive system needed to be empty while less able candidates focused on the amount of extra glucose in the blood even though it wouldn’t have been labelled.

**E29.**          (a)     Most candidates obtained at least one mark, often for indicating that starch is insoluble or has a coiled structure. Approximately a third of candidates obtained a second mark for explaining how a particular feature of starch enables it to act as a storage substance. However, a significant minority of candidates scored zero, often by failing to provide sufficient details or by describing the structure of a protein.

(b)     (i)      Just over half the candidates correctly named part A as beta glucose. Glucose on its own as an answer was not credited. Common incorrect responses included alpha glucose, deoxyribose and amino acid.

(ii)     Most candidates correctly named bond B as glycosidic. A common incorrect response was hydrogen.

(c)     Very few candidates failed to gain at least one mark on this question. Almost a third of candidates gained all three marks. Most candidates mentioned that the cell wall provides strength and support with many also referring to the presence of hydrogen bonds. Better candidates included reference to the long, straight chains of glucose and described how microfibrils or macrofibrils are formed.

**E31.**(a)     Although this question produced an even spread of marks across the entire ability range, the overall marks were disappointing for a question largely targeted at Grade E candidates. Many appeared uncertain as to the distribution of starch and glycogen, the identity of deoxyribose as a carbohydrate or of DNA helicase as an enzyme.

(b)     Most candidates were able to gain some credit for recognising that condensation involved the elimination of a molecule of water, although there were some who apparently failed to appreciate that water molecules contained two hydrogen atoms and an oxygen atom, or that condensation involved linking the molecules shown. The better candidates selected the appropriate atoms and gained both of the available marks.

(c)     In part (i), candidates were usually able to make an appropriate reference to the role of hydrogen bonds in strengthening either cellulose or the cell wall. Many, however, were uncertain as to the location of these bonds and produced answers referring to linking the β-glucose residues. Part (ii) was usually well answered and most candidates were able to discuss the compact shape of starch molecules. There were, however, some answers incorrectly based on the idea of a large surface area to volume ratio.

**E32.**(a)     (i)      Only better candidates clearly understood the idea that some individuals did not eat the food due to discomfort from eating it in the past.

(ii)     Most candidates clearly described a positive correlation in one form or another. Candidates failing to gain this mark often provided only part of the information in the column heading C.

(iii)    Better candidates had little difficulty explaining that correlation does not mean that there is a causal relationship and that some other factor may be involved. However, many candidates only provided part of this explanation for one mark or provided answers that bore little relevance to the wording of the question.

(b)     Many candidates gained both marks in this question, often for understanding that self-diagnosis and subjectivity of ‘discomfort’ could make the data unreliable. The idea of untruthful responses was also often credited.

**E33.**Given that this question was targeted at grade **E**, it is surprising that all parts proved to be good discriminators.

(a)     Nearly half of students gained full marks. Students who did not showed a vast range of incorrect answers.

(b)     Most students correctly named the type of reaction as ‘hydrolysis’. The most common incorrect response was ‘condensation’.

(c)     Just over 60% of students gained full marks. This was usually for relating the insolubility of starch to no osmotic effect, or the coiled shape of starch to being compact. However, some students were prevented from scoring full marks due to giving a definition of ‘compact’. The response ‘compact so can fit a lot into a small space’ was frequently seen.

(d)     Nearly half of students scored full marks. A common error seen in weaker responses was to divide the actual length by the measured length. Similarly, the ability to convert between millimetres and micrometres proved to be a good discriminator.

**E34.**(a)     (i)      Over 90% of students correctly explained that vancomycin does not affect human cells as these cells do not contain a cell wall.

(ii)     Approximately two thirds of students gained this mark by outlining the role of ribosomes in protein synthesis.

(b)     This proved to be an effective discriminator. Most students obtained at least one mark often by referring to vertical gene transmission. Many students then referred to the reproduction of resistant bacteria to gain a second mark. Over a third of students gained maximum marks by explaining that a mutation leads to resistant strains or by stating that a resistant gene or allele is produced. Unfortunately, some weaker students incorrectly referred to bacteria becoming 'immune' or to bacteria reproduction by 'mitosis'.

**E35.**(a)     It was pleasing to find that the vast majority of students are familiar with the monosaccharides in sucrose and lactose.

(b)     This proved to be one of the most challenging questions on the paper. Only about ten percent of students got both marks and sixty-five percent scored zero. The question clearly asks about digestion of starch in the small intestine. Despite this, many had the salivary glands as the site of production of the amylase active in the intestine (which was ignored by the examiners). Very few had any idea where maltase is produced and answers ranged from the thyroid gland to the pancreas.

**E36.**         (a)      (i)      This was generally well known, although a significant number of students did not qualify the beta glucose. Amino acids and bases were given by a few students.

(ii)     Also generally well known, with most students gaining the mark.

(iii)    This was answered less well than the first two parts of this question. Incorrect answers included ‘hydrogen’, ‘hydroxide’ and ‘alkali’ showing students knew what should be there but not the correct term for the group.

(b)     (i)      This question was answered well. The most frequent correct responses were for identifying the glucose isomer and molecular shape. Incorrect responses gave functional comparisons, rather than structural, or failed to compare like with like.

(ii)     Quite a high proportion failed to attempt this question otherwise it was generally answered well, with a variety of explanations that showed good understanding. Incorrect references to ‘strong hydrogen bonds’ resulted in a number of students failing to gain credit.

**E37.**(a)     A surprising number of students did not do well on this question. Some muddled the names of the reactant with the name of the test, such as the biuret test for starch. Others gave an incorrect procedure, such as boiling with hydrochloric acid. Some gave the wrong colour change, such as turning brown.

(b)     This question discriminated clearly between students who had a good understanding of the biochemical nature of starch and students who had only a shaky memory of digestion from GCSE. The slower, two-step process by which starch is hydrolysed, firstly into maltose and then from maltose into glucose, was described well in better answers. Weaker answers referred to starch being insoluble, or a polysaccharide as the explanation for slower absorption.

(c)     Almost all students gained this mark.

(d)     (i)       Almost all students gave a simple description of correlation, which was not true for groups 1 and 2, so did not gain the mark. This was another instance where students did not look closely enough at the data before starting to formulate their answer.

(ii)     Although most students seemed to understand the idea behind this, a significant number did not write precisely enough. For example, they may have stated that risk of CHD increases as GL increases but did not specify that this was true for diet group 2 and above. Omitting to name the coronary artery as the site of atheroma development also meant that some students did not obtain mark point 3. The stem of the question stated that a diet with high GL increases the concentration of harmful lipids in the blood. Students should have realised that re-stating this would not obtain a mark and that they needed to make the link with atheroma.

**E38.**(a)     The majority of students gained both of the marks on this question, although some failed to score because they made unqualified references to protein or lipid. Although some students had learnt the term ‘integral protein’, few qualified this to show they recognised this integral protein spanned the membrane. A few answers referred to guard cells, microvilli and mitochondria, suggesting that the students had not understood the difference between the molecular structure of a membrane and the gross structure of cells or organelles.

(b)     (i)       Most students knew this term although some were clearly guessing between condensation and hydrolysis, having written both down and then crossed out one or other of the terms.

(ii)     The great majority of students gave mark points 3 and 4, with a few failing to score because they used abbreviations such as ER or RER. These abbreviations were not accepted, since students were asked to name the organelle. The full name endoplasmic reticulum is given in the specification, with no abbreviation offered as an alternative. Where Golgi was given as the organelle, the associated function was not often correctly linked to protein formation. For mark point 6 (release of energy / make ATP), references to producing or making energy were not given credit. Incorrect references to cilia, microvilli, stomach acids and lysosomes suggested that some students did not understand what was meant by the term organelle.

**E39.**Both parts of this question discriminated well but for different reasons. Part (a) tested understanding of how enzymes work and (b) tested recall of how inhibitors of enzymes work.

(a)     Many students obtained one or two marks by referring to the tertiary structure of the enzyme and/or the complementary fit; demonstrating understanding of why maltase only catalyses the reaction involving maltose. Only students with an understanding of how enzymes act as catalysts that lower activation energy obtained further marks. These students wrote about how the formation of the enzyme-substrate complex involved an induced fit. They went on to write about how this stressed bonds in the substrate molecule, making it more reactive and thus lowering the activation energy for the reaction. They also noted that the enzyme, as a catalyst, remains unchanged after the reaction. Many students appeared to be triggered by the word ‘temperature’ and wrote about why the enzyme would not work if the temperature was above or below normal body temperature; denaturing being frequently mentioned. These responses were not answering the question and did not receive any credit.

(b)     About half of students obtained all five marks in this part, displaying good recall of how competitive and non-competitive inhibitors work. It was encouraging to see that quite a few wrote about the relative effects of increasing substrate concentration on the two types of inhibition. Some students got the two types of inhibitor mixed up and failed to score one or two of the marks. Poor expression also hindered quite a few, with statements such as, “The competitive inhibitor has the *same* shape as the substrate.”, or “The non-competitive inhibitor binds to the other active site of the enzyme”.

**E41.**This question was not answered well and, in some cases, not marked well either. Students and assessors alike did not consider responses in the context of an energy *boost*. Words like ‘quickly’, ‘rapidly’, ߢmore’ or ‘respiration’ were frequently lacking. It is vital that assessors appreciate both what a question is asking and the essence of the marking points.

**E42.**(a)     This part discriminated more than was, perhaps, intended. In both (i) and (ii), many students did not read the question carefully enough and included comparisons of properties or function, rather than structure. For example, many wrote about starch and cellulose being insoluble but this is not a similarity of structure. About 40% obtained both marks in (i) and 60% in (ii).

(b)     This required students to use the figure and apply some basic concepts. As in (a), some students did not read the stem of the question carefully enough and couched their answers in terms of structures I and J.

(i)      Many students described (in various ways) the large open space in the sieve cell and some went on to suggest that this would lead to a (relatively) unrestricted flow; about 30% obtained 2 marks and 40% 1 mark.

(ii)     This was where more students failed to score because of answers based around plasmodesmata (J), which are precluded by the stem of the question. Over 40% obtained 2 marks by linking energy from mitochondria to active transport. Some students missed one mark because the examiners rejected references to mitochondria creating or making energy.