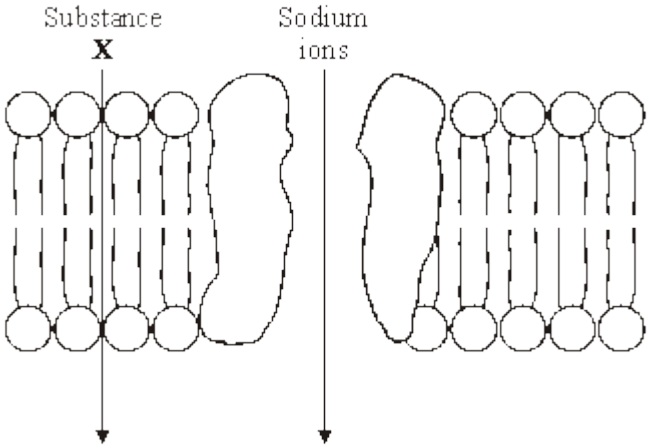
EXAM PAPERS PRACTICE

Transport across cell membranes 2

Level: OCR A Level H420
Subject: Biology
Exam Board: Suitable for all boards
Topic: Transport across cell membranes 2
Type: Questionnaire

To be used by all students preparing for OCR A Level Biology H420 foundation or higher tier but also suitable for students of other boards.

1 The diagram shows part of a plasma membrane. The arrows show the path taken by sodium ions and by substance **X** when they diffuse through the membrane into a cell.



(a) An optical microscope cannot be used to see a plasma membrane. Explain why.

_____

_____

_____

_____

(2)

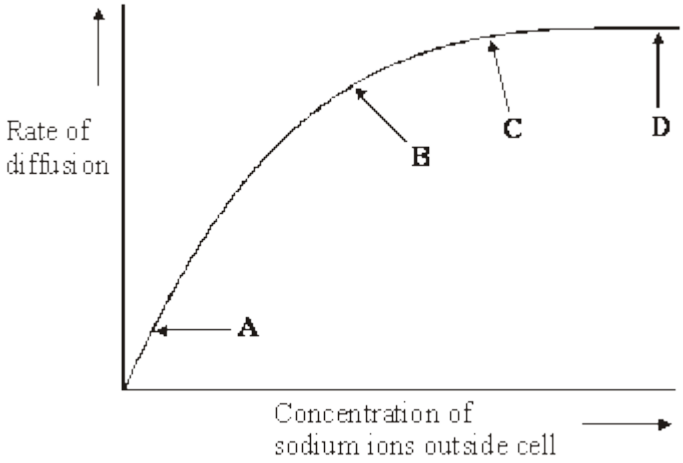
(b) Give **one** property of the molecules of substance **X** which allows them to diffuse through the membrane at the position shown.

_____

_____

(1)

(c) The effect of the concentration of sodium ions in the surrounding solution on their rate of diffusion across the membrane was investigated. The graph shows the results.



(i) What limits the diffusion of sodium ions across the membrane between **A** and **B** on the graph? Give the evidence for your answer.

Limiting factor _____

Evidence _____

_____

(2)

(ii) Explain the shape of the curve between **C** and **D**.

_____

_____

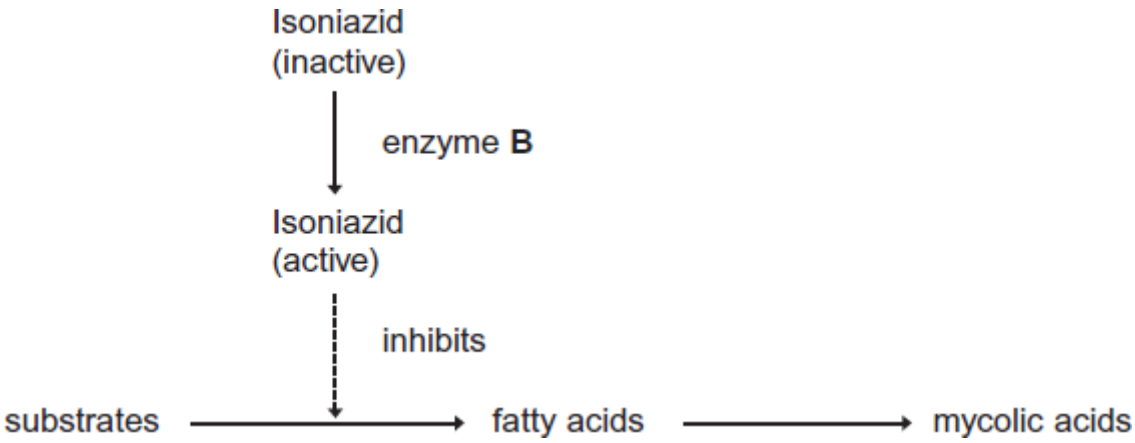
_____

_____

(2)

(Total 7 marks)

2 Mycolic acids are substances that form part of the cell wall of the bacterium that causes tuberculosis. Mycolic acids are made from fatty acids. Isoniazid is an antibioticthat is used to treat tuberculosis. The diagram shows how this antibiotic inhibits the production of mycolic acids in this bacterium.



(a) Treatment with isoniazid leads to the osmotic lysis of this bacterium. Use information in the diagram to suggest how.

(2)

(b) Human cells also produce fatty acids. Isoniazid does not affect the production of these fatty acids.

Use information in the diagram to suggest **one** reason why isoniazid does **not** affect the production of fatty acids in human cells.

(1)

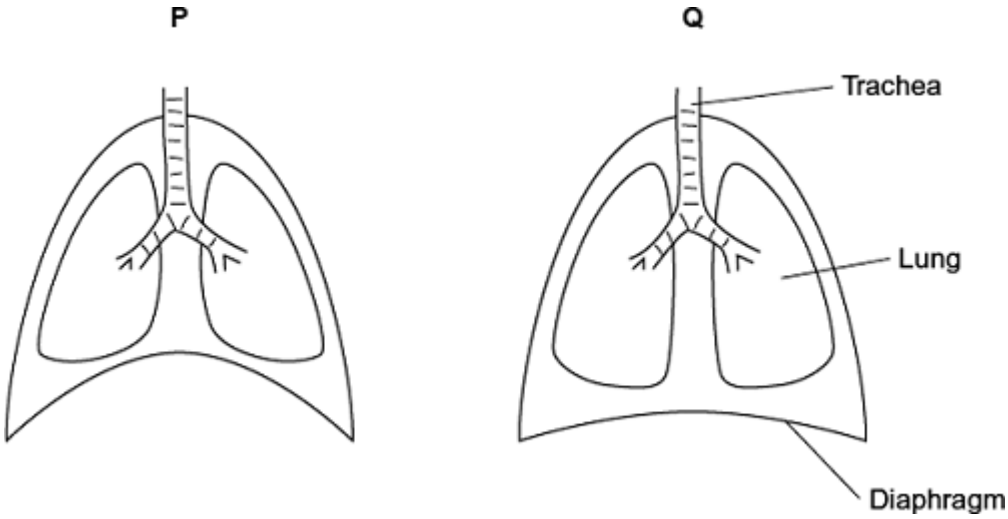
(c) A mutation in the gene coding for enzyme **B** could lead to the production of a non-functional enzyme. Explain how.

(Extra space)

(3)

(Total 6 marks)

3 The diagram shows the position of the diaphragm at times **P** and **Q**.



(a) Describe what happens to the diaphragm between times **P** and **Q** to bring about the change in its shape.

(2)

(b) Air moves into the lungs between times **P** and **Q**. Explain how the diaphragm causes this.

_____

_____

_____

_____

_____

*(Extra space)*_____

_____

_____

_____

(3)

(c) Describe how oxygen in air in the alveoli enters the blood in capillaries.

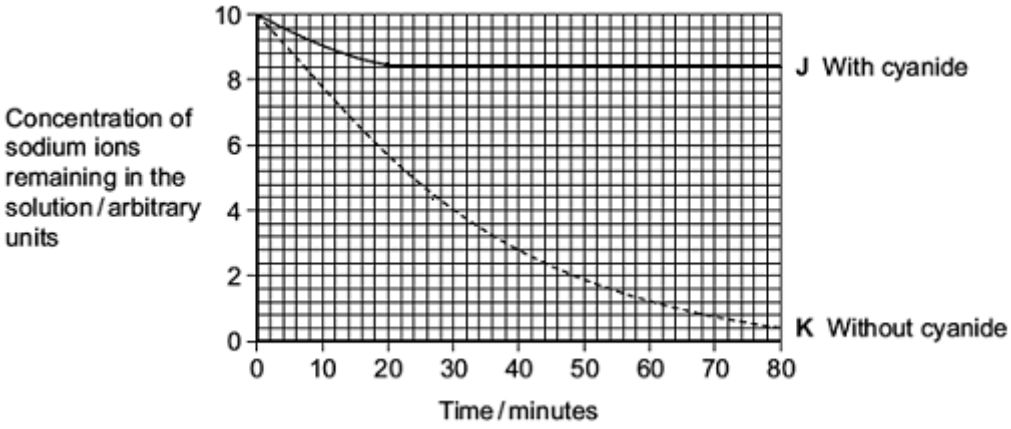
(2)

(Total 7 marks)

4 A scientist investigated the effect of cyanide on the uptake of sodium ions by animal tissue.
He set up two beakers, **J** and **K**.
He put equal volumes of a solution containing sodium ions and equal masses of an animal tissue in each beaker.

- He added cyanide to beaker **J**.
- He did not add cyanide to beaker **K**.

He measured the concentration of sodium ions remaining in the solution in each beaker, for 80 minutes. The graph shows his results.



(a) Calculate the rate of uptake of sodium ions by the tissue in beaker **K** for the first 30 minutes. Show your working.

Answer _____ arbitrary units per minute

(2)

(b) Adding cyanide affects the uptake of sodium ions by the tissue. Use the graph to describe how.

_____

_____

_____

_____

_____

(2)

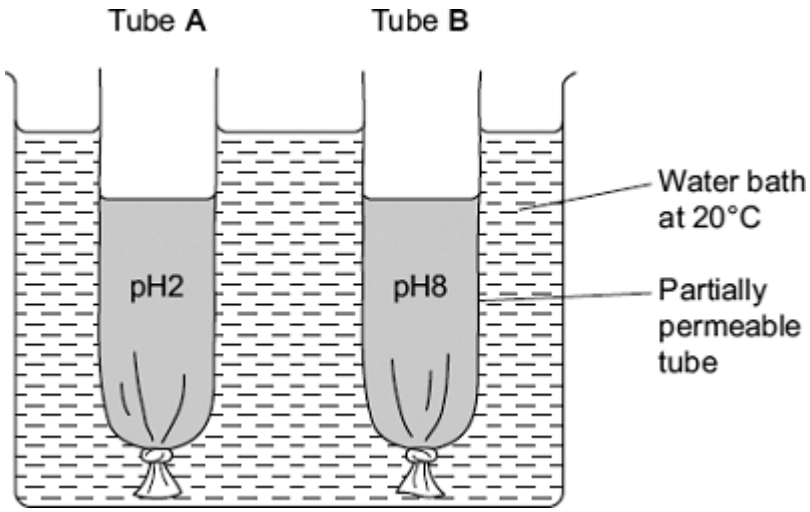
(c) Cyanide is a substance which affects respiration.
Use information in the question to explain the effect of cyanide on the uptake of sodium ions by the tissue.

(Extra space)

(3)

(Total 7 marks)

5 (a) A student investigated the effect of pH on the activity of the enzyme amylase.
She set up the apparatus shown in the diagram.



The tubes were made from Visking tubing. Visking tubing is partially permeable.
She added an equal volume of amylase solution and starch to each tube.

- She added a buffer solution at pH2 to tube **A**.
- She added an equal volume of buffer solution at pH8 to tube **B**.

After 30 minutes, she measured the height of the solutions in both tubes.
She then tested the solutions in tubes **A** and **B** for the presence of reducing sugars.

Describe how the student would show that reducing sugars were present in a solution.

_____

_____

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_____

_____

_____

*(Extra space)*_____

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_____

(3)

(b) After 30 minutes, the solution in tube **B** was higher than the solution in tube **A**.

(i) Explain why the solution in tube **B** was higher.

(Extra space)

(3)

(ii) The student concluded from her investigation that the optimum pH of amylase was pH8. Is this conclusion valid? Explain your answer

(1)

(Total 7 marks)

6 Read the following passage.

Gluten is a protein found in wheat. When gluten is digested in the small intestine, the products include peptides. Peptides are short chains of amino acids. These peptides cannot be absorbed by facilitated diffusion and leave the gut in faeces

Some people have coeliac disease. The epithelial cells of people with coeliac disease do not absorb the products of digestion very well. In these people, some of the peptides from gluten can pass between the epithelial cells lining the small intestine and enter the intestine wall. Here, the peptides cause an immune response that leads to the destruction of microvilli on the epithelial cells.

Scientists have identified a drug which might help people with coeliac disease. It reduces the movement of peptides between epithelial cells. They have carried out trials of the drug with patients with coeliac disease.

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

(a) Name the type of chemical reaction which produces amino acids from proteins.

_____

(1)

(b) The peptides released when gluten is digested cannot be absorbed by facilitated diffusion (lines 2 – 3). Suggest why.

_____

_____

_____

_____

_____

_____

*(Extra space)*_____

_____

_____

(3)

*(Extra space)*_____

_____

_____

(3)

(c) Explain why the peptides cause an immune response (lines 7 – 8).

_____

_____

_____

(1)

(d) Scientists have carried out trials of a drug to treat coeliac disease (lines 10 – 11). Suggest **two** factors that should be considered before the drug can be used on patients with the disease.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

7 Strawberries may be dehydrated by removing most of the water they contain. Dehydrated strawberries have many different uses in the food industry.

Food scientists investigated the effect of using osmosis to dehydrate strawberries.

1. The scientists weighed a sample of strawberries and then cut them into 10 mm thick slices.
2. They put the strawberry slices into a 1.2 mol dm^{-3} solution of sucrose at a temperature of 25 °C.
3. After 1 hour, they removed the slices from the sucrose solution and washed them in water. They dried the slices by blotting them and then weighed them.
4. They also measured the texture of the strawberry slices.
5. The scientists repeated steps 1 to 4, but they left the strawberry slices in the sucrose solution for different amounts of time.

The results of the investigation are shown in the table.

Length of time in sucrose solution / hours	Percentage loss in mass	Texture / arbitrary units
0	Not applicable	1.2
1	15.96	0.9
2	22.88	0.7
4	32.36	0.7
6	38.78	0.7

(a) (i) In this investigation, the scientists cut the strawberries into slices (step 1). Explain the advantage of this.

(2)

(ii) The scientists blotted the strawberry slices dry before weighing them (step 3). Explain why.

(2)

(b) In the second column of the table, the percentage loss in mass for one of the values has been recorded as not applicable. Explain why.

(1)

(c) Use the table to describe how the length of time in the sucrose solution affected the strawberries.

(Extra space)

(3)

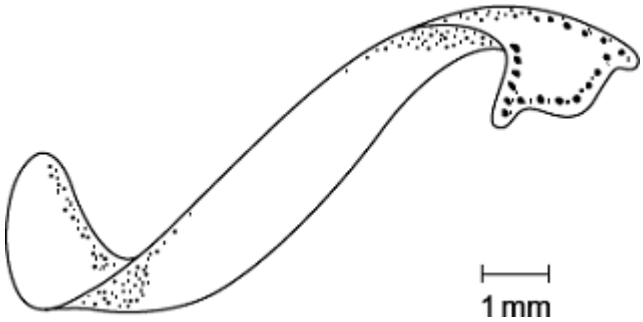
(d) You could use the data in the table to predict the time that strawberries should be left in sucrose solution to dehydrate them fully. Describe how you could use a graph to do this.

(Extra space)

(3)

(Total 11 marks)

8 (a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.
The drawing shows one type of flatworm.



(i) Name the process by which oxygen reaches the cells inside the body of this flatworm.

_____

(1)

(ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.
Using the diagram, explain how **two** features of the flatworm's body allow efficient gas exchange.

1. _____

_____

2. _____

_____

(2)

(b) (i) A leaf is an organ. What is an organ?

_____

_____

_____

(1)

(ii) Describe how carbon dioxide in the air outside a leaf reaches mesophyll cells inside the leaf.

_____

_____

_____

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_____

_____

*(Extra space)*_____

_____

_____

(3)

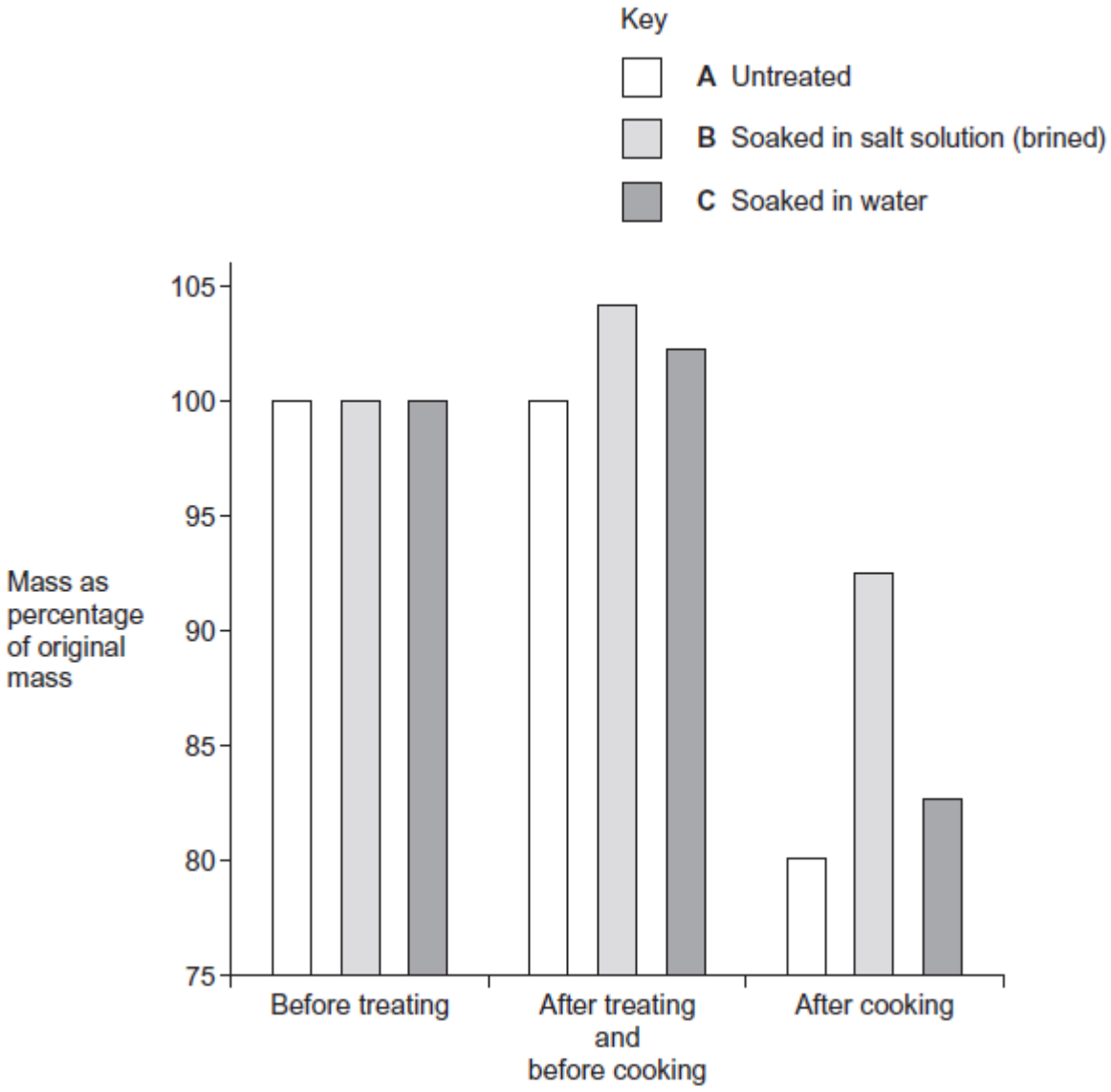
(Total 7 marks)

9 Turkey meat can dry out when it is cooked in an oven. One way to overcome this is to soak the meat in a salt solution before cooking it. This is called brining.

A food writer organised a demonstration. He treated three similar pieces of turkey in different ways.

- Piece **A** was untreated.
- Piece **B** was soaked overnight in a 6% solution of salt. A 6% solution of salt has a greater solute concentration than the cells in turkey meat.
- Piece **C** was soaked overnight in water.

He put all three pieces in an oven at 150 °C. He left each piece until it was cooked and the temperature in its centre was 65 °C. The writer weighed each piece at different stages in the demonstration. The graph shows his results.



(a) (i) Explain the advantage of using percentage change in mass in this investigation.

(2)

(ii) The pieces of turkey meat were cooked. Explain the advantage of leaving them in the oven until the temperature in the centre of each piece was 65 °C.

(2)

(iii) Recording mass is a valid way to measure the dependent variable in this investigation.
Evaluate this statement.

(2)

(b) Students suggested that osmosis resulted in cooked brined turkey meat containing more water than cooked untreated meat.

Use your knowledge of water potential and the data in the graph to explain why this suggestion could not be correct.

(2)

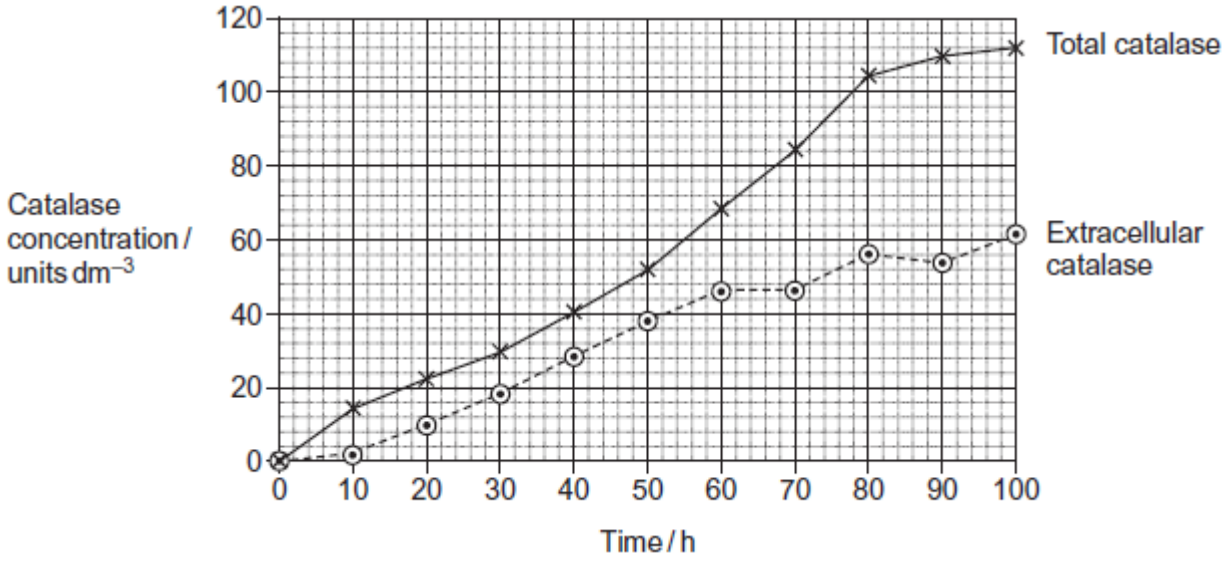
(Total 8 marks)

10 Some of the catalase produced by *Aspergillus niger* is intracellular and some is extracellular. Intracellular enzymes stay inside the cells that produce them. Extracellular enzymes are secreted from the cells that produce them.

Another group of scientists grew a different strain of *A. niger*.

- *A. niger* grows from tiny structures called spores. The scientists kept the spores in an isotonic medium at a low temperature until they needed them.
- They put spores of *A. niger* into a 500 cm^3 flask containing a sterile medium. The medium contained starch.
- They measured the total amount of catalase and the amount of extracellular catalase produced by the fungus over a period of 100 hours.

The graph shows their results.



(a) (i) The scientists kept the spores in an isotonic medium until they were needed. Suggest why it was important that the medium was isotonic.

_____

_____

_____

_____

_____

(2)

(ii) The scientists kept the spores at a low temperature until they were needed. Suggest why.

_____

_____

_____

(1)

(b) Starch is a source of carbon, hydrogen and oxygen for the fungus. Name one other chemical element that must be in the culture medium before *A. niger* can synthesise catalase. Give the reason for your answer.

Chemical element _____

Reason _____

_____

_____

_____

(2)

(c) To get reliable results in this investigation, the medium must be sterile. Explain why.

_____

_____

_____

_____

_____

(2)

(d) (i) At what time was the concentration of intracellular catalase highest?

_____

(1)

(ii) Between what times was the rate of total catalase production highest?

_____

(1)

(e) Technologists prefer to manufacture extracellular enzymes rather than intracellular enzymes. This is because intracellular enzymes are more expensive to purify than extracellular enzymes. Suggest why intracellular enzymes are more expensive to purify.

(2)

(Total 11 marks)

11 Vaccines protect people against disease. Explain how.

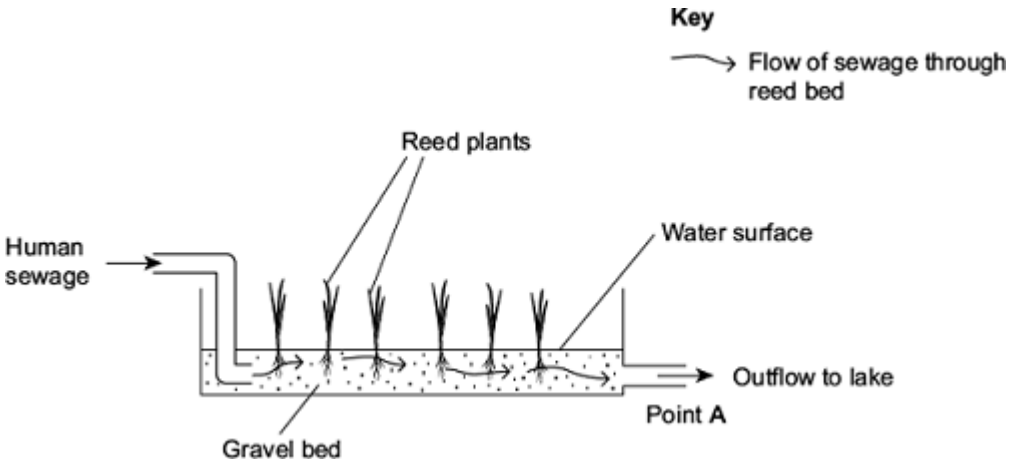
(*Extra space*)

(Total 5 marks)

12 (a) Name the process by which some bacteria oxidise ammonia to nitrate.

(1)

Reeds are plants that grow with their roots under water. A reed bed contains a large number of growing reeds. Reed beds may be used to absorb nitrates produced when bacteria break down human sewage. The diagram shows a reed bed.



(b) Reeds have hollow, air-filled tissue in their stems which supplies oxygen to their roots. Explain how this enables the roots to take up nitrogen-containing substances.

_____

_____

_____

_____

_____

(2)

(c) (i) There is an optimum rate at which human sewage should flow through the reed bed. If the flow of human sewage is too fast, the nitrate concentration at point **A** falls. Explain why.

_____

_____

_____

_____

_____

(2)

(ii) An increase in nitrate concentration in the water entering the lake could affect algae and fish in the lake. Explain how.

_____

_____

_____

_____

_____

_____

*(Extra space)*_____

_____

_____

(3)

(Total 8 marks)

13 (a) Give **two** ways in which active transport is different from facilitated diffusion.

1. _____

_____

2. _____

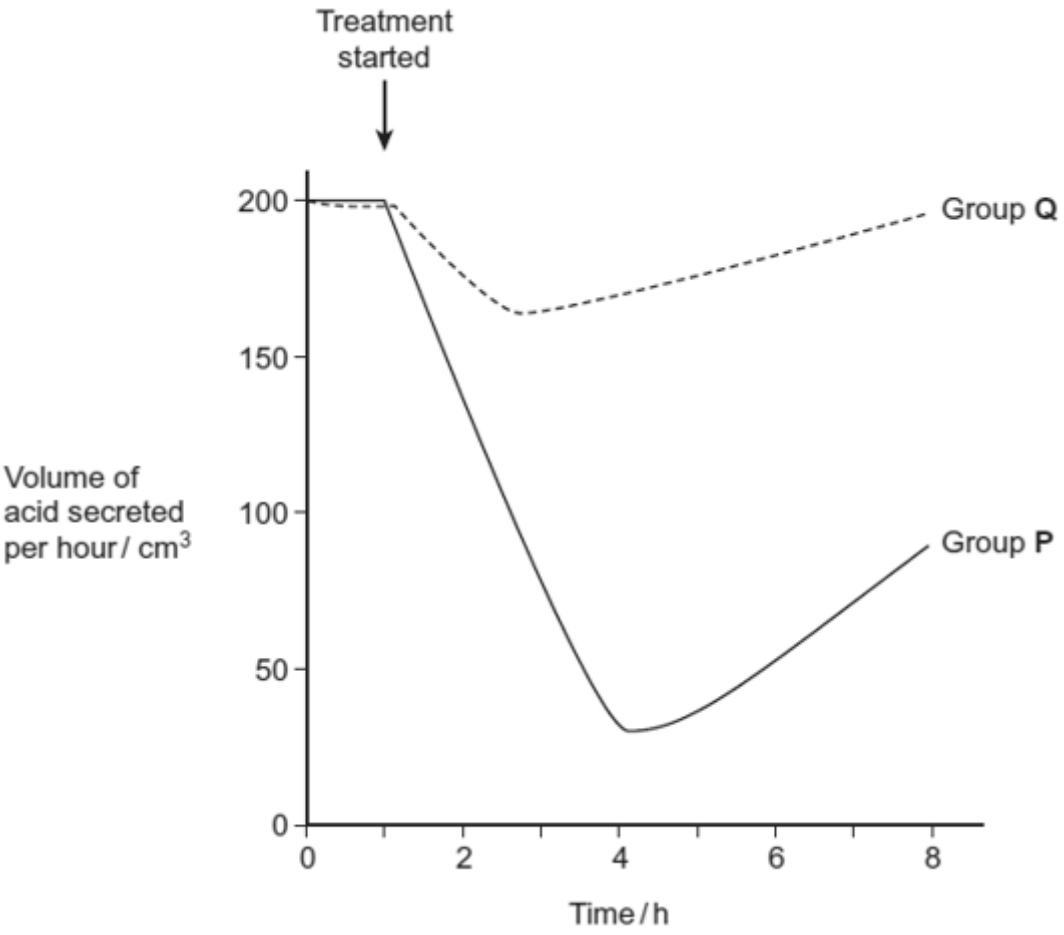
_____

(2)

Scientists investigated the effect of a drug called a proton pump inhibitor. The drug is given as a tablet to people who produce too much acid in their stomach. It binds to a carrier protein in the surface membrane of cells lining the stomach. This carrier protein usually moves hydrogen ions into the stomach by active transport.

The scientists used two groups of people in their investigation. All the people produced too much acid in their stomach. People in group **P** were given the drug. Group **Q** was the control group.

The graph shows the results.



(b) (i) The scientists used a control group in this trial. Explain why.

_____

_____

(1)

(ii) Suggest how the control group would have been treated.

_____

_____

_____

_____

(2)

(c) Describe the effect of taking the drug on acid secretion.

_____

_____

_____

(1)

(Total 6 marks)

14 The equation shows the breakdown of lactose by the enzyme lactase.

Lactose + water $\xrightarrow{\text{lactase}}$ galactose + monosaccharide **X**

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

_____

(1)

(ii) Name monosaccharide **X**.

_____

(1)

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

_____

_____

_____

_____

_____

(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.

_____

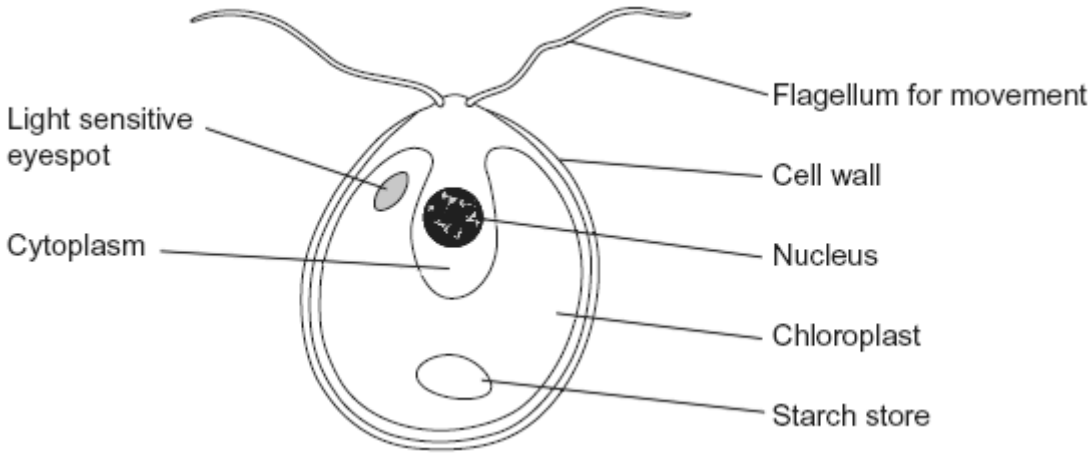
(1)

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

(2)

(Total 7 marks)

15 The diagram shows an organism called *Chlamydomonas*.



(a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1.

2.

(2)

(b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

(2)

(c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis.

Use information in the diagram to explain what these adaptations are.

(Extra space)

(3)

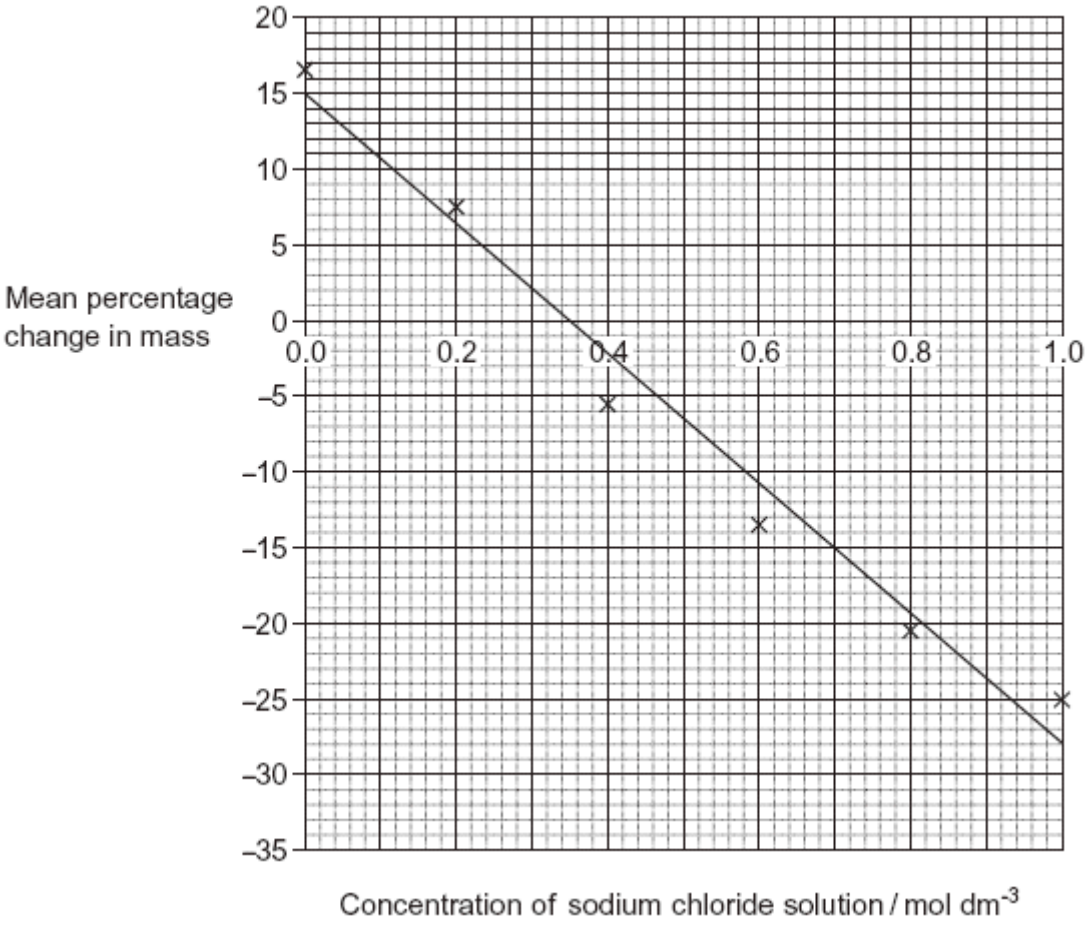
(Total 7 marks)

16 A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

(a) Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

(2)

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.



(b) The student made up all the sodium chloride solutions using a 1.0 mol dm^{-3} sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm^3 of a 0.2 mol dm^{-3} sodium chloride solution.

Volume of 1.0 mol dm^{-3} sodium chloride solution	**Volume of distilled water**

(1)

(c) The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

_____

_____

_____

_____

_____

(2)

(d) The student carried out several repeats at each concentration of sodium chloride solution. Explain why the repeats were important.

_____

_____

_____

_____

_____

(2)

(e) Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

_____ mol dm^{-3}

(1)

(Total 8 marks)

17 (a) Many different substances enter and leave a cell by crossing its cell surface membrane. Describe how substances can cross a cell surface membrane.

(5)

(b) Describe and explain how the lungs are adapted to allow rapid exchange of oxygen between air in the alveoli and blood in the capillaries around them.

(5)

(Total 10 marks)

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

Lactose + _____ ⟶ Glucose + _____

(2)

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

_____

(1)

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

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

_____

_____

(1)

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

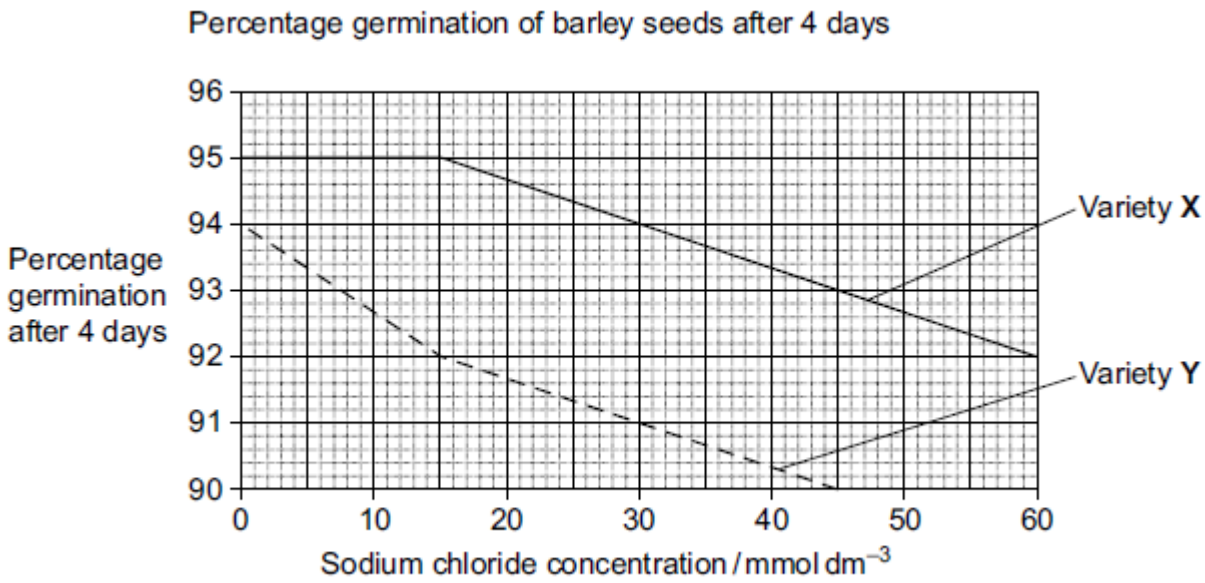
_____

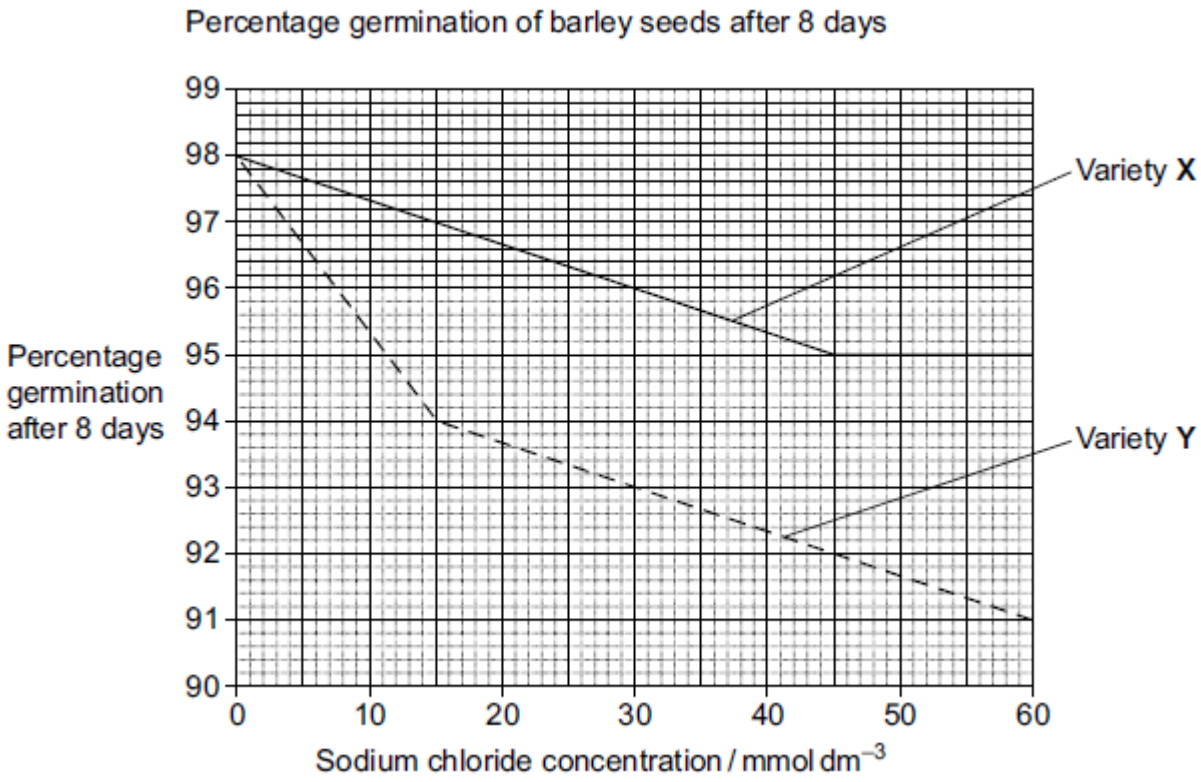
_____

(1)

(Total 5 marks)

19 Scientists investigated the effects of different concentrations of sodium chloride on the germination of the seeds of two varieties of barley. The seeds were soaked for one hour in different concentrations of sodium chloride solutions and then germinated in distilled water at 25°C. The scientists found the percentage of germinated seeds after 4 days and again after 8 days.





Describe what the data in above shows about the effect of sodium chloride concentration on germination in these two varieties of barley.

(Extra space)

(Total 3 marks)

20 Students investigated the effect of different concentrations of sodium chloride solution on discs cut from an apple. They weighed each disc and then put one disc into each of a range of sodium chloride solutions of different concentrations. They left the discs in the solutions for 24 hours and then weighed them again. Their results are shown in the table.

Concentration of sodium chloride solution / mol dm^{-3}	Mass of disc at start / g	Mass of disc at end / g	Ratio of mass at start to mass at end
0.00	16.1	17.2	0.94
0.15	19.1	20.2	0.95
0.30	24.3	23.2	1.05
0.45	20.2	18.7	1.08
0.60	23.7	21.9	
0.75	14.9	13.7	1.09

(a) (i) Calculate the ratio of the mass at the start to the mass at the end for the disc placed in the 0.60 mol dm^{-3} sodium chloride solution.

Answer _____

(1)

(ii) The students gave their results as a ratio. What is the advantage of giving the results as a ratio?

_____

_____

_____

_____

_____

(2)

(iii) The students were advised that they could improve the reliability of their results by taking additional readings at the same concentrations of sodium chloride.

Explain how.

(2)

(b) (i) The students used a graph of their results to find the sodium chloride solution with the same water potential as the apple tissue. Describe how they did this.

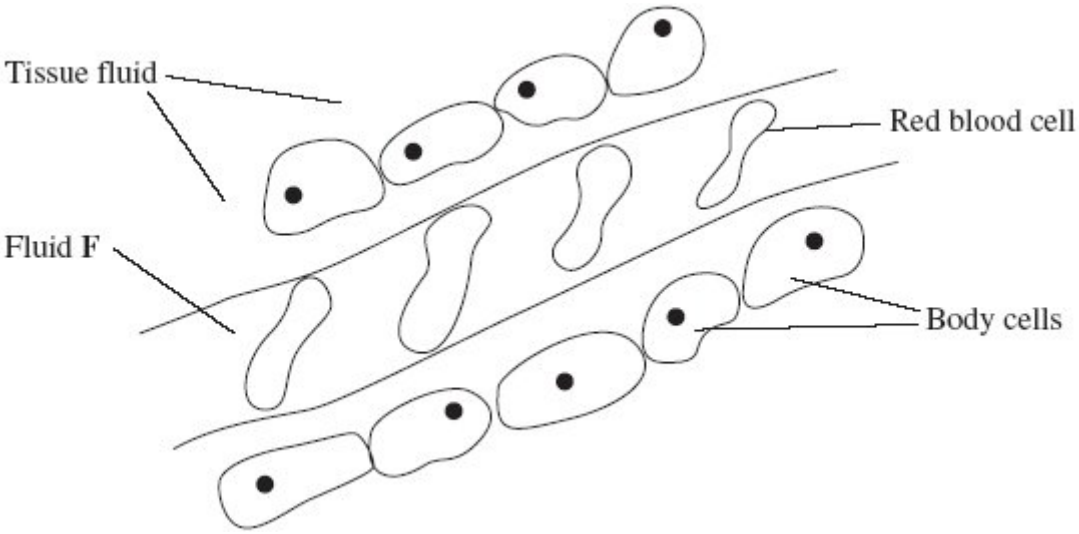
(2)

(ii) The students were advised that they could improve their graph by taking additional readings. Explain how.

(2)

(Total 9 marks)

21 The diagram shows tissue fluid and cells surrounding a capillary.



(a) Name fluid **F**.

_____

(1)

(b) Give **one** way in which fluid **F** is different from tissue fluid.

_____

(1)

(c) (i) The blood pressure is high at the start of the capillary. Explain how the left ventricle causes the blood to be at high pressure.

_____

_____

(1)

(ii) The blood pressure decreases along the length of the capillary. What causes this decrease in pressure?

_____

_____

(1)

(d) In children, some diets may result in a low concentration of protein in fluid **F**. This can cause the accumulation of tissue fluid. Explain the link between a low concentration of protein in fluid **F** and the accumulation of tissue fluid.

(3)

(Total 7 marks)

22 The effect of watering tomato plants with sodium chloride solution on the mass of tomatoes

Type of tomato plant	Watered with	Mean mass of tomatoes / g	
		fresh mass	dry mass
Normal	Distilled water	115.9	6.5
Normal	Sodium chloride solution	87.8	6.6
GM	Distilled water	101.3	6.4
GM	Sodium chloride solution	57.4	6.5

(a) What conclusions can you draw about the effects of watering plants with sodium chloride solution on the mass of tomatoes?

(2)

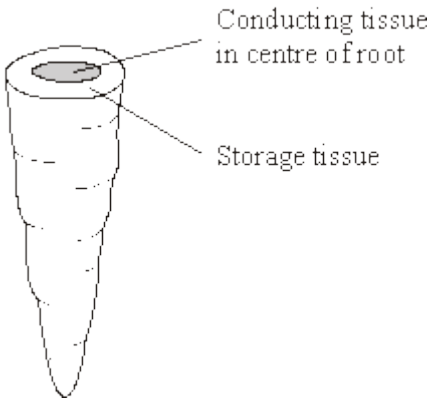
(b) Use your knowledge of water potential to suggest how watering plants with sodium chloride solution affects the fresh mass of the tomatoes.

(Extra space) _____

(3)

(Total 5 marks)

23 The diagram shows a carrot.



A group of students investigated the effect of sucrose concentration on the length of cylinders cut from a carrot.

(a) The students used a cork borer to cut cylinders from the carrot. Describe how the students should cut these cylinders to make sure that this was a fair test and would produce reliable results.

(2)

(b) They measured the initial length of each cylinder then placed the cylinders into test tubes containing different concentrations of sucrose solution. Bungs were placed in the tubes and the tubes were left overnight. Explain why the bungs were placed in the tubes.

(2)

(c) The students then measured the final lengths of the carrot cylinders. Their results are shown in the table.

Concentration of sucrose / mol dm^{-3}	$\frac{\text{Final length}}{\text{Initial length}}$
0.0	1.4
0.2	1.4
0.4	1.2
0.6	1.1
0.8	0.9

(i) The students used these results to find the concentration of sucrose that has the same water potential as the carrot cylinders. Describe how they could have done this.

(2)

(ii) Was it important in this investigation that the carrot cylinders had the same initial length? Explain your answer.

(1)

(Total 7 marks)

24 Read the following passage.

Campylobacter jejuni is a bacterium. It is one of the commonest causes of diarrhoea in humans. The illness that it causes does not usually last very long and many sufferers do not even go to the doctor. The only treatment required is the use of oral rehydration solutions to replace the water lost by diarrhoea. In 1998, laboratory tests confirmed 60 000 cases of diarrhoea caused by this bacterium in the UK. The bacterium was more frequently found in males than in females with a ratio of 1.5 : 1.

In rare cases, the nervous system may be affected. Scientists are now beginning to understand the cause of this. Sugars in the antigens on the surface of the bacteria are identical to some of the sugars on the surface of nerve cells. Antibodies produced against the bacteria may therefore attack the body's nerve cells. There can be serious problems if this leads to paralysis of the diaphragm. Breathing difficulties result and the patient may die.

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

(a) (i) The number of cases of diarrhoea confirmed as being caused by *Campylobacter jejuni* in the UK in 1998 was 60 000 (lines 4–5). Explain why the true number of cases is thought to be more than this.

_____

_____

_____

(1)

(ii) Calculate the number of cases of diarrhoea confirmed as being caused by *Campylobacter jejuni* in men in 1998.

Answer _____

(1)

(b) Explain why antibodies produced against *Campylobacter jejuni* also attack nerve cells (lines 9 –10).

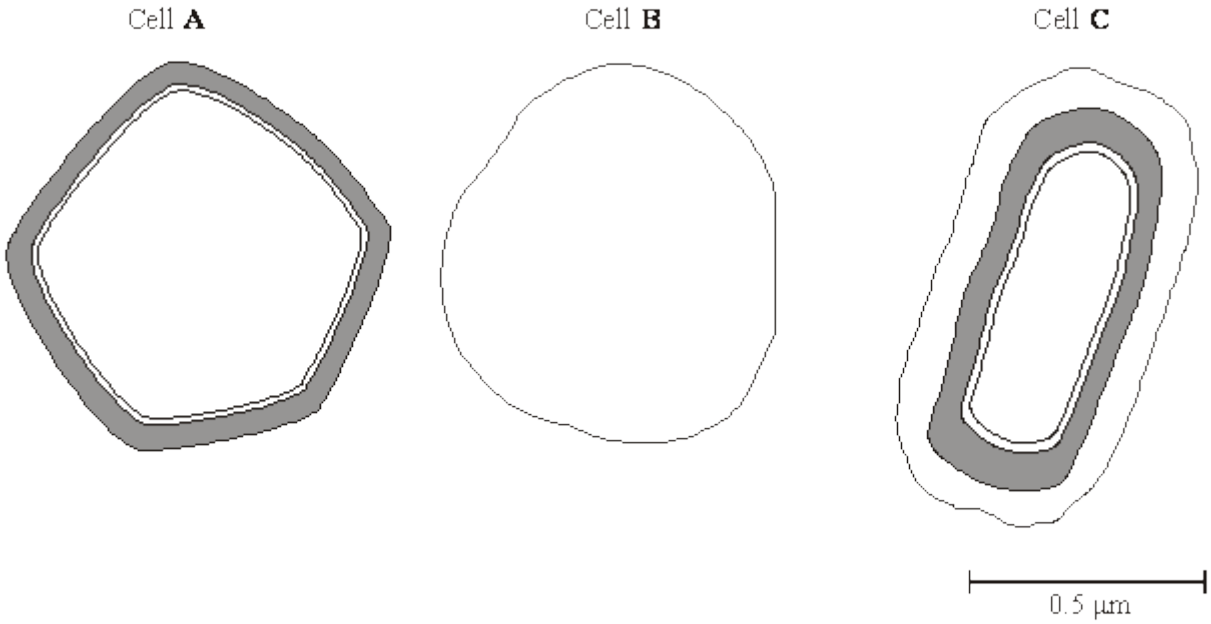
(3)

(c) Explain how paralysis of the diaphragm leads to breathing difficulties (line 11).

(2)

(Total 7 marks)

25 The diagram shows the outer layers of three different cells, **A**, **B** and **C**.



(a) What is the evidence from the diagram that

(i) cell **B** is an animal cell,

_____

_____

(1)

(ii) cell **C** is a prokaryotic cell?

_____

_____

(1)

(b) Explain how you would calculate the magnification of cell **C**.

_____

_____

(1)

(c) Cell **A** is a plant cell. Name a polysaccharide which may be found in cell **A** but would not be found in the animal cell.

_____

(1)

(d) Penicillin is an antibiotic. It prevents the formation of bacterial cell walls. As a result, bacterial cells that have been treated with penicillin swell and burst as water enters.

(i) Explain how water enters a bacterial cell.

(2)

(ii) Suggest why penicillin has no effect on plant cells.

(1)

(Total 7 marks)

26 (a) A plant cell was observed with an optical microscope. Describe how the length of the cell could be estimated.

(2)

(b) The water potential of a plant cell is –400 kPa. The cell is put in a solution with a water potential of –650 kPa. Describe and explain what will happen to the cell.

(3)

(c) A group of students investigated the effect of sucrose concentration on the change in length of cylinders of tissue cut from a young carrot. They measured the initial lengths of the carrot cylinders, then placed one in each of a number of sucrose solutions. After 18 hours, they removed the carrot cylinders and measured their final lengths. Some of the results are shown in the table.

Concentration of sucrose / mol dm^{-3}	**Percentage decrease in length of carrot cylinder**
0.4	4.2
0.5	8.7
0.6	13.0
0.7	16.8
0.8	18.1
0.9	18.1
1.0	18.1

(i) The carrot cylinders were left for 18 hours in the sucrose solutions. Explain why they were left for a long time.

_____

_____

(1)

(ii) Explain how you would use a graph to predict the concentration of sucrose that would result in no change in length of the carrot cylinders.

_____

_____

_____

_____

(2)

(iii) Young carrots store sugars in their tissues but, in older carrots, some of this is converted to starch. How would using cylinders of tissue from older carrots affect the results obtained for a sucrose solution of 0.6 mol dm^{-3}? Give a reason for your answer.

_____

_____

_____

_____

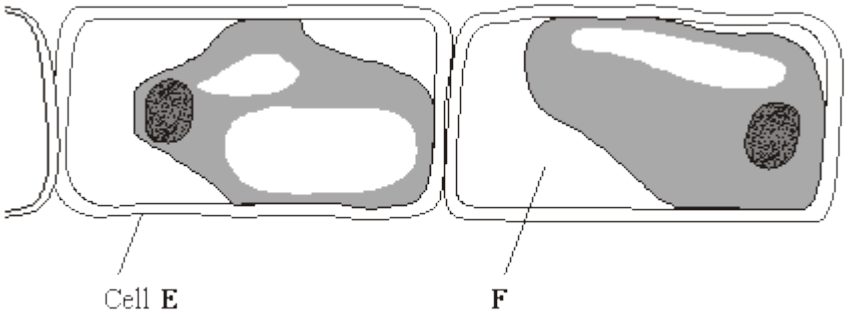
(2)

(Total 10 marks)

27 Tradescantia is a house plant. There are small hairs on its flowers. These hairs are made of cells. **Figure 1** shows the appearance of cells from one of these hairs after 20 minutes in distilled water. **Figure 2** shows cells from another hair after 20 minutes in a solution of potassium nitrate.

Figure 1 (in distilled water)

Figure 2 (in potassium nitrate solution)



(a) What does **Figure 2** suggest about the permeability of the plasma membranes surrounding these cells?

_____

_____

(1)

(b) What is present in the space labelled **F**? Explain your answer.

(2)

(c) How would the water potential of the sap in the vacuole of cell **E** differ from the water potential of the sap in the vacuole of cell **D**? Explain your answer.

(3)

(Total 6 marks)

28 Read the following passage.

During the course of a day, we come into contact with many poisonous substances. These include industrial and household chemicals. The skin acts as a barrier and prevents many of these substances entering and harming the body.

The skin is one of the largest organs in the body. It is composed of several layers of tissue. The outer layer consists of dead cells packed with keratins. Keratins are a group of proteins that differ from each other in their primary structure. Each keratin molecule consists of several polypeptide chains, each individual chain wound into a spiral or helix. The polypeptide chains include many sulphur-containing amino acids and these help to give the keratin molecules their characteristic strength.

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

(a) What is the evidence from the passage that keratin molecules have a quaternary structure?

(1)

(b) Explain how sulphur-containing amino acids help to give keratin molecules their characteristic strength (lines 8–9).

(2)

(c) Explain why differences in primary structure result in keratins with different properties (line 6).

(2)

(d) The skin prevents poisonous substances entering and harming the body (line 3). Explain why these substances are unable to pass through the outer layer of skin cells by active transport.

(3)

(e) Skin cells may be studied with a transmission electron microscope or an optical microscope. Explain the advantages and limitations of using a transmission electron microscope to study cells.

(6)

(Total 14 marks)

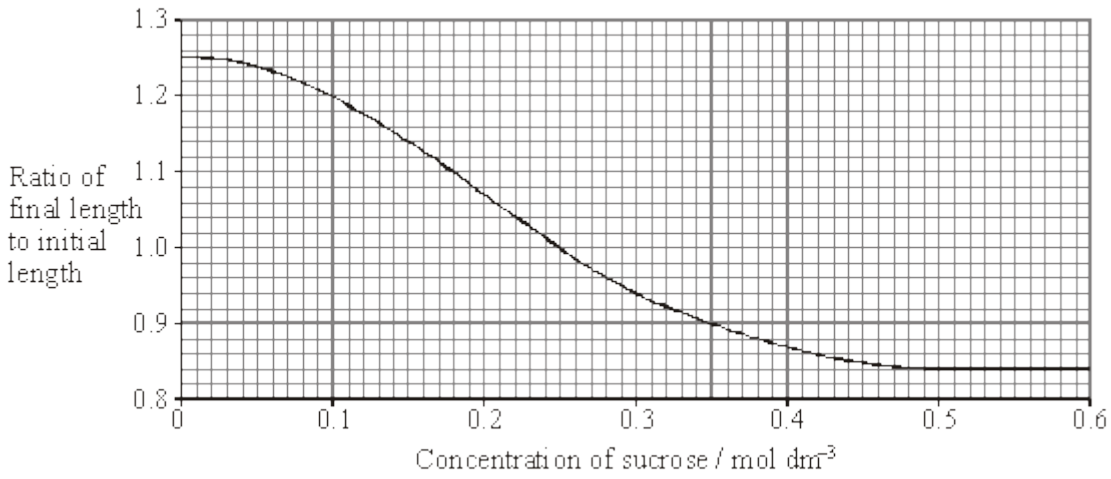
29 (a) Discs of carrot were placed in a solution containing potassium ions (K^+). The concentration of oxygen in air bubbled through the solution was changed and the rates of respiration and uptake of potassium ions were measured. The results are shown in the table.

Concentration of oxygen / %	Rate of respiration / arbitrary units	Rate of uptake of potassium ions / arbitrary units
2.7	31	29
12.2	69	72
20.8	90	80

Describe and explain the link between oxygen concentration, rate of respiration and rate of uptake of potassium ions.

(4)

(b) Cylinders of potato were cut using a cork borer. Their initial lengths were measured. Each cylinder was then put in a different concentration of sucrose solution for 12 hours. The graph shows the changes in length of the potato cylinders in the different sugar solutions.



(i) In what concentration of sucrose did the length of the potato cylinder remain the same?

(1)

(ii) The initial length of the potato cylinder in the solution of concentration 0.1 mol dm^{-3} was 90 mm. Calculate its final length. Show your working.

Final length = _____ mm

(2)

(iii) Explain the change in length which occurs in a sucrose solution of concentration 0.5 mol dm^{-3}.

_____

_____

_____

_____

(2)

(Total 9 marks)

30 In a hospital laboratory, a sterile Petri dish of nutrient agar was inoculated with bacteria from a patient with a throat infection. Four discs, each of which had been soaked in a different antibiotic, were placed on top of the bacteria. The dish was incubated at 37 °C. **Figure 1** shows the appearance of the dish after incubation.

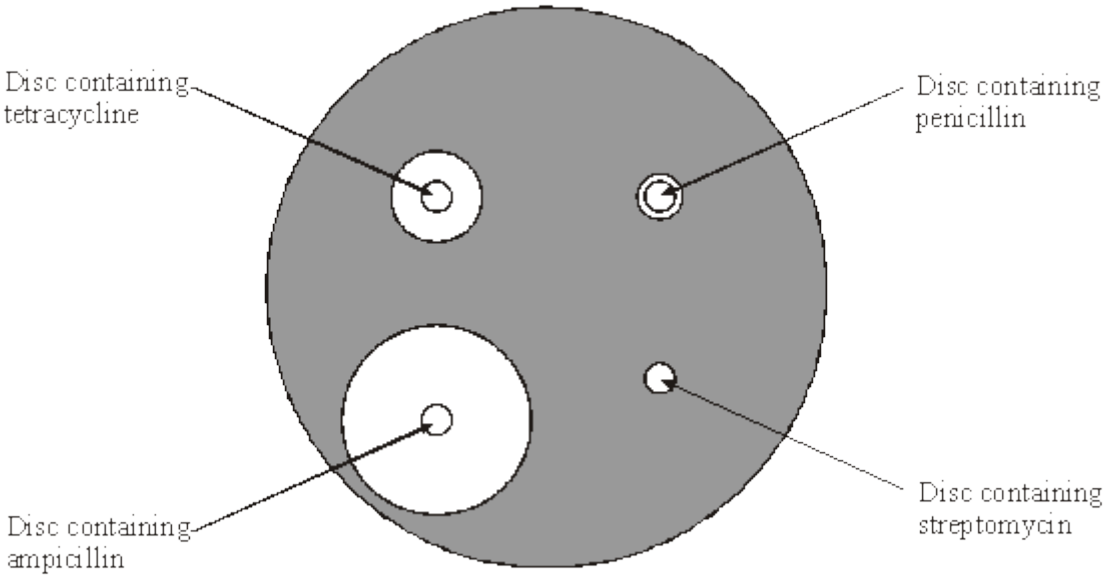


Figure 1

(a) Explain why there are clear zones around some of the discs containing antibiotic.

_____

_____

_____

_____

(2)

(b) It was suggested that ampicillin might be the best antibiotic to treat the patient's throat infection. Give the evidence from the laboratory test to support this suggestion.

_____

_____

(1)

(c) Tetracycline binds to bacterial ribosomes. This is shown in **Figure 2**.

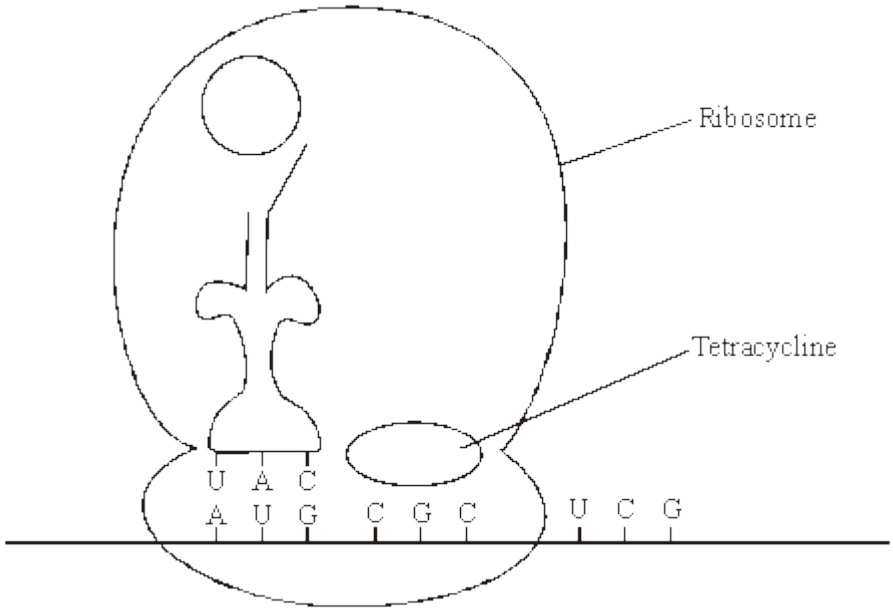


Figure 2

Tetracycline prevents bacterial growth by preventing protein synthesis. Give **two** other ways in which antibiotics can prevent bacterial growth.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

31 (a) (i) An arteriole is described as an organ. Explain why.

_____

_____

_____

(1)

(ii) An arteriole contains muscle fibres. Explain how these muscle fibres reduce blood flow to capillaries.

_____

_____

_____

_____

_____

(2)

(b) (i) A capillary has a thin wall. This leads to rapid exchange of substances between the blood and tissue fluid. Explain why.

_____

_____

_____

(1)

(ii) Blood flow in capillaries is slow. Give the advantage of this.

_____

_____

_____

(1)

(c) Kwashiorkor is a disease caused by a lack of protein in the blood. This leads to a swollen abdomen due to a build up of tissue fluid.

Explain why a lack of protein in the blood causes a build up of tissue fluid.

(Extra space)

(3)

(Total 8 marks)