



AQA B3.1 Movement of molecules in and out of cells LEVEL 3



128 minutes



128 marks

Q1. Plants need chemical energy for respiration and for active transport.

(i) Write a balanced chemical equation which represents the process of respiration in plants.

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(2)

(ii) Describe the process of active transport in the root hair cells of plants.

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(3)

(Total 5 marks)

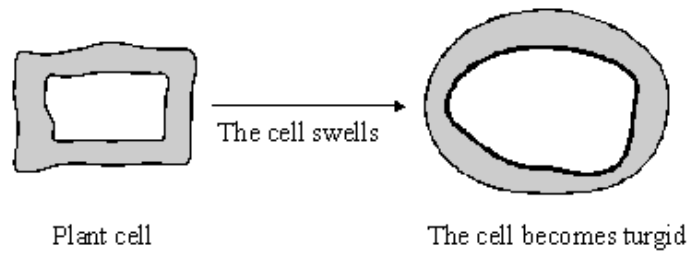
Q2. Plant roots obtain some of their mineral salts from the soil by active transport.

What is involved in *active transport*?

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(Total 4 marks)

Q3. (a) The diagrams show what happens to the shape of a plant cell placed in distilled water.



(i) Explain why the cell swells and becomes turgid. Name the process involved.

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(2)

(ii) Give **one** feature of the cell wall which allows the cell to become turgid.

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(1)

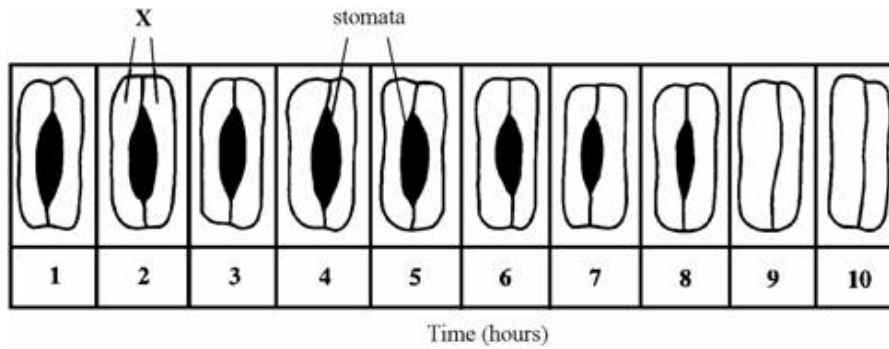
(b) Describe the change which will occur if a piece of peeled potato is placed in a concentrated sugar solution and explain why this change occurs.

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(3)

(Total 6 marks)

Q4. A potted plant was left in a hot, brightly lit room for ten hours. The plant was not watered during this period. The drawings show how the mean width of stomata changed over the ten hour period.



(a) Why do plants need stomata?

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(1)

(b) Name the cells labelled **X** on the drawing.

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(1)

(c) The width of the stomata changed over the ten hour period. Explain the advantage to the plant of this change.

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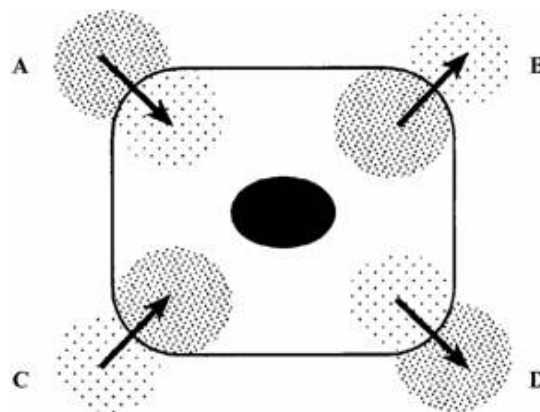
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(2)

(Total 4 marks)

Q5. (a) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically.
Which arrow, **A**, **B**, **C** or **D**, represents:

- (i) movement of oxygen molecules;
- (ii) movement of carbon dioxide molecules?

(2)

(b) Name the process by which these gases move into and out of the cell.

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(1)

(c) Which arrow, **A**, **B**, **C** or **D**, represents the active uptake of sugar molecules by the cell?

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Explain the reason for your answer.

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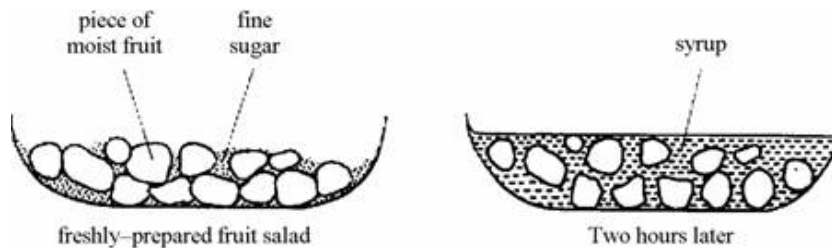
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(2)

(Total 5 marks)

Q6. A cook prepares a fresh fruit salad by cutting up a variety of fruits and placing them in a bowl with layers of sugar in between. After two hours the fruit is surrounded by syrup (concentrated sugar solution).



Explain, as fully as you can, why syrup (concentrated sugar solution) was produced after two hours.

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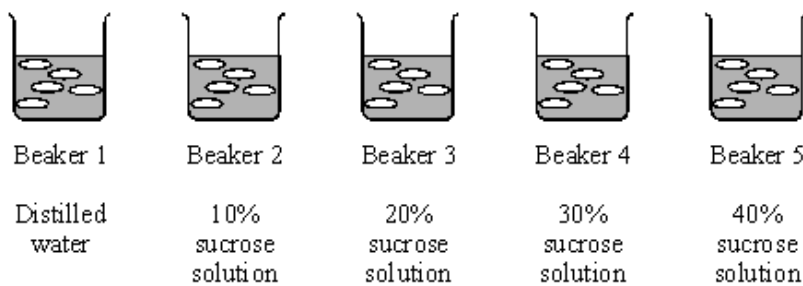
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(Total 4 marks)

Q7. Some students set up an experiment using osmosis to find the concentration of sucrose solution in potato cell sap. They used discs of potato cut to the same size and weighing approximately 10 gms. The discs were put into each of five beakers.



(a) (i) After two hours they reweighed the discs after carefully blotting them first. Why did the students blot the potato before weighing it?

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(1)

(ii) Their results are shown in the table below.

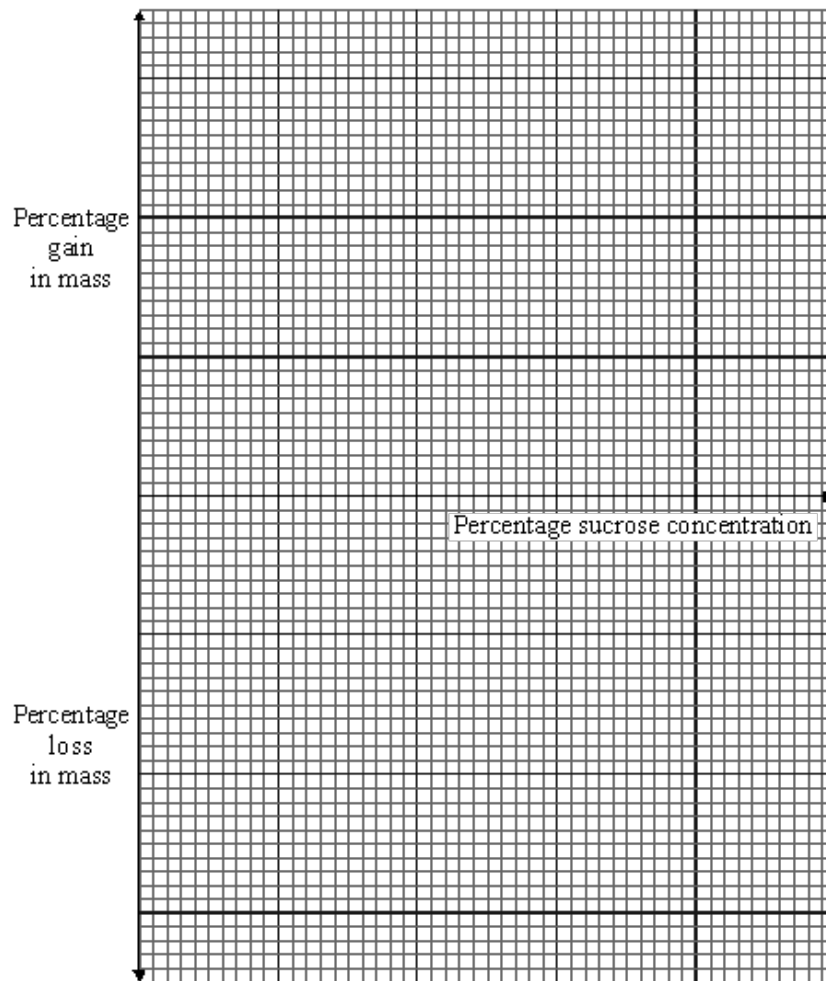
	Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
Final mass in g	13.0	12.2	9.0	7.9	7.3
Initial mass in g	10.0	10.6	10.0	10.1	10.4

The students calculated the % gain or loss in mass of potato. Complete this table of results for Beakers 2, 4 and 5.

Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
$13 - 10.0 = 3.0$ $\frac{3.0}{10.0} \times 100\% = 30\%$		$9.0 - 10.0 =$ -1.0 $\frac{-1.0}{10.0} \times 100\%$ $= -10\%$		
Gain in mass = 30%		Loss in mass = 10%		

(3)

(b) (i) Draw a graph of % Gain or Loss in mass against sucrose concentration.



(3)

(ii) Use the graph to find the concentration of potato cell sap.

Concentration of cell sap = % sucrose solution

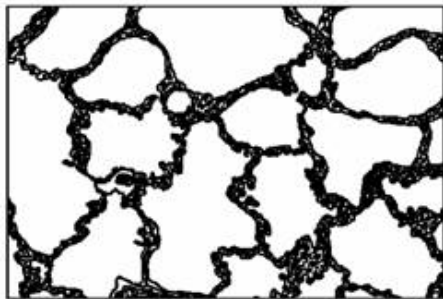
(1)

(iii) Explain in terms of osmosis how you chose this value.

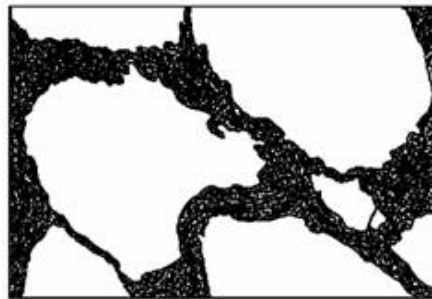
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(2)
(Total 10 marks)

Q8. Emphysema is a disease of the lungs. People who smoke cigarettes are more likely to suffer from emphysema. The diagrams show lung tissue from a healthy person and lung tissue from a person with emphysema. The diagrams are drawn to the same scale.



Lung tissue from a healthy person



Lung tissue from a person with emphysema

Explain how emphysema reduces the amount of oxygen which diffuses into the blood

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(Total 2 marks)

Q9. The table shows the concentrations of some mineral ions in the cells of a pond plant and in the surrounding pond water.

	Concentration in mmol per dm ³		
	Potassium	Calcium	Sulphate
Plant cells	49.0	7.0	7.0
Pond water	0.5	0.7	0.4

- (i) The plant cells would not have been able to absorb these mineral ions from the pond water by diffusion. Explain why not.

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(2)

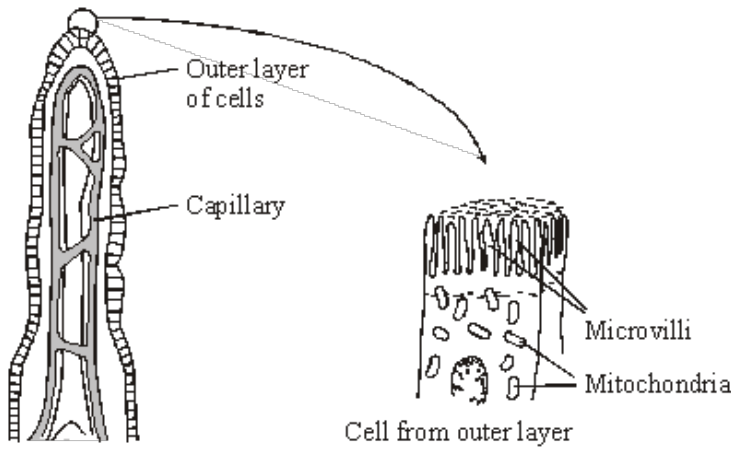
- (ii) Suggest a process which would allow these ions to be absorbed from the pond water by the plant cells.

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(1)

(Total 3 marks)

Q10. The small intestine is lined with millions of villi. The diagram shows the structure of a villus.



In the small intestine, some of the products of digestion are absorbed into the blood by *active transport*.

- (a) Explain what is meant by *active transport*.

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(2)

- (b) How do microvilli and mitochondria help in the active transport of the products of digestion from the small intestine into the blood?

Microvilli

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Mitochondria

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(2)
(Total 4 marks)

- Q11.** (a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

	Concentration of sulfate ions in mmol per dm ³
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

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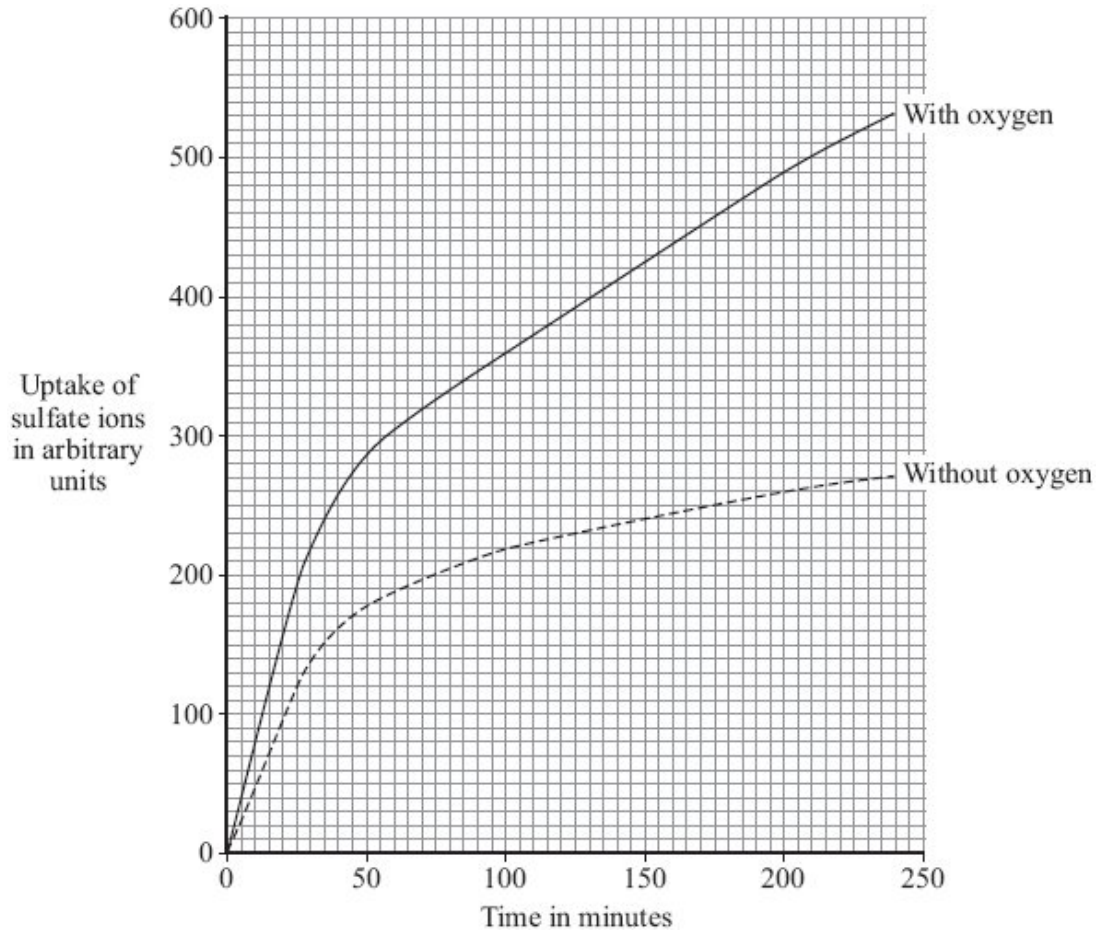
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(2)

- (b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph below shows the results.



- (i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

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Answer arbitrary units

(2)

- (ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

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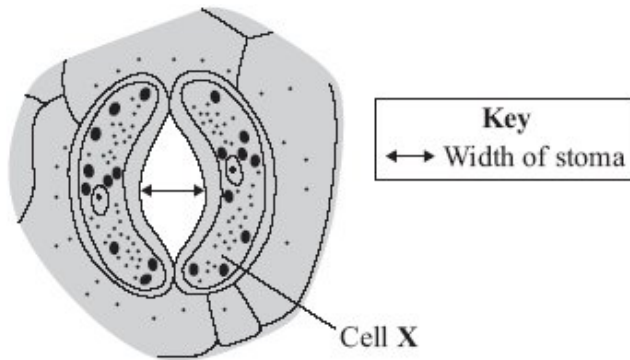
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(3)
(Total 7 marks)

Q12. Plant leaves have many stomata.

The diagram shows a stoma.



(a) Name cell X

(1)

- (b) The table shows the mean widths of the stomata at different times of the day for two different species of plant.
 Species **A** normally grows in hot, dry deserts.
 Species **B** grows in the UK.

	Time of day In hours	Mean width of stomata as a percentage of their maximum width	
		Species A	Species B
	0	95	5
Dark	2	86	5
	4	52	6
Light	6	6	40
	8	4	92
	10	2	98
	12	1	100
	14	0	100
	16	1	96
	18	5	54
Dark	20	86	6
	22	93	5
	24	95	5

The data in the table show that species **A** is better adapted than species **B** to living in hot, dry deserts.

Explain how.

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(4)
(Total 5 marks)

Q13. (a) Some scientists investigated the rates of absorption of different sugars by the small intestine.

In one experiment they used a piece of normal intestine.
In a second experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it prevents respiration.

The results are shown in the table.

Sugar	Relative rates of absorption	
	Normal intestine	Intestine poisoned by cyanide
Glucose	1.00	0.33
Galactose	1.10	0.53
Xylose	0.30	0.31
Arabinose	0.29	0.29

(i) Name **two** sugars from the table which can be absorbed by active transport.

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(1)

(ii) Use evidence from the table to explain why you chose these sugars.

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(3)

(b) All of the sugars named in the table can be absorbed by diffusion.
Explain how information from the table provides evidence for this.

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(2)

(Total 6 marks)

Q14. Diffusion and active transport take place in healthy kidneys.

(a) Explain what is meant by:

(i) diffusion

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(2)

(ii) active transport

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(2)

(b) Describe, as fully as you can, how urine is produced by the kidneys.

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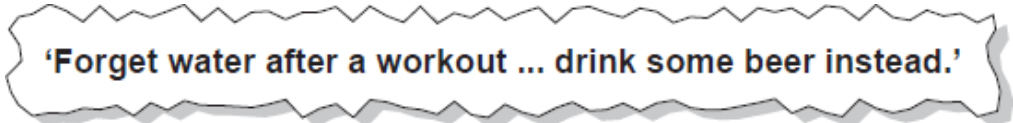
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(Total 9 marks)

Q15. Drinking after exercise to replace the water lost in sweat is called rehydration. Scientists at a Spanish university investigated rehydration after exercise.

- 24 students took part in the investigation.
- All the students ran on a treadmill in a temperature of 40 °C until they were exhausted.
- 12 of the students were each given half a litre of beer to drink.
- The other 12 students were each given half a litre of tap water to drink.
- Both groups of students were then allowed to drink as much tap water as they wanted.
- The scientists measured how quickly each student rehydrated.
- The students who had been given beer rehydrated 'slightly better' than the ones given only water.

A newspaper reported the investigation.

The headline was



The newspaper headline was **not** justified.

Explain why.

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(Total 3 marks)

Q16. Read the following information about how the small intestine absorbs sugars.

- The blood absorbs glucose and some other sugars, like xylose, from the small intestine.
- Glucose molecules are the same size as xylose molecules, but glucose is absorbed more quickly than xylose.
- Experiments with pieces of intestine show that the uptake of oxygen by the intestine is 50 % higher in the presence of glucose than in the absence of glucose. Xylose does not have this effect on the uptake of oxygen.
- The cells lining the small intestine have many mitochondria.

Explain how this information provides evidence that glucose is absorbed by the small intestine using *active transport*.

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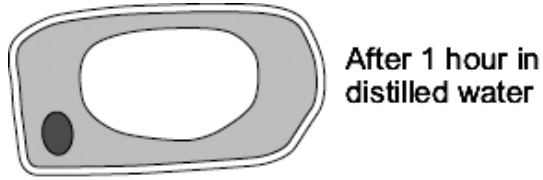
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(4)
(Total 4 marks)

Q17. The diagram shows the same plant cell:

- after 1 hour in distilled water
- after 1 hour in strong sugar solution.



(a) Describe **two** ways in which the cell in the strong sugar solution is different from the cell in distilled water.

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(2)

(b) Explain how the differences between the cell in the strong sugar solution and the cell in distilled water were caused.

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(2)
(Total 4 marks)

Q18. The table shows the concentrations of three mineral ions in the roots of a plant and in the water in the surrounding soil.

Mineral ion	Concentration in millimoles per kilogram	
	Plant root	Soil
Calcium	120	2.0
Magnesium	80	3.1
Potassium	250	1.2

(a) (i) The plant roots could **not** have absorbed these mineral ions by diffusion.

Explain why.

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(2)

(ii) Name the process by which the plant roots absorb mineral ions.

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(1)

(b) How do the following features of plant roots help the plant to absorb mineral ions from the soil?

(i) A plant root has thousands of root hairs.

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(1)

(ii) A root hair cell contains many mitochondria.

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(2)

(iii) Many of the cells in the root store starch.

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(1)
(Total 7 marks)

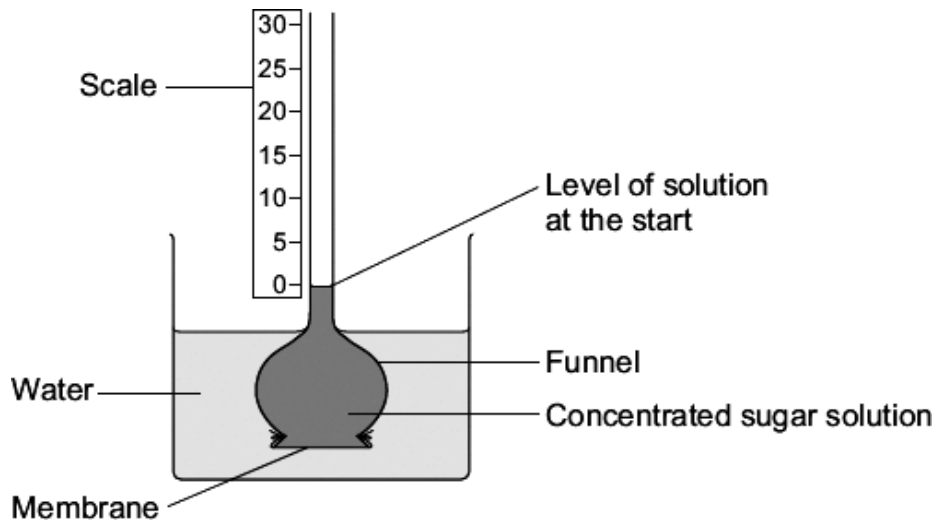
Q19. Some substances move through membranes.

A student set up an investigation.

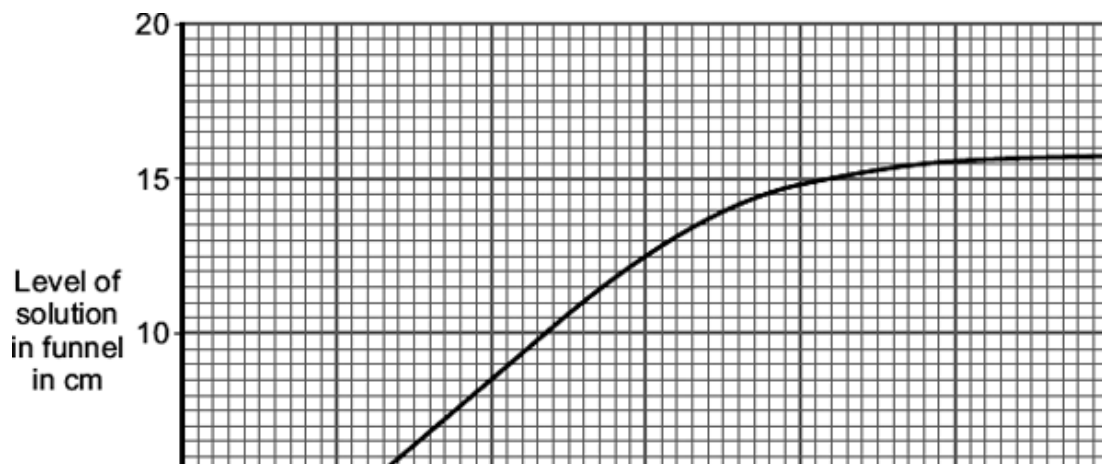
The student:

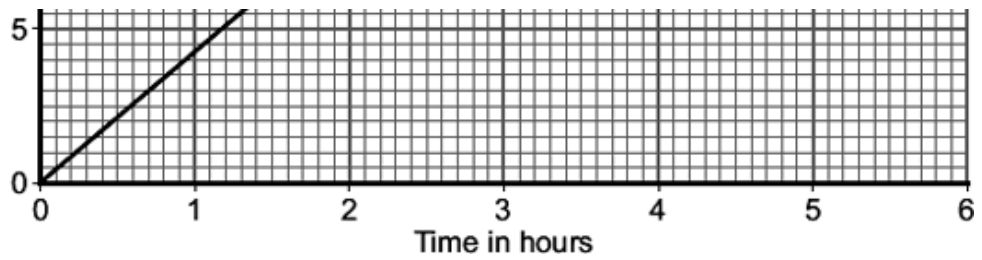
- tied a thin membrane across the end of a funnel
- put concentrated sugar solution in the funnel
- put the funnel in a beaker of water
- measured the level of the solution in the funnel every 30 minutes.

The diagram shows the apparatus.



The graph shows the results.





- (a) After 3 hours, the level of the solution in the funnel is different from the level at the start.
Explain why, as fully as you can.

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(3)

- (b) The student repeated the investigation using dilute sugar solution instead of concentrated sugar solution.

In what way would you expect the results using dilute sugar solution to be different from the results using concentrated sugar solution?

Give the reason for your answer.

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(2)

(Total 5 marks)

Q20.

(a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

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(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

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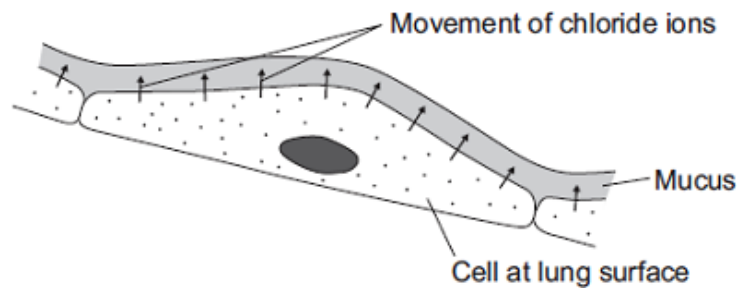
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(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

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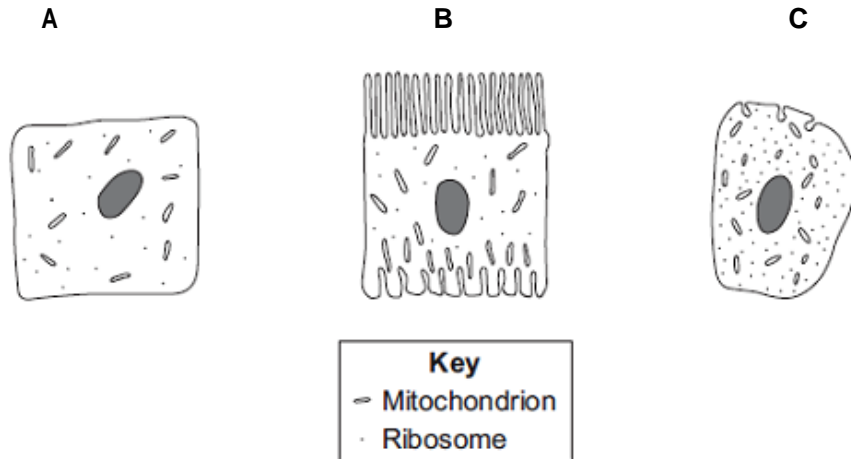
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(3)
(Total 11 marks)

Q21. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or

out of the cell?

Give **one** reason for your choice.

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(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

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(1)

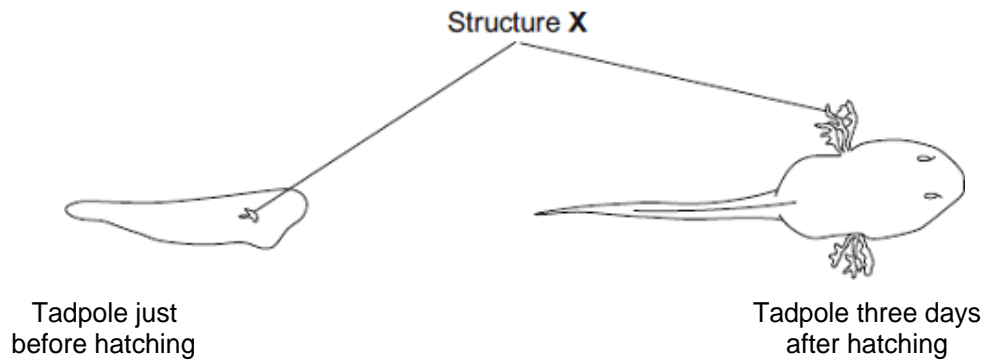
(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

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(2)

(Total 4 marks)

Q22. The young stages of frogs are called tadpoles. The tadpoles live in fresh water. The drawings show a tadpole just before hatching and three days after hatching. Structure **X** helps in the exchange of substances between the tadpole and the water.



(a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

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(1)

(b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer. To gain full marks you should refer to structure **X**.

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(4)
 (Total 5 marks)

Q23. Plants exchange substances with the environment.

- (a) Plant roots absorb water mainly by osmosis.
Plant roots absorb ions mainly by active transport.

Explain why roots need to use the two different methods to absorb water and ions.

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(4)

- (b) What is meant by the *transpiration stream*?

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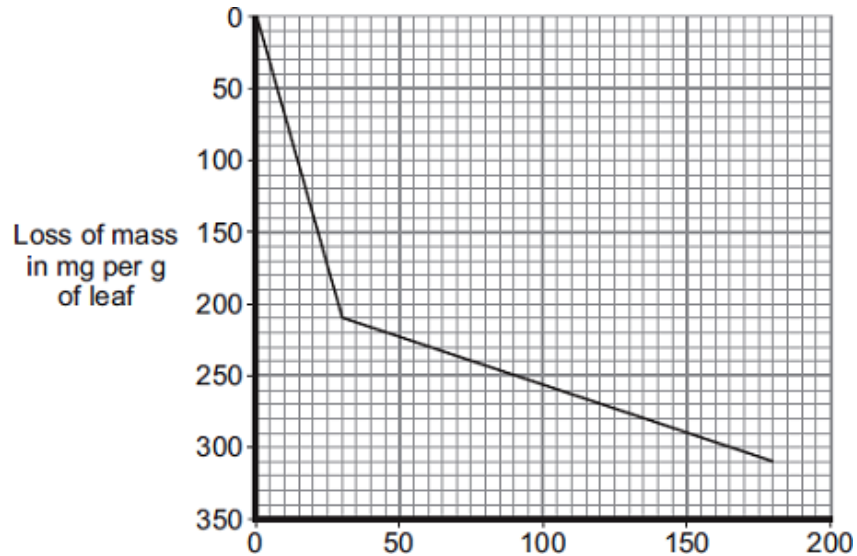
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(c) Students investigated the loss of water vapour from leaves.

The students:

- cut some leaves off a plant
- measured the mass of these leaves every 30 minutes for 180 minutes.

The graph shows the students' results.



(i) The rate of mass loss in the first 30 minutes was 7 milligrams per gram of leaf per minute.

Calculate the rate of mass loss between 30 minutes and 180 minutes.

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Rate of mass loss = milligrams per gram of leaf per minute

(2)

(ii) The rate of mass loss between 0 and 30 minutes was very different from the rate of mass loss between 30 and 180 minutes.

Suggest an explanation for the difference between the two rates.

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(2)

(Total 11 marks)

