Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8579957431

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Blank pages are indicated.

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Answer **all** questions.

1 Water and mineral ions are transported up the stem of a plant to the leaves within xylem vessels.

Some water and mineral ions can pass out of xylem vessel elements to supply parenchyma tissue in the stem.

(a) Fig. 1.1 is a plan diagram of a section through a stem.

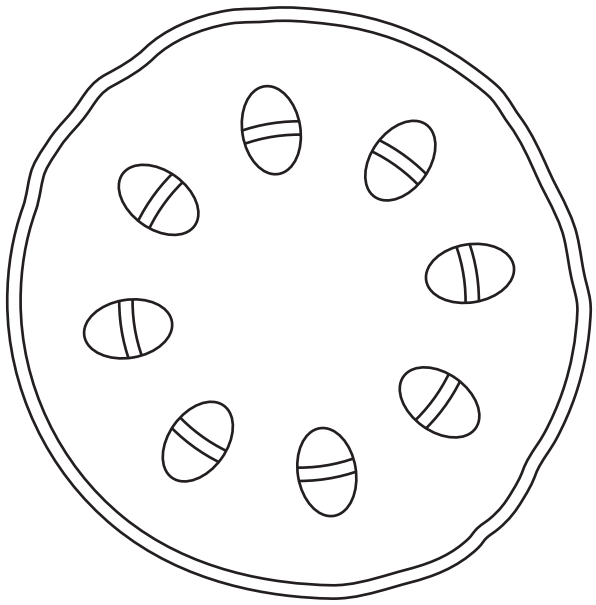


Fig. 1.1

Identify **one** location where xylem tissue occurs in the stem by drawing a label line and the letter **X** on Fig. 1.1. [1]

(b) Explain how hydrogen bonding between water molecules contributes to the movement of water within xylem vessels up the stem to the leaves.

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(c) Fig. 1.2 is a diagram of a photomicrograph showing three adjacent parenchyma cells in the stem. These parenchyma cells can be described as typical plant cells.

The arrows show the direction of movement of water between the cells.

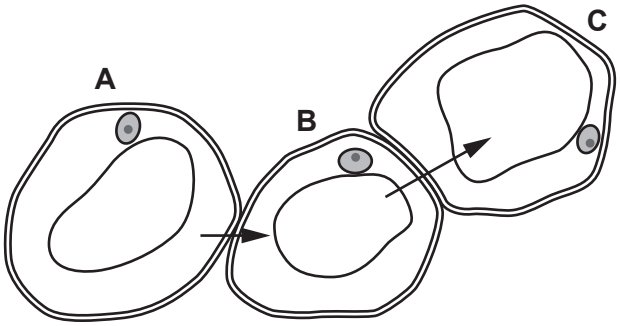


Fig. 1.2

(i) Describe **and** explain the movement of water shown in Fig. 1.2.

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(ii) Only some of the structures visible using the light microscope have been included in Fig. 1.2.

List the features that can be seen using the high power of a light microscope that help identify a parenchyma cell as a plant cell and **not** as an animal cell.

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..... [3]

[Total: 10]

2 In 2016, the highest number of cases of malaria and deaths caused by the disease were in sub-Saharan Africa. In many areas of sub-Saharan Africa, malaria is endemic (continually present) and people are at high risk of becoming infected with the *Plasmodium* pathogen.

In high risk areas it is recommended that:

- homes are provided with insecticide-treated nets (ITN)
- the surfaces inside homes where *Anopheles* mosquitoes may rest are sprayed with insecticide. This is known as indoor residual spraying (IRS).

(a) Explain how the use of ITN and IRS can help break the transmission cycle of malaria.

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(b) Fig. 2.1 shows the proportion of the population in sub-Saharan Africa at risk of malaria that is protected by using IRS or ITN, or both, in the years 2010 to 2016.

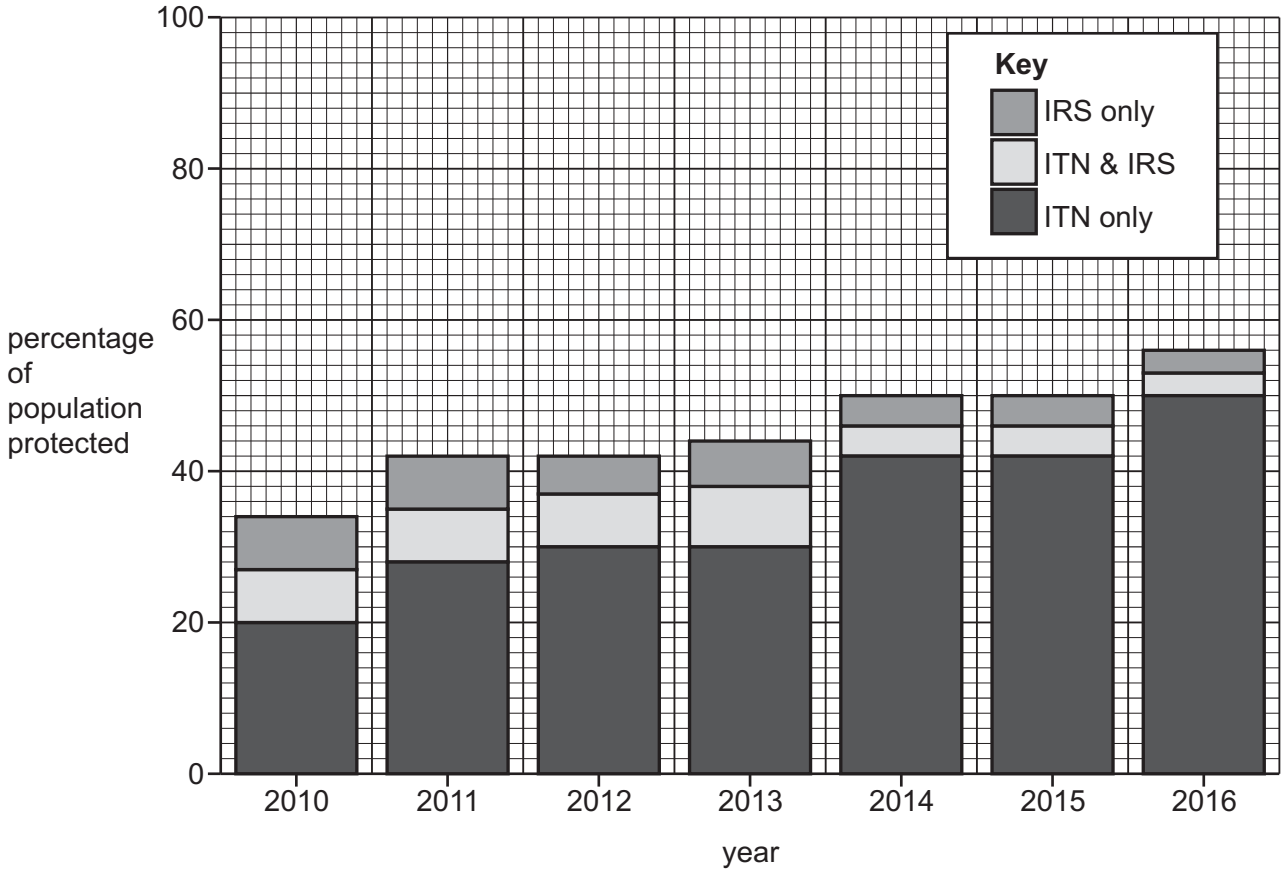


Fig. 2.1

The main trend in Fig. 2.1 shows that there is an increase in the percentage of the population protected over time.

(i) State **one** other trend shown in Fig. 2.1.

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..... [1]

(ii) Explain why the main trend shown in Fig. 2.1 could be a concern for the World Health Organization.

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..... [1]

(iii) With reference to Fig. 2.1, suggest a reason for the difference in trends shown for ITN only compared with IRS only.

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..... [1]

(c) In a primary immune response, antibodies against *Plasmodium* are produced within one to two weeks following infection. In some people, the pathogen is eliminated and the concentration of antibodies in the circulation decreases over time.

Infection again by *Plasmodium* with the same antigens causes a secondary response that also involves antibody production.

State **and** explain how the antibody response following a second infection will differ from the primary immune response.

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[Turn over

(d) In malaria, the production of antibodies is beneficial to recovery, whereas in the disease myasthenia gravis the production of antibodies is harmful.

Explain why the production of antibodies in a person with myasthenia gravis is harmful.

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[Total: 11]

3 **(a)** Fig. 3.1 is a photomicrograph of a section through two different types of blood vessels, **X** and **Y**.

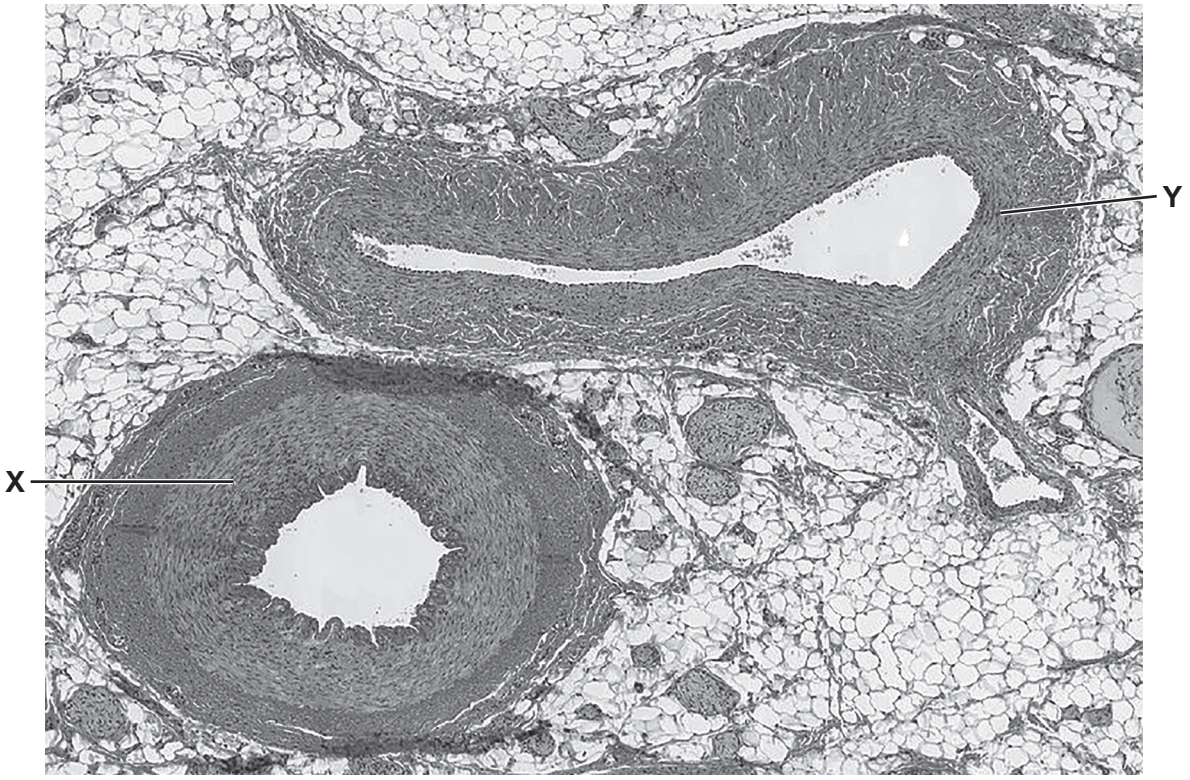


Fig. 3.1

(i) Name the two types of blood vessel shown by **X** and **Y** in Fig. 3.1.

X .....

Y ..... [1]

(ii) State the reasons for your identification of the type of blood vessel shown by **Y** in Fig. 3.1.

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..... [2]

(b) Tissue fluid and lymph are formed when blood arrives in the capillary networks of body tissues.

(i) Explain why tissue fluid is more similar to blood plasma than it is to blood.

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..... [2]

(ii) Explain why the tissue fluid formed after blood arrives in the capillary network has a **higher** concentration of amino acids than the newly formed lymph draining away from the network.

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..... [1]

(c) The trachea, bronchi and bronchioles in the gas exchange system require a supply of glucose and oxygen from the blood for the functioning of smooth muscle.

Outline the function of smooth muscle in the gas exchange system.

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..... [2]

[Total: 8]

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4 *Saccharomyces cerevisiae* is a unicellular fungus that is important in the brewing and baking industries.

Fig. 4.1 is a diagram of a transmission electron micrograph of *S. cerevisiae*.

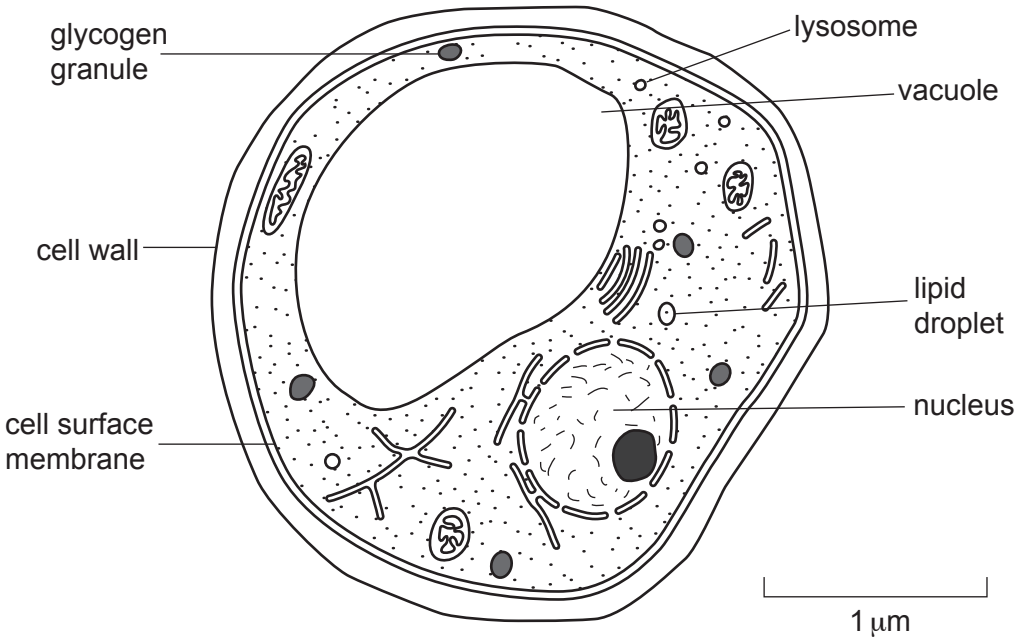


Fig. 4.1

(a) A student was asked to calculate the magnification of the image shown in Fig. 4.1.

The student began by measuring the length of the scale bar in millimetres using a millimetre ruler.

State what the student should do next to obtain the correct answer.

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..... [1]

(b) One function of the lipid droplets shown in Fig. 4.1 is to store triglycerides.

The triglycerides in a lipid droplet are surrounded by a single layer (monolayer) of phospholipids.

Suggest **and** explain why phospholipids, rather than triglycerides, are used for the outer monolayer of the lipid droplet.

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..... [2]

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(c) The lysosomes and vacuole of *S. cerevisiae* contain acid hydrolases (hydrolytic enzymes) that function in an acid pH.

Explain why lysosomes need hydrolases to carry out their function.

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..... [1]

(d) A disaccharide, trehalose, is a reserve store of energy for *S. cerevisiae* when glycogen stores decrease. The monomer of glycogen and trehalose is α-glucose.

(i) Complete Fig. 4.2 to show the ring structure of **one** α-glucose molecule.

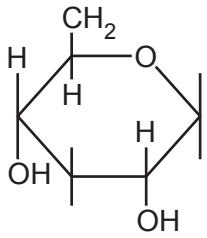


Fig. 4.2

[2]

(ii) A student carried out tests on a solution of trehalose and correctly concluded that trehalose is a **non-reducing** sugar.

Outline the procedure carried out by the student **and** state the results that were obtained.

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..... [3]

(e) The hydrolysis of trehalose is catalysed by two different enzymes produced by *S. cerevisiae*, regulatory trehalase and non-regulatory trehalase.

A study was carried out to compare regulatory trehalase and non-regulatory trehalase extracted from *S. cerevisiae*.

The results of the study showed that:

- regulatory trehalase had a higher K_m value (Michaelis-Menten constant) than non-regulatory trehalase
- the optimum pH of regulatory trehalase was pH 7.0–7.8
- the optimum pH of non-regulatory trehalase was pH 4.5–5.0.

(i) Explain what is meant by a higher K_m value.

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..... [2]

(ii) Regulatory trehalase is found only in the cytosol, the fluid part of the cytoplasm.

Non-regulatory trehalase has been found on the external surface of the cell surface membrane and inside the cell.

State the location inside the cell where non-regulatory trehalase is likely to be found **and** explain the reason for your answer.

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..... [2]

(iii) Explain whether both types of trehalase, regulatory and non-regulatory, can be described as intracellular enzymes.

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..... [1]

(f) *Saccharomyces boulardii* is a strain of *S. cerevisiae*. It has been researched for its possible health benefits for some gut diseases.

Researchers investigating trehalase extracted from *S. boulardii* concluded that only one type of trehalase was present in the extract.

Fig. 4.3 shows the effect of pH on the activity of the trehalase extracted from *S. boulardii*.

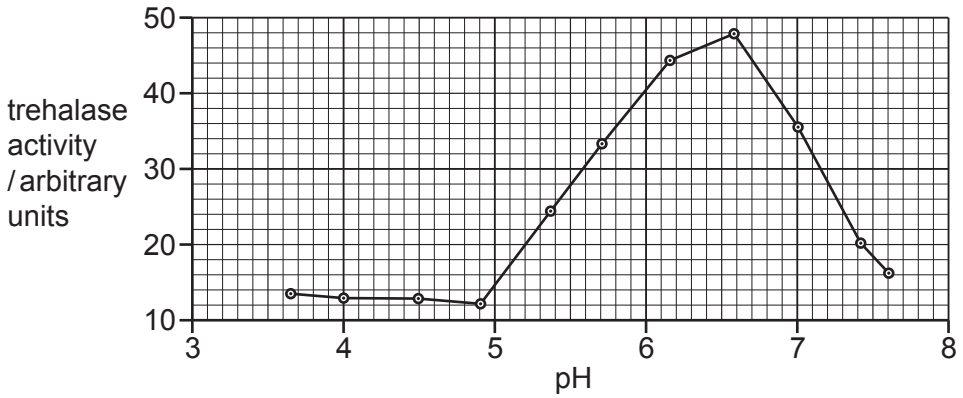


Fig. 4.3

With reference to Fig. 4.3 and to the two different types of trehalase enzyme produced by *S. cerevisiae*, state **and** explain what can be deduced about the type of trehalase present in *S. boulardii*.

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[Total: 17]

5 Blood cells are formed from tissue stem cells in the bone marrow. These bone marrow stem cells go through a number of mitotic cell cycles to form the fully functioning blood cell.

Fig. 5.1 shows the three main stages of the cell cycle.

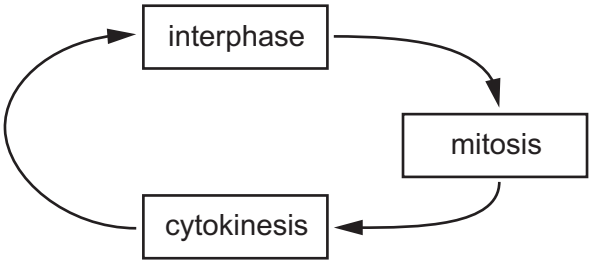


Fig. 5.1

The activity of genes changes during the mitotic cell cycle.

When genes are being expressed, the cell produces many messenger RNA (mRNA) molecules and ATP molecules.

(a) Explain what is meant by a gene.

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..... [2]

(b) Name the main stage of the cell cycle in Fig. 5.1 during which most mRNA and ATP is formed.

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(c) Fig. 5.2 is an incomplete diagram of an ATP molecule.

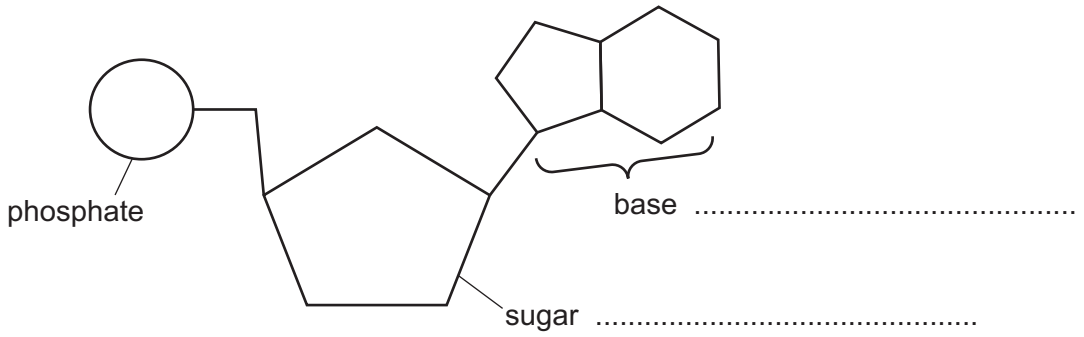


Fig. 5.2

(i) On Fig. 5.2:

- complete the diagram of the ATP molecule
- write the name of the base in the space provided
- write the name of the sugar in the space provided.

[3]

(ii) The base shown in Fig. 5.2 has a double ring structure.

State the term for a base that has a double ring structure.

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(d) Suggest **and** explain the role of mitosis in the formation of blood cells by the bone marrow stem cells.

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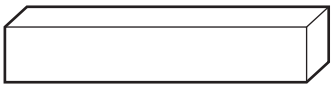
[Total: 10]

6 A student carried out an investigation to estimate the water potential of potato tissue. The main steps in the procedure and in the analysis of results are outlined in Fig. 6.1.

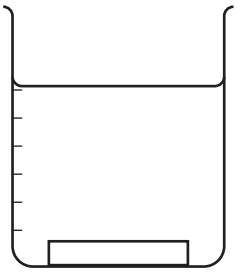
beaker	concentration of sucrose solution / mol dm^{-3}
1	0.0
2	0.1
3	0.2
4	0.3
5	0.4
6	0.5

Six different concentrations of sucrose solution were prepared and an equal volume of each was placed in a labelled beaker.

↓



Six equal-sized blocks of potato tissue were cut out of the same potato, blotted dry and weighed.



One potato block was immersed in the solution in each beaker for 30 minutes.

After this time, the block was removed, blotted dry and reweighed.

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The experiment was repeated twice.

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The mean percentage change in mass of potato tissue was calculated for each concentration of sucrose used.

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A graph was drawn of mean percentage change in the mass of potato tissue against concentration of sucrose.

Fig. 6.1

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(a) Explain why the different concentrations of sucrose result in different mean percentage changes in mass of potato tissue.

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(b) State how the graph is used to estimate the water potential of the potato tissue.

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[Total: 4]

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