Paper 5: Planning an Investigation: Cambridge (CIE) A Level Biology 9700 Exam Questions

22 questions · 58 marks · about 70 minutes. Answer in the spaces, then check the mark schemes at the end.

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1 Tree plantations are areas where trees are planted for a particular purpose. Some tree plantations increase the supply of wood for construction and fuel. In many plantations, fast-growing, alien tree species are planted.

Undergrowth is found in and around plantations, increasing plant biodiversity. Undergrowth is mainly made up of indigenous (native) small plants and shrubs.

Fig. 1.1 shows part of a plantation of eucalyptus trees.



Fig. 1.1

Bangladesh has many tree plantations as part of a national tree-planting programme.

Two fast-growing, alien tree species planted in Bangladesh are acacia, *Acacia auriculiformis*, and eucalyptus, *Eucalyptus camaldulensis*.

Acacia and eucalyptus are considered to be invasive species as they outcompete indigenous tree species such as sal tree, *Shorea robusta*, and mango, *Mangifera indica*.

Scientists carried out an investigation into the biodiversity of plant species in the undergrowth in plantations of alien trees compared with the undergrowth in plantations of indigenous trees.

The hypothesis that the scientists tested was stated as:

The undergrowth in plantations of alien tree species will have a lower biodiversity of plant species than the undergrowth in plantations of indigenous tree species.

(a) (i) Identify the independent variable in this investigation.

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Question 2 · Paper 5 · February/March 2025 (52) · Q3(a) · 2 marks

3 Type 1 diabetes is a disease that occurs when the pancreas stops producing insulin. Type 1 diabetes occurs most commonly in children and is often the result of the immune system destroying beta cells in the pancreas. Beta cells are the cells in the pancreas that make insulin.

Rotavirus is a genus of RNA viruses that can cause infections in people throughout most of the world. Infection by *Rotavirus* causes sickness and diarrhoea in babies and young children, and may damage the pancreas. *Rotavirus* infections are also associated with the development of type 1 diabetes in children.

In May 2007, a vaccination against *Rotavirus* was introduced in Australia. All babies aged from 2 months to 4 months were offered the *Rotavirus* vaccine.

Some scientists decided to investigate whether vaccination against *Rotavirus* had reduced the number of children with type 1 diabetes in Australia.

(a) Identify the **independent** variable **and** the **dependent** variable in this investigation.

independent variable .....

dependent variable .....

[2]

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2 Rice, *Oryza sativa*, is an important food crop. Rice plants are wind pollinated. Pollen containing the male gamete is transferred by the wind to female reproductive organs of rice plants. Fertilisation and grain formation then occur.

Weedy rice is a wild form of rice that grows in fields of cultivated rice. Weedy rice competes with cultivated rice for resources. Weedy rice plants are taller than cultivated rice plants and produce a low yield of rice grains.

Several genetically modified (GM) varieties of cultivated rice have been developed.

One concern about the use of GM rice is gene flow from GM rice plants to weedy rice. Gene flow occurs when the wind carries pollen from GM rice plants to weedy rice plants.

Some scientists investigated gene flow from herbicide-resistant GM rice plants to weedy rice plants. The GM rice plants had a gene for herbicide resistance. Weedy rice plants do not have the gene for herbicide resistance.

The scientists wanted to test the hypothesis that:

> Gene flow from GM rice to weedy rice decreases as the distance between the GM rice crop and weedy rice increases.

The scientists planted GM rice and weedy rice in a field, as shown in Fig. 2.1.

Fig. 2.1 also shows that the wind normally blows in a north–west (NW) direction.

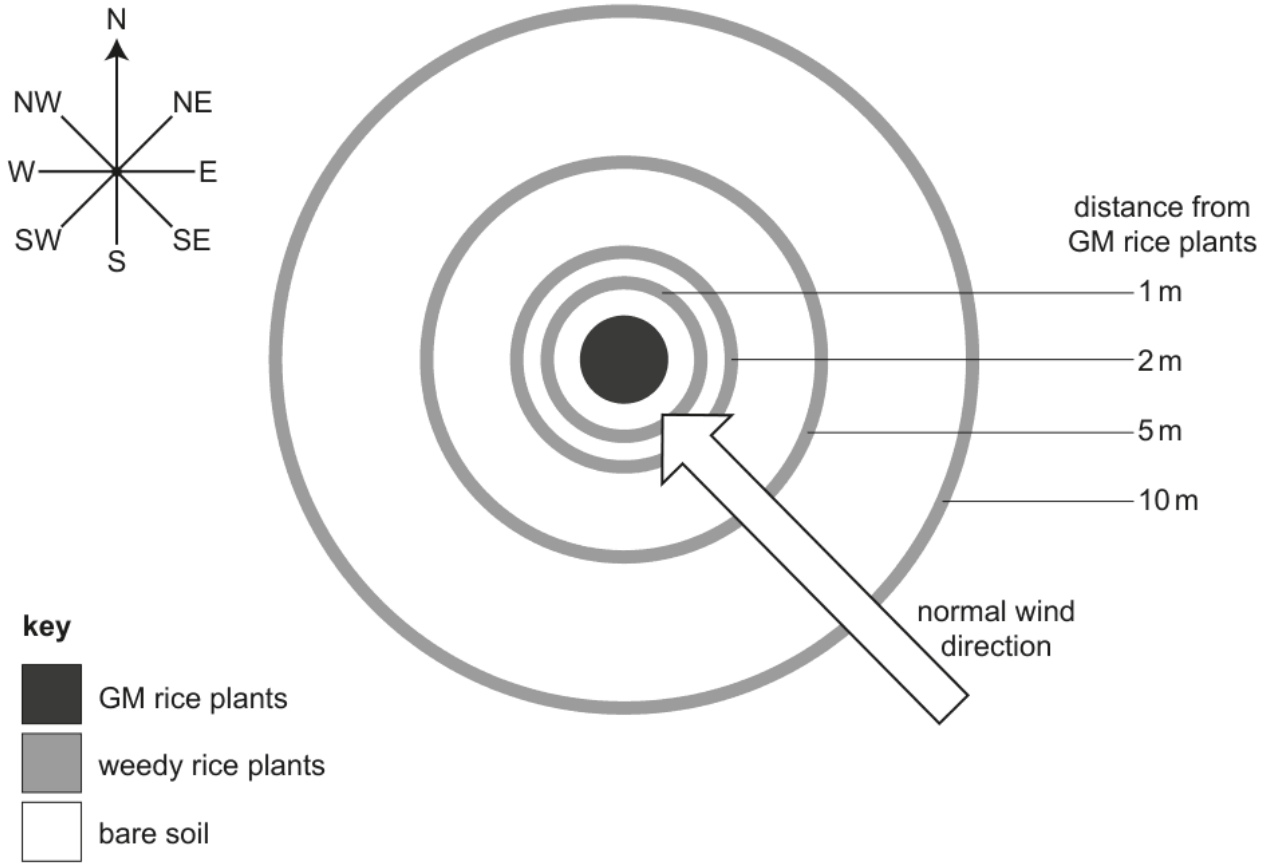


Fig. 2.1

After the plants had been pollinated and the rice grains had developed, the grains were collected from the **weedy** rice plants **only**.

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1 Fig. 1.1 **A** shows the root vegetable beetroot, *Beta vulgaris*.

Fig. 1.1 **B** shows a single cell from the beetroot tissue. The vacuole contains the red pigment, betalain.

The pigment molecules are too large to diffuse out of the vacuole.

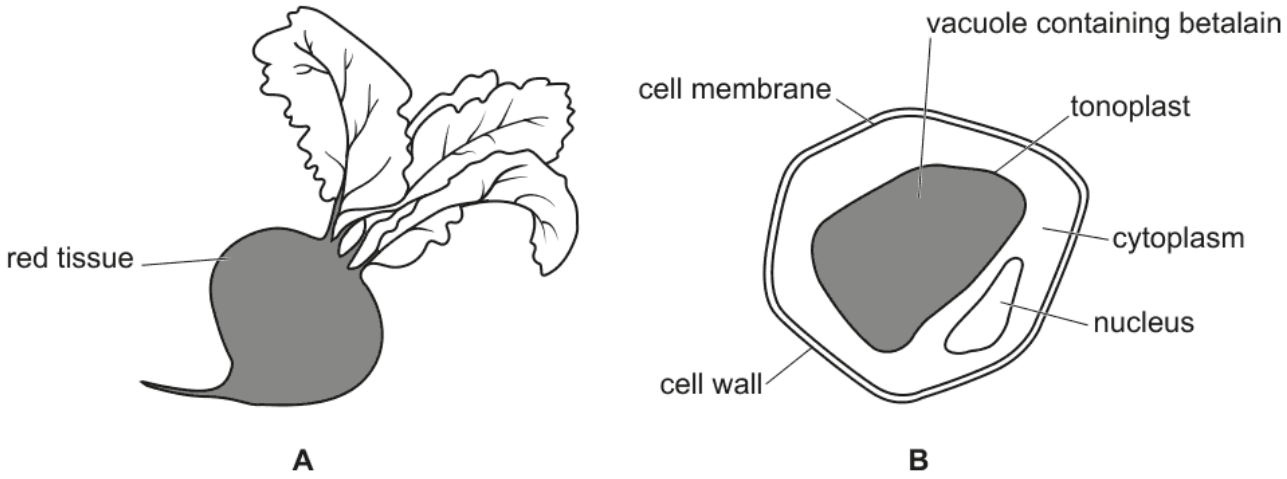


Fig. 1.1

When pieces of beetroot are soaked in a solution of calcium hypochlorite, $Ca(ClO)_2$, the beetroot tissue changes from red to white. This is caused by the calcium hypochlorite diffusing into the beetroot cell vacuoles and decolourising the betalain pigment.

Fig. 1.2 shows a cube of beetroot before soaking in the solution of calcium hypochlorite and the halved cube of beetroot after soaking in the solution of calcium hypochlorite.

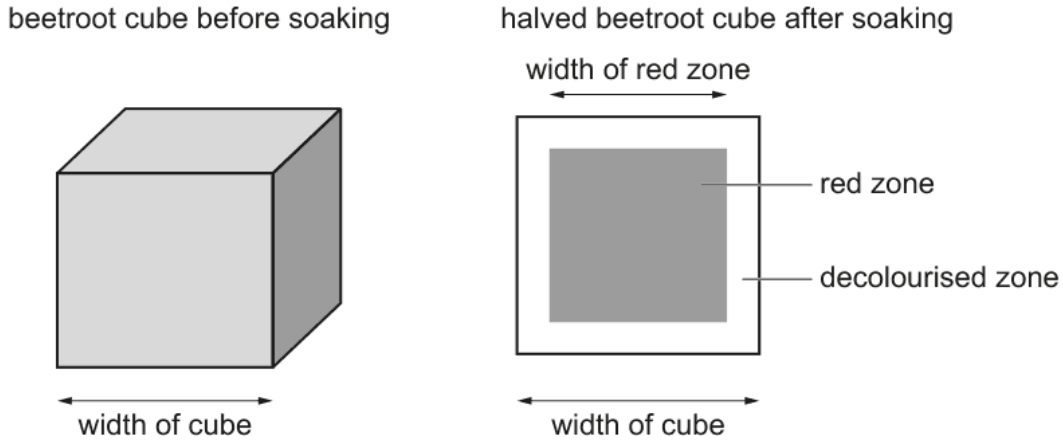


Fig. 1.2

In a class experiment:

- Cubes of beetroot of different dimensions were placed in a beaker containing a 10% solution of calcium hypochlorite.

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(ii) Sketch a curve on Fig. 1.3 to show how you expect the width of red tissue to change as the surface area:volume ratio changes if the hypothesis is correct.

Label the axes.



Fig. 1.3

[2]

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1 Potatoes are underground organs made by the potato plant, *Solanum tuberosum*.

Fig. 1.1 shows a potato plant.

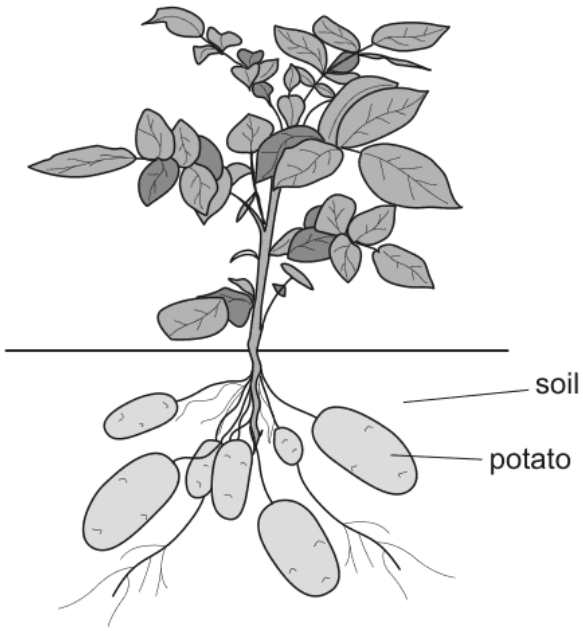


Fig. 1.1

Potatoes contain high quantities of starch and are a popular food. After harvesting, potatoes are stored. During storage, the starch content of potatoes gradually decreases due to the breakdown of starch molecules into glucose.

A glucose assay using a Benedict's test and a colorimeter can be used to determine the concentration of glucose in potatoes.

The glucose assay uses these steps:

- The outer skin is removed from a potato.
- The potato is cut into small pieces that are then ground into a pulp using a mortar and pestle.
- The potato pulp is filtered to remove most of the solids and obtain potato juice.
- Excess Benedict's solution is added to the potato juice.
- The mixture is heated in a water-bath at 90 °C for five minutes. During this five-minute period, copper ions (Cu^{2+}) in the Benedict's solution react with glucose in the potato juice to form an insoluble precipitate.
- The mixture is filtered to remove the precipitate. The filtrate, which is blue, contains copper ions that did not react with the glucose in the potato juice while the mixture was being heated.
- A sample of the blue filtrate is transferred to a colorimeter tube (cuvette).
- A colorimeter is used to measure the absorbance of the blue filtrate.
- A calibration curve is used to determine the glucose concentration of the potato juice from the measurement of absorbance.

Fig. 1.2 shows one type of colorimeter.

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(iii) Sketch, on Fig. 1.3, a graph of the expected calibration curve that the student would obtain.

Include the axis labels.



Fig. 1.3

[2]

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Question 7 · information from earlier in the question

1 The plantain lily, *Hosta plantaginea,* as shown in Fig. 1.1, is a flowering plant found in Asia.

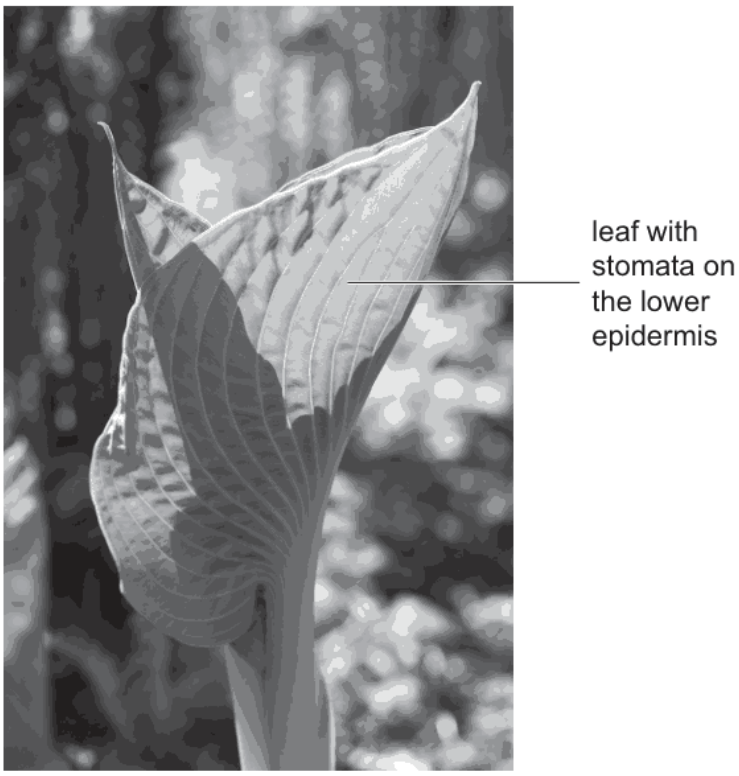


Fig. 1.1

The hydrostatic pressure increases inside guard cells when water enters the guard cells down a water potential gradient. This affects the width of the stomata.

Fig. 1.2 shows 1 open stoma from the plantain lily surrounded by 2 guard cells.

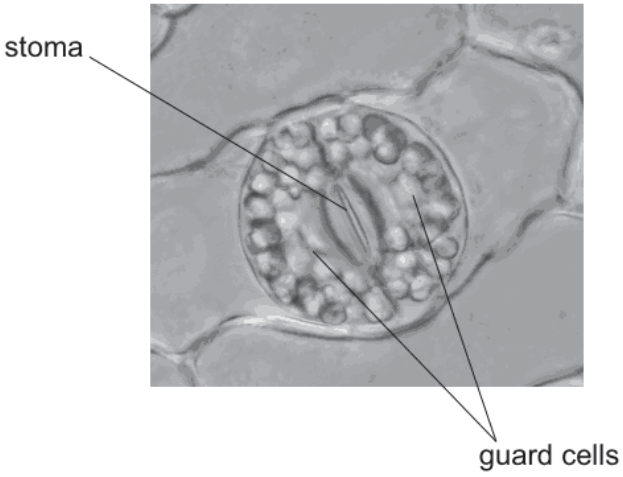


Fig. 1.2

A student investigated the effect of different sucrose solutions on the width of stomata in the leaves of plantain lily.

The student:

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Question 7 · Paper 5 · October/November 2025 (52) · Q1(a)(iv) · 2 marks

(iv) Predict the effect of increasing the sucrose concentration from 0.0% to 20.0% on the width of stomata in the leaves of plantain lily.

Explain your prediction.

prediction .....

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explanation .....

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[2]

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1 Tree plantations are areas where trees are planted for a particular purpose. Some tree plantations increase the supply of wood for construction and fuel. In many plantations, fast-growing, alien tree species are planted.

Undergrowth is found in and around plantations, increasing plant biodiversity. Undergrowth is mainly made up of indigenous (native) small plants and shrubs.

Fig. 1.1 shows part of a plantation of eucalyptus trees.



Fig. 1.1

Bangladesh has many tree plantations as part of a national tree-planting programme.

Two fast-growing, alien tree species planted in Bangladesh are acacia, *Acacia auriculiformis*, and eucalyptus, *Eucalyptus camaldulensis*.

Acacia and eucalyptus are considered to be invasive species as they outcompete indigenous tree species such as sal tree, *Shorea robusta*, and mango, *Mangifera indica*.

Scientists carried out an investigation into the biodiversity of plant species in the undergrowth in plantations of alien trees compared with the undergrowth in plantations of indigenous trees.

The hypothesis that the scientists tested was stated as:

The undergrowth in plantations of alien tree species will have a lower biodiversity of plant species than the undergrowth in plantations of indigenous tree species.

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Question 8 · Paper 5 · May/June 2024 (52) · Q1(a)(ii) · 2 marks

For the investigation, plantations were selected within the same region of Bangladesh with the same environmental conditions.

- Three plantations of each tree species were selected: acacia, eucalyptus, sal tree and mango.
- A plot measuring 36 m by 36 m was studied within each plantation.
- For each plot, belt transects were used to collect the data needed to determine Simpson's index of diversity (*D*).

For each type of plantation, Simpson's index of diversity (*D*) was calculated for the plant species in the undergrowth.

Each plot was studied in April, July and November.

(ii) Identify **two** variables the scientists standardised in this investigation.

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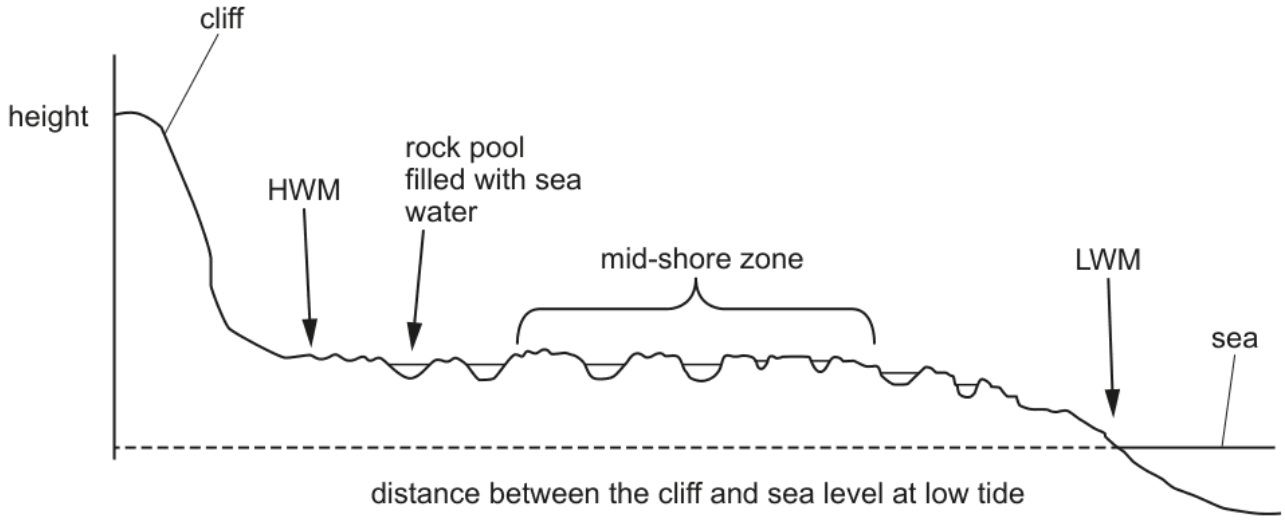
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1 Rocky shore ecosystems are found in some coastal regions. These ecosystems are inhabited by many different species of algae and animals. Twice each day the sea level rises to the high tide level and decreases to the low tide level in a regular pattern. The organisms in these ecosystems are exposed to very different conditions during the course of each day.

Algae are photosynthetic protoctists. Multicellular algae are found in many marine ecosystems.

Rock pools are formed in depressions in the shore as the water level lowers when the tide goes out.

Fig. 1.1 is a profile of a rocky shore ecosystem showing the positions of some rock pools. The mid-shore zone lies between the lower-shore zone and the upper-shore zone.



HWM = high-water mark – the highest point on the shore that is covered by sea water at high tide
LWM = low-water mark – the lowest point on the shore that is exposed to the air at low tide

Fig. 1.1

Fig. 1.2 shows a large rock pool on the mid-shore zone surrounded by smaller rock pools at low tide.



Fig. 1.2

A student investigated the distribution and abundance of large, multicellular algae on a rocky shore in North Wales in the UK at low tide on one day in October 2011.

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2 Air pollution due to motor vehicles is an environmental issue that needs constant monitoring.

Lichens consist of protoctists and fungi living in close association. The protoctists and fungi each benefit from this association. Lichens are found in a large range of habitats, including on the surface of tree trunks (tree bark), as shown in Fig. 2.1.



Fig. 2.1

Lichens are sensitive to air pollution. The abundance of lichens decreases with increasing levels of air pollution and so lichens can be used to monitor levels of air pollution.

Some scientists investigated the relationship between distance from a road and levels of air pollution. The scientists investigated this relationship by measuring the abundance of lichens on the tree trunks in a woodland beside a busy road.

The scientists used the grid shown in Fig. 2.2 to determine the abundance of lichens on the tree trunks.

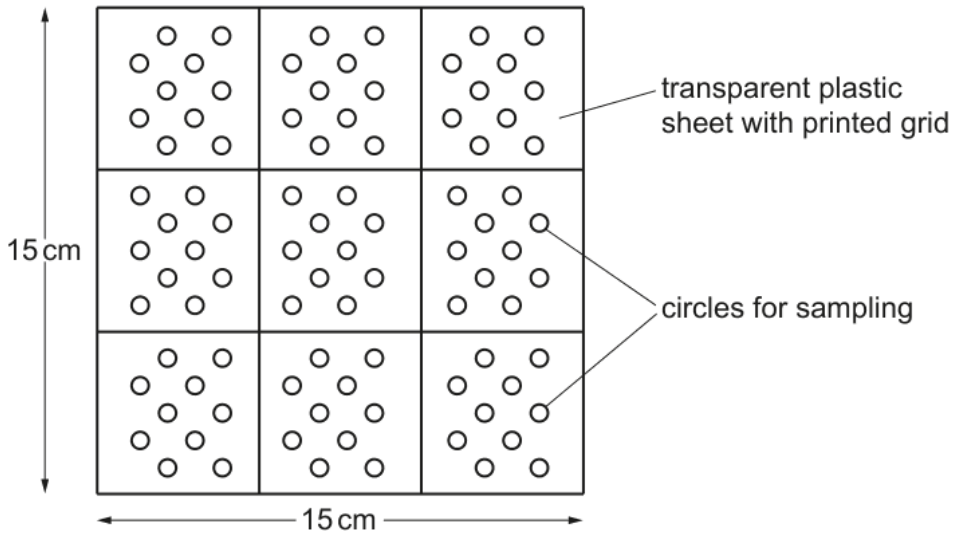


Fig. 2.2

For each tree sampled, the scientists:

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Question 11 · information from earlier in the question

2 An invasive alien species is a species that has been introduced into an ecosystem where it is not normally found and causes harm to this ecosystem. Invasive alien species can change habitats, reduce biodiversity and cause the extinction of native species. Saltcedar trees, *Tamarix* spp., are invasive alien species introduced to North America from Europe and Asia in the early 1800s.

A biologist carried out an investigation in a woodland ecosystem next to the Virgin River in Arizona, North America. In the woodland, there were areas that contained only saltcedar trees and areas that contained a mixture of native tree species and saltcedar trees.

The biologist wanted to test the hypothesis that:

The diversity of rodents (mice and rats) is lower in areas with only saltcedar trees than in areas with a mixture of native tree species and saltcedar trees.

Question 11 · Paper 5 · February/March 2022 (52) · Q2(b)(i) · 1 mark

(b) The biologist decided to trap rodents in an area with only saltcedar trees and to trap rodents in an area with a mixture of native tree species and saltcedar trees.

The biologist:

- placed 25 small mammal traps at random sites in each area of woodland
- baited each trap with 10 g of food for rodents
- checked each trap after 24 hours
- identified any rodents caught in the trap
- marked the rodents with an ear tag and released them back into the woodland
- carried out this trapping process on four days in April.

The number of **different** individuals of each rodent species trapped during the four trapping sessions was recorded.

(i) Identify **three** variables, **other than** the small mammal trap and ear tag, that the biologist standardised in this investigation.

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1 Some students wanted to investigate the effect of light intensity on the rate of photosynthesis in the Brazilian waterweed, *Egeria densa*. This plant is found in freshwater ponds.

The students used the apparatus shown in Fig. 1.1 in their investigation. A stand and clamp were used to hold the apparatus in a vertical position.

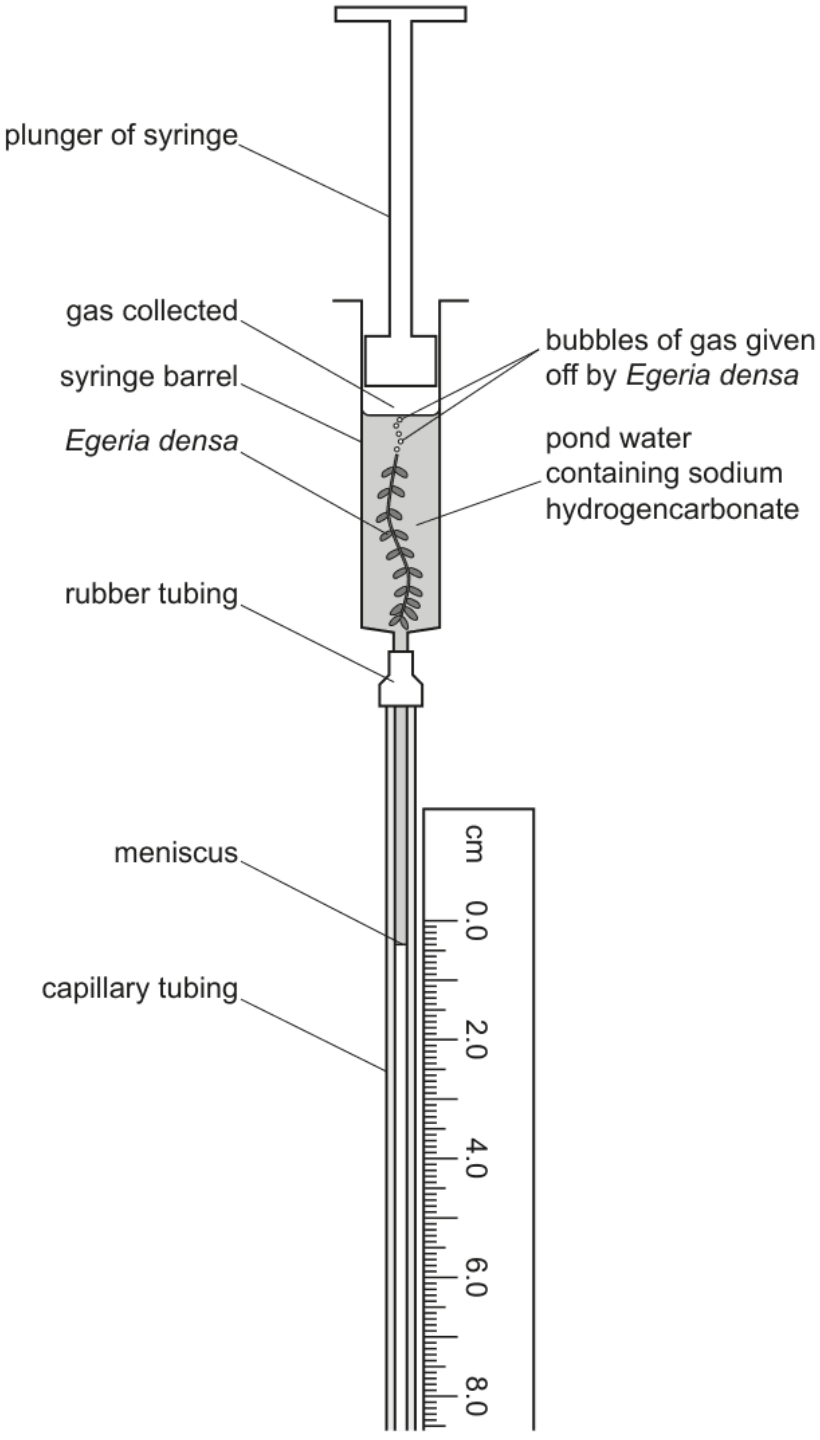


Fig. 1.1

The students carried out these steps to set up the apparatus shown in Fig. 1.1.

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2 A main feature of Huntington's disease (HD) is a loss of neurones from a region of the brain known as the striatum. A study of brain tissue taken from people with HD showed higher than normal (increased) urea concentrations in the anterior striatum and cerebellum regions of the brain.

Urea is a toxic waste product of amino acid and protein metabolism. It is produced from ammonia, which is also toxic, in an enzyme-controlled cycle known as the urea cycle.

Scientists carried out a study using transgenic (genetically modified) sheep, known as *OVT73*, to investigate the increased urea concentrations. *OVT73* have the mutant allele of the *Huntingtin* (*HTT*) gene. At the time of the study, *OVT73* were 5 years old and had no detectable loss of striatal neurones or disease symptoms.

Samples of tissue were taken from the same region of the anterior striatum in:
- six *OVT73* (three females and three males)
- a control group of non-transgenic sheep.

(a) Describe **two** features of an appropriate control group for this investigation.

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1 Egg albumen (egg white) is a good source of protein. Some eggs contain up to 10.0% w/v (100 g dm^{-3}) protein.

A biuret assay can be used to determine the concentration of protein in egg albumen.

- Biuret reagent is a mixture of copper(II) sulfate solution and sodium hydroxide solution.
- In a biuret assay, biuret reagent is added to a solution.
- If protein is present, copper(II) ions (Cu^{2+}) in the biuret reagent bind with the nitrogen atoms that form peptide bonds in the protein.
- This binding causes the reagent to change from a clear, pale blue to a purple colour.
- Different concentrations of protein result in different intensities of purple colour.

A colorimeter can be used to measure differences in the intensity of the purple colour in samples tested.

Fig. 1.1 shows a colorimeter that measures the absorbance of light when it passes through different coloured solutions.



Fig. 1.1

(a) Outline how a colorimeter is set up so that a test cuvette can be placed in the slot to obtain a correct measurement of intensity of a coloured solution.

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(b) A student carried out a biuret assay to determine the concentration of protein in egg albumen from eggs produced by a chicken that had been fed on a new type of chicken feed. The eggs produced by the chicken before eating the new feed contained 6.0% w/v of protein in the egg albumen.

Egg albumen is diluted to obtain a concentration that is suitable for testing in the biuret assay. For example, egg albumen with 6.0% w/v protein is diluted by a factor of 10 to obtain a 0.6% w/v solution for a biuret assay.

To carry out the biuret assay on egg albumen of unknown protein concentration, a calibration curve needs to be produced. This involves using standard solutions of known concentrations of protein.

(i) The range of concentrations that can be measured using a colorimeter in a biuret assay is 0.1 – 1.0% w/v.

A stock solution of 1.0% w/v protein can be diluted using distilled water to prepare the standard solutions of protein.

Describe how the student could prepare a 0.1% solution of protein using the stock solution.

Construct a table to show how the dilution is made for the 0.1% solution and for other concentrations the student could use to produce a calibration curve for the biuret assay.

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Space for table.

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Question 16 · Paper 5 · May/June 2024 (52) · Q1(d)(i) · 2 marks

In China, a different group of scientists investigated whether the roots of invasive plant species produce chemicals that have an effect on the growth of other plants.

The scientists prepared an extract of the roots of staghorn sumac, *Rhus typhina*. Staghorn sumac is an invasive plant species.

The scientists prepared a stock solution of the root extract with a concentration of $10\,mg\,cm^{-3}$. The scientists then used the stock solution to prepare solutions with different concentrations of root extract.

(d) (i) Describe how the scientists could use the stock solution to prepare **$50\,cm^3$** of solutions of the root extract with concentrations of $2.5\,mg\,cm^{-3}$ and $7.5\,mg\,cm^{-3}$.

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1 Some students wanted to investigate the effect of light intensity on the rate of photosynthesis in the Brazilian waterweed, *Egeria densa*. This plant is found in freshwater ponds.

The students used the apparatus shown in Fig. 1.1 in their investigation. A stand and clamp were used to hold the apparatus in a vertical position.

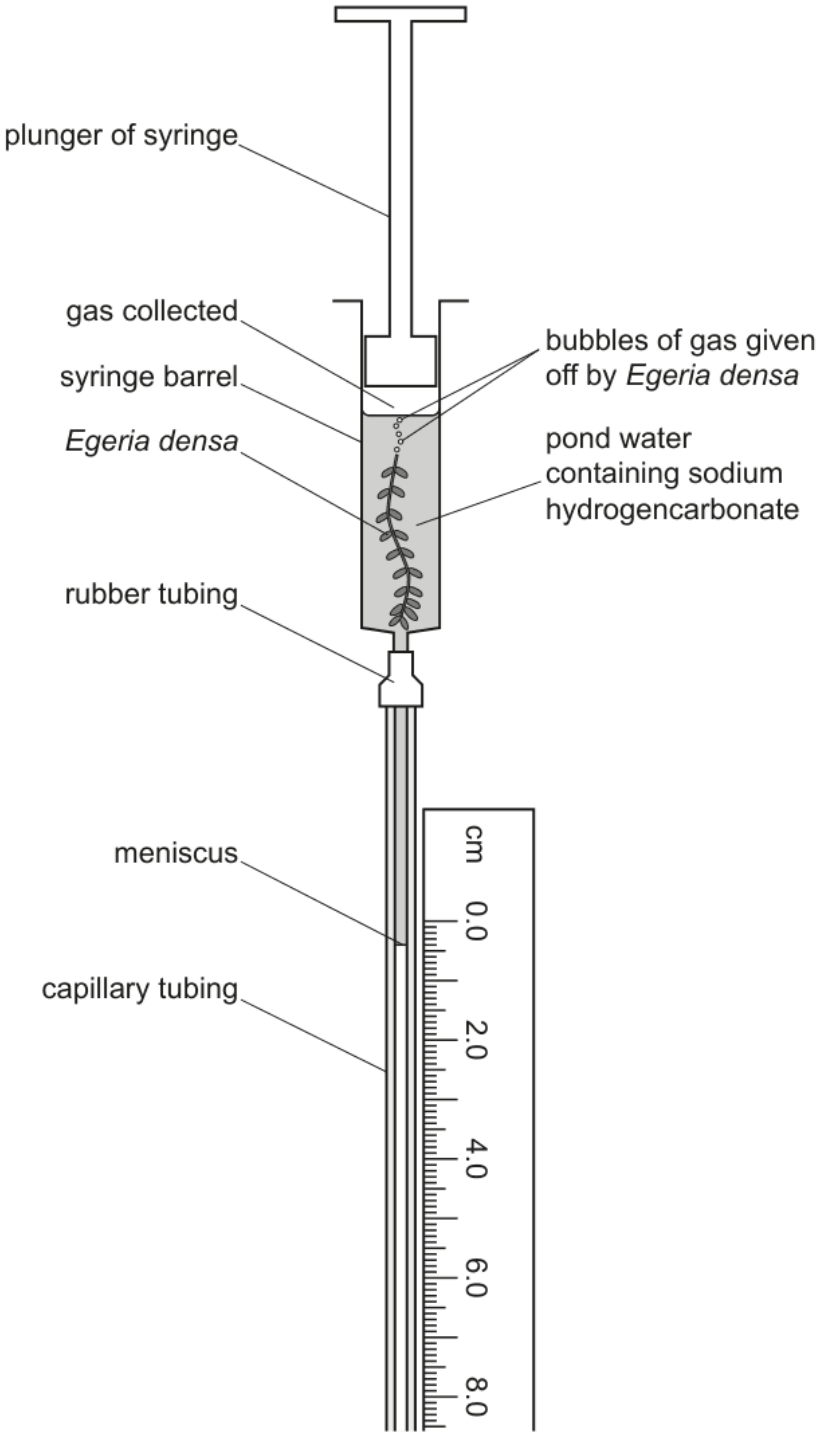


Fig. 1.1

The students carried out these steps to set up the apparatus shown in Fig. 1.1.

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Question 17 · Paper 5 · February/March 2022 (52) · Q1(b)(i) · 7 marks

(b) (i) Describe a method, using the apparatus shown in Fig. 1.1, that the students could use to investigate the effect of light intensity on the rate of photosynthesis of *E. densa*.

Your method should be set out in a logical order and be detailed enough to allow another person to follow it.

The steps carried out to set up the apparatus shown in Fig. 1.1 should **not** be included.

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Question 18 · information from earlier in the question

2 An invasive alien species is a species that has been introduced into an ecosystem where it is not normally found and causes harm to this ecosystem. Invasive alien species can change habitats, reduce biodiversity and cause the extinction of native species. Saltcedar trees, *Tamarix* spp., are invasive alien species introduced to North America from Europe and Asia in the early 1800s.

A biologist carried out an investigation in a woodland ecosystem next to the Virgin River in Arizona, North America. In the woodland, there were areas that contained only saltcedar trees and areas that contained a mixture of native tree species and saltcedar trees.

The biologist wanted to test the hypothesis that:

The diversity of rodents (mice and rats) is lower in areas with only saltcedar trees than in areas with a mixture of native tree species and saltcedar trees.

(b) The biologist decided to trap rodents in an area with only saltcedar trees and to trap rodents in an area with a mixture of native tree species and saltcedar trees.

The biologist:

- placed 25 small mammal traps at random sites in each area of woodland
- baited each trap with 10 g of food for rodents
- checked each trap after 24 hours
- identified any rodents caught in the trap
- marked the rodents with an ear tag and released them back into the woodland
- carried out this trapping process on four days in April.

The number of **different** individuals of each rodent species trapped during the four trapping sessions was recorded.

Question 18 · Paper 5 · February/March 2022 (52) · Q2(b)(ii) · 2 marks

(ii) Describe a method that the biologist could have used to select the trap sites randomly.

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Question 19 · information from earlier in the question

1 Fig. 1.1 **A** shows the root vegetable beetroot, *Beta vulgaris*.

Fig. 1.1 **B** shows a single cell from the beetroot tissue. The vacuole contains the red pigment, betalain.

The pigment molecules are too large to diffuse out of the vacuole.

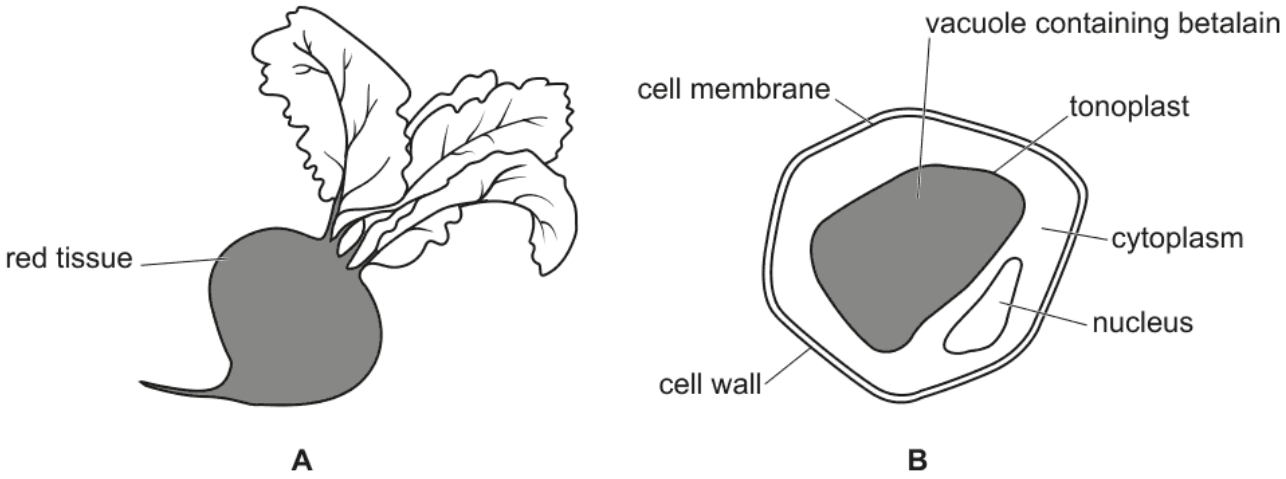


Fig. 1.1

When pieces of beetroot are soaked in a solution of calcium hypochlorite, $Ca(ClO)_2$, the beetroot tissue changes from red to white. This is caused by the calcium hypochlorite diffusing into the beetroot cell vacuoles and decolourising the betalain pigment.

Fig. 1.2 shows a cube of beetroot before soaking in the solution of calcium hypochlorite and the halved cube of beetroot after soaking in the solution of calcium hypochlorite.

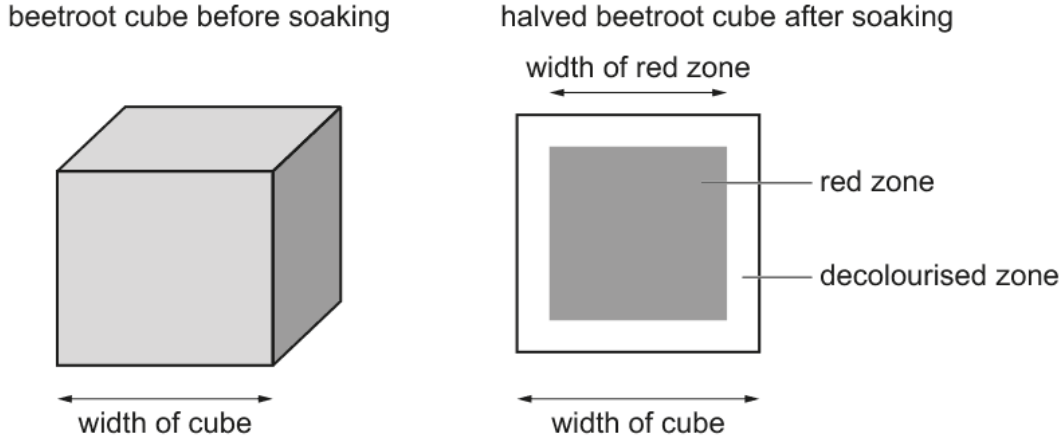


Fig. 1.2

In a class experiment:

- Cubes of beetroot of different dimensions were placed in a beaker containing a 10% solution of calcium hypochlorite.

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Question 19 · Paper 5 · May/June 2022 (52) · Q1(b)(i) · 7 marks

(b) (i) Describe a method the students could use to collect the data needed to test their hypothesis.

The students were provided with beetroot tissue, a 10% calcium hypochlorite solution and standard laboratory equipment.

Your method should be set out in a logical order and be detailed enough to let another person follow it.

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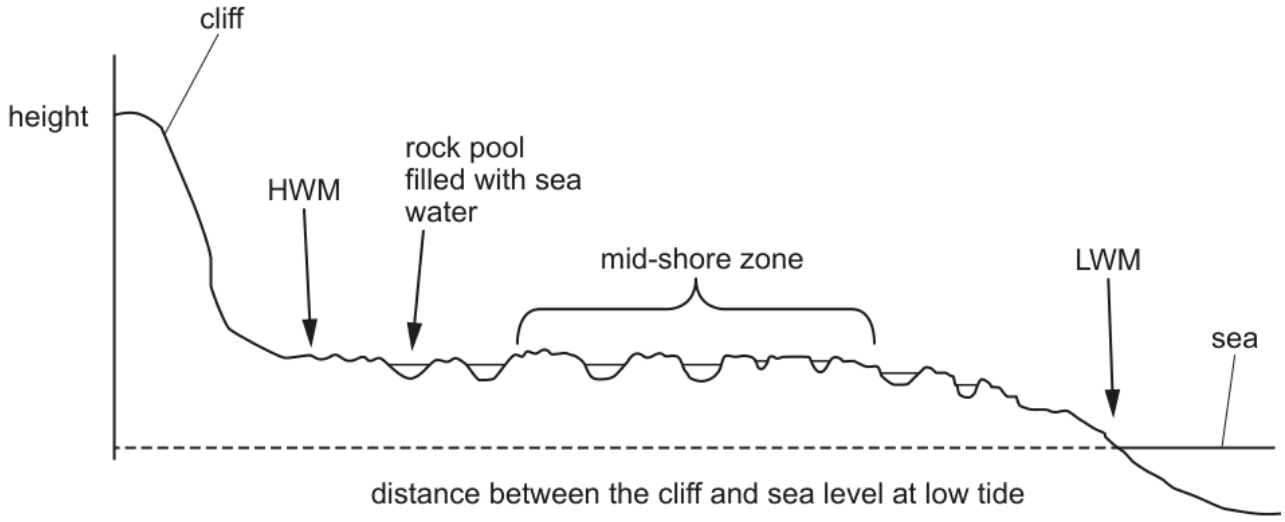
Question 20 · information from earlier in the question

1 Rocky shore ecosystems are found in some coastal regions. These ecosystems are inhabited by many different species of algae and animals. Twice each day the sea level rises to the high tide level and decreases to the low tide level in a regular pattern. The organisms in these ecosystems are exposed to very different conditions during the course of each day.

Algae are photosynthetic protoctists. Multicellular algae are found in many marine ecosystems.

Rock pools are formed in depressions in the shore as the water level lowers when the tide goes out.

Fig. 1.1 is a profile of a rocky shore ecosystem showing the positions of some rock pools. The mid-shore zone lies between the lower-shore zone and the upper-shore zone.



HWM = high-water mark – the highest point on the shore that is covered by sea water at high tide
LWM = low-water mark – the lowest point on the shore that is exposed to the air at low tide

Fig. 1.1

Fig. 1.2 shows a large rock pool on the mid-shore zone surrounded by smaller rock pools at low tide.



Fig. 1.2

A student investigated the distribution and abundance of large, multicellular algae on a rocky shore in North Wales in the UK at low tide on one day in October 2011.

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(d) The student noticed that part of the rocky shore had **no** rock pools. The student observed that the species of algae were not distributed equally on this part of the rocky shore from the LWM to the HWM.

Describe an investigation to find out how the distribution **and** abundance of the different species of algae varies on a rocky shore with **no** rock pools from the LWM to the HWM.

Your method should be set out in a logical order and be detailed enough for another person to follow.

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Question 21 · information from earlier in the question

1 Sand dunes are important ecosystems that are found in many regions of the world. Sand dune ecosystems can be damaged by natural events, such as extreme weather conditions, and by human activities including farming and tourism.

Fig. 1.1 is a map of part of a national park in a coastal area of northern Europe. The map shows the range of ecosystems present, including two types of sand dune ecosystem: yellow dune and grey dune.

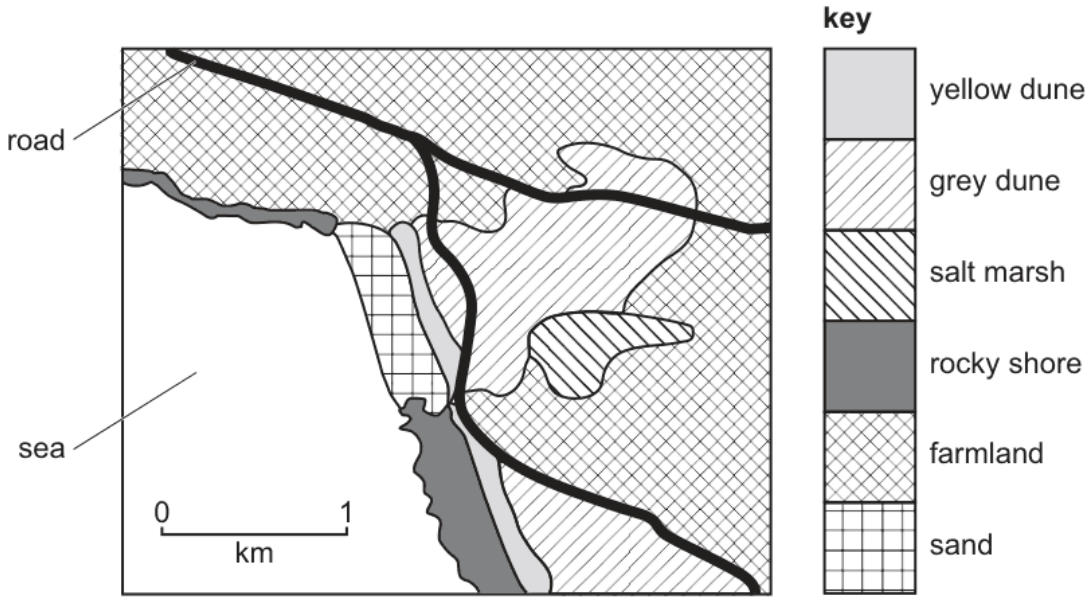


Fig. 1.1

A biologist decided to study the grey dune ecosystem. The biologist visited the ecosystem in the summer, in the month of June.

(c) The national park managers introduced some conservation practices to protect the grey sand dune ecosystem and maintain biodiversity.

The biologist decided to investigate changes to the ecosystem during the ten-year period after the conservation practices were introduced.

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Question 21 · Paper 5 · February/March 2025 (52) · Q1(c)(ii) · 7 marks

(ii) Describe a method the biologist could use to investigate changes in the species diversity of the plants in the grey dune ecosystem during the ten-year period after the conservation practices were introduced.

Your method should be set out in a logical order and be detailed enough to allow another person to follow it.

Details of how to calculate Simpson's index of diversity should **not** be included.

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2 Air pollution due to motor vehicles is an environmental issue that needs constant monitoring.

Lichens consist of protoctists and fungi living in close association. The protoctists and fungi each benefit from this association. Lichens are found in a large range of habitats, including on the surface of tree trunks (tree bark), as shown in Fig. 2.1.



Fig. 2.1

Lichens are sensitive to air pollution. The abundance of lichens decreases with increasing levels of air pollution and so lichens can be used to monitor levels of air pollution.

Some scientists investigated the relationship between distance from a road and levels of air pollution. The scientists investigated this relationship by measuring the abundance of lichens on the tree trunks in a woodland beside a busy road.

The scientists used the grid shown in Fig. 2.2 to determine the abundance of lichens on the tree trunks.

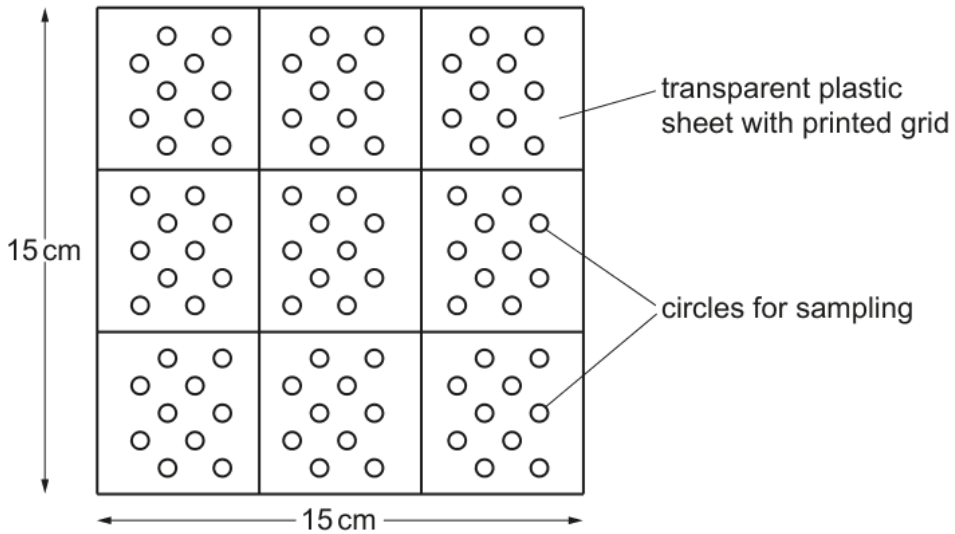


Fig. 2.2

For each tree sampled, the scientists:

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Question 22 · Paper 5 · May/June 2023 (52) · Q2(a)(ii) · 2 marks

(ii) State **one** risk **and** the safety precaution that the scientists should take when measuring the abundance of the lichens on the tree trunks.

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Mark schemes

Question 1 · Paper 5 · May/June 2024 (52) · Q1(a)(i) · 1 mark

1(a)(i)	species of tree **or** type of tree ;	**1**

Question 2 · Paper 5 · February/March 2025 (52) · Q3(a) · 2 marks

3(a)	*independent variable:* vaccinated or not vaccinated (against *Rotavirus*) ; *dependent variable:* number of children with (type 1) diabetes (per 100 000 population in Australia) ;	**2**

Question 3 · Paper 5 · February/March 2023 (52) · Q2(a)(i) · 1 mark

2(a)(i)	distance from GM rice plants **and** direction from GM rice plants ;	**1**

Question 4 · Paper 5 · May/June 2022 (52) · Q1(a)(i) · 1 mark

1(a)(i)	width of red area after soaking **or** width of red area remaining ;	**1**

Question 5 · Paper 5 · May/June 2022 (52) · Q1(a)(ii) · 2 marks

1(a)(ii)	axes correctly labelled for independent and dependent variable ; line / smooth curve, showing inverse correlation ;	**2**

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Question 6 · Paper 5 · February/March 2023 (52) · Q1(a)(iii) · 2 marks

1(a)(iii)	correct axis labels **and** orientation ; *x*-axis label: percentage glucose concentration *y*-axis label: absorbance (no units or absorbance units or arbitrary units) appropriately shaped line ; line with negative gradient	**2**

Question 7 · Paper 5 · October/November 2025 (52) · Q1(a)(iv) · 2 marks

1(a)(iv)	*predict:* (as sucrose concentration increases width of stomata) decreases ; *Explain (must match the prediction)*: (as the sucrose concentration increases) water leaves the guard cells, by, osmosis / down a water potential gradient / from high to low water potential ; **or** (as the sucrose concentration increases) **less** water **enters** the guard cells, by osmosis / down a water potential gradient from high to low water potential ;	**2**

Question 8 · Paper 5 · May/June 2024 (52) · Q1(a)(ii) · 2 marks

1(a)(ii)	*any **two** from:* 1 (same) number of / 3, plantations for each tree species ; 2 (same) size/area of, plot/(sampling)area / 36 m x 36 m / 1296m^2 ; 3 (same / used a) belt transect (same method in all plots/plantations) ; 4 (same) months / seasons (of the year) **or** sampling at the same times ;	**2**

Question 9 · Paper 5 · October/November 2023 (52) · Q1(a) · 2 marks

1(a)	*any **two** from* 1 low tide ; 2 day / date / month / season ; 3 (same) rocky shore / (same) location ; 4 (mid-shore) zone ; 5 random selection of rock pools ; 6 deepest part of rock pool measured ;	**2**

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Question 10 · Paper 5 · May/June 2023 (52) · Q2(a)(i) · 2 marks

2(a)(i)	*any **two** from:* type /species of tree / type of bark ; height (of grid) above ground ; side / aspect of tree ; age / size of tree ; AVP grid placed horizontally / orientated as diamond shape ;	**2**

Question 11 · Paper 5 · February/March 2022 (52) · Q2(b)(i) · 1 mark

2(b)(i)	three standardised variables ; *from:* 25 traps / same number, of traps in each area 25 traps / same number, of traps in each trapping session mass / 10 g, food (for rodents) / bait time interval / 24 hours, before checking trap four / same number of, days / sessions (for each area) month / April / season / time of year	**1**

Question 12 · Paper 5 · February/March 2022 (52) · Q1(a) · 1 mark

1(a)	*idea of* replace (live) water plant / *Egeria densa* with: dead / AW, water plant (of the same volume) **or** sterile / inert / glass beads / AW, material (of same volume) **or** pond water with sodium hydrogencarbonate (no water plant) ;	**1**

Question 13 · Paper 5 · October/November 2022 (52) · Q2(a) · 1 mark

2(a)	*any **two** from:* 1 same number of each sex ; 2 same / similar, age **or** five years old ; 3 same, breed / type / AW (of sheep) ; 4 same / similar, mass / size ; 5 do not have, mutation / mutant allele / Huntington's (disease / allele) / neurological disease ;	**1**

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Question 14 · Paper 5 · October/November 2022 (52) · Q1(a) · 2 marks

1(a)	*any **two** from:* 1 use coloured filter / set wavelength ; 2 calibrate colorimeter / <u>set</u> colorimeter (absorbance) to zero ; 3 water (used to calibrate colorimeter) ;	**2**

Question 15 · Paper 5 · October/November 2022 (52) · Q1(b)(i) · 2 marks

1(b)(i)	*From description **or** table:* 1 Correct method to dilute stock solution with water to 0.1% ; *Table:* 2 At least five stated concentrations including 0.1%, **all** with correct volumes of stock **and** water including volume units and concentration unit ;	**2**

Question 16 · Paper 5 · May/June 2024 (52) · Q1(d)(i) · 2 marks

1(d)(i) **2**

concentration / mg cm^{-3}	volume of stock solution / cm^3	volume of (distilled) water / cm^3
7.5	37.5	12.5 ;
2.5	12.5	37.5 ;

Question 17 · Paper 5 · February/March 2022 (52) · Q1(b)(i) · 7 marks

1(b)(i)	*any **seven** from:*	**7**
	1 use, lamp / AW, at different distances from plant **or** use, lamp / AW, with different power ratings / wattages (at same distances) ;	
	2 use a minimum of five, different / stated, light intensities / AW ;	
	3 use, a light meter / an app, to measure light intensity ;	
	4 carry out investigation, in a darkened room / with no other light source / AW ;	
	5 measure / note / record, the distance the, meniscus / AW, moves along the capillary tube / scale, in a fixed time **or** measure / note / record, the time the, meniscus / AW, takes to travel, a fixed distance on the capillary tube / scale ;	
	6 use, same / stated, length of water plant / *Egeria densa* ;	
	7 use, same / stated, mass / concentration, of sodium hydrogencarbonate ;	
	8 use a method to reduce heating effect of lamp ;	
	9 *idea of* equilibration / acclimatisation, of, water plant / *Egeria densa* / whole apparatus (to each light intensity) ;	
	10 use at least three measurements (at each light intensity / AW,) **and** calculate a mean ;	
	11 safety comment with hazard, risk **and** precaution ;	

Question 18 · Paper 5 · February/March 2022 (52) · Q2(b)(ii) · 2 marks

2(b)(ii)	any suitable method of generating, random numbers / coordinates / positions ; use the numbers generated, as coordinates / grid reference, to locate each trap site ;	**2**

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Question 19 · Paper 5 · May/June 2022 (52) · Q1(b)(i) · 7 marks

1(b)(i) — **7**

*any **seven** from:*

1 use, same / same age, beetroot ;
2 minimum 5 cubes with different, size / dimensions ;
3 widths evenly spaced / if stated must be within range 0.5–5 cm ;
4 equipment for cutting / measurement of cubes ;
5 calculate / AW, the SA:V ratio ;
6 cubes are fully, covered / submerged, (by calcium hypochlorite) ;
7 remove after, same / stated, time (minutes) ;
8 method of maintaining the same temperature (once cubes are immersed) ;
9 method of drying cubes (after soaking) ;
10 cut in half and measure the width of the red tissue after soaking ;
11 repeat experiment a minimum of twice and calculate a mean ;
12 named hazard and risk and precaution ;

hazard	risk	precaution
calcium hypochlorite	Irritant / harmful / toxic / corrosive	gloves / goggles PPE / tweezers
scalpel	cuts / injury, to skin	cut away from fingers / cut on a tile
beetroot	allergen	gloves

Question 20 · Paper 5 · October/November 2023 (52) · Q1(d) · 7 marks

1(d) — **7**

*any **seven** from*

sampling process
1 belt transect ;
2 place a, rope / AW, from LWM to HWM ;
3 sample at regular intervals along the transect ;
4 use a quadrat ;
5 same / same size of, quadrat ;

measuring process
6 method of identifying species (of algae) ;
7 take care not to miss small species ;
8 (count / record) number of (different) species (of algae) (in each quadrat) ;
9 method for determining abundance of each species (in each quadrat) ;
10 repeat belt transect at two other positions along the shore and calculate means ;
11 named suitable hazard and risk and precaution ;
12 AVP ;

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Question 21 · Paper 5 · February/March 2025 (52) · Q1(c)(ii) · 7 marks

1(c)(ii) — *any **seven** from:* — **7**

1 use quadrats ;

2 method of, random / systematic, placement of quadrats ;

3 use, same / stated, size (frame / point), quadrat ;

4 method of identifying (plant) species ;

5 count the number of individuals of each (plant) species ;

6 *idea of* taking care to note, low growing / small / easy to miss, species ;

7 *idea of* sampling, 10 or more / AW, separate points / quadrats (in the grey dune habitat) ;

8 (measure biodiversity of plant species) at regular intervals (over the 10-year period) **and** at the same time of the year ;

9 repeat (whole investigation over 10 years) at different, times of year / seasons ;

10 named hazard **and** risk **and** precaution ;

hazard	risk	precaution
plants / pollen	allergy / irritation / injury	gloves / eye protection / mask / PPE / protective clothing
animals	allergy / irritation / injury	gloves / eye protection / mask / PPE / protective clothing
grey dunes / ecosystem	getting lost / trip hazard / injury	wear suitable shoes / clothes / gloves / PPE stay, in a group / with expert / ranger

Question 22 · Paper 5 · May/June 2023 (52) · Q2(a)(ii) · 2 marks

2(a)(ii) — **2**

Hazard and risk – 1 mark ;		Precaution – 1 mark ;
Trees / plants / leaves / bark / pollen	scratches / allergy / irritation toxins	suitable PPE / medication don't ingest
Animals /Animal waste	dangerous / allergy / bites / toxoplasmosis	medication / work in a group / travel with an expert /suitable PPE
Fungi / Lichen	irritation / allergic reaction toxic / poisonous	suitable PPE do not ingest
Inhaling fungal spores	(lung) infection	wear a mask
Traffic	collision / fumes / air pollution	cone off the road / hi vis vest / look + listen / suitable PPE
Woods / holes /trip hazards	Injury from trips / falling / falling branches / getting lost / hypodermic needles	look where you're stepping / hard hat / don't climb trees / GPS / map

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