OCR
Oxford Cambridge and RSA

Friday 24 May 2019 – Morning

AS Level Biology A

H020/02 Depth in biology

Time allowed: 1 hour 30 minutes

6439501670

You must have:
- the Insert (inserted)

You may use:
- a scientific or graphical calculator
- a ruler (cm/mm)

H020002

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*****).
- This document consists of **24** pages.

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Answer **all** the questions.

1 Aphids are small insects that feed on the sap that is translocated through the plant in the phloem. These insects insert their fine mouthparts, stylets, into phloem tissue and allow the sap to flow out of the phloem.

One method of collecting sap is to allow the aphid to feed as shown in Fig. 1.

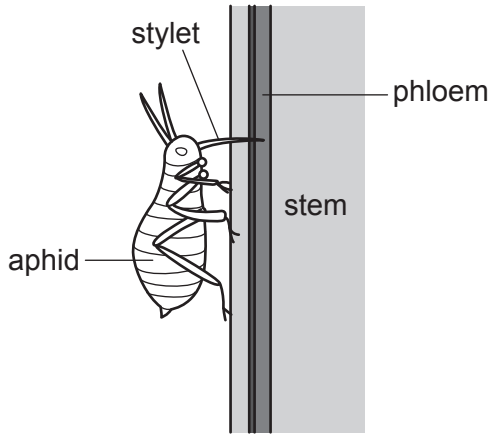


Fig. 1

The aphid is then anaesthetised and the stylet is cut off close to the aphid's head. The sap can then be collected and analysed.

A researcher analysed the sap collected and the results are shown in Table 1.

Substance tested for	Conclusion
glucose	negative
starch	negative
sucrose	positive

Table 1

(a) (i) Phloem tissue is made up of different cell types.

Identify the type of phloem cell into which the stylet is inserted to obtain the sap.

..... **[1]**

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(ii) Separate samples of the sap were tested for the presence of glucose, starch and sucrose.

Using Table 1, complete the following passage, using the most appropriate terms.

In order to test for the presence of glucose, ...

..... was added to the sap sample and boiled. The final colour was ..... and so it was possible to arrive at the conclusion shown in Table 1.

When iodine solution was added to the sap sample, the final colour was ..... . To test for the presence of sucrose, the sample was first boiled with ..... . After the rest of the test had been completed, the colour of the mixture indicated that sucrose was present in the sample. **[4]**

(b) Sucrose is carried in phloem sap from source to sink.

(i) Explain why starch is not transported in the sap.

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..... **[1]**

(ii) Suggest why sucrose is a more suitable transport molecule than glucose.

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..... **[1]**

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2 Fig. 2, **on the insert**, is a photomicrograph of a mammalian blood smear.

(a) Calculate the image length, in μm, represented by the scale bar.

Give your answer to **2** significant figures.

length = ... μm **[2]**

(b) **(i)** Name the cell labelled **B**.

..... **[1]**

(ii) Cells **A**, **C** and **D** work together to carry out an important function.

State the function that cells **A**, **C** and **D** perform.

..... **[1]**

(c) The smear has been stained with haematoxylin and eosin stain. This is a differential stain.

- Haematoxylin stains nucleic acid blue.
- Eosin stains protein (including cytoplasmic proteins) pink or red.

(i) Explain why it is important to use a differential stain when examining a blood smear under the microscope.

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(ii) Using Fig. 2 **on the insert**, and the information provided, suggest **and** explain why the cytoplasm of cell **C** and cell **D** reacted differently to the stain.

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..... **[4]**

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3 **(a)** The Scottish wildcat and European wildcat are both classified in the same species, *Felis silvestris*. Researchers have suggested that both wildcats originated from the same population.

During the Ice Age, the British Isles were connected by ice to mainland Europe.

- After the Ice Age, sea levels rose and the British Isles became isolated from the rest of Europe. The isolated population of wildcats in the British Isles developed slightly different characteristics from the mainland population in Europe.
- A subspecies is a group of individuals that is geographically isolated from others of the same species and that is distinguishable from other populations of the same species.
- The Scottish wildcat is now classified as the subspecies *Felis silvestris grampia* and the European wildcat as the subspecies *Felis silvestris silvestris*.

(i) Name the genus of the Scottish wildcat.

..... **[1]**

(ii) The information above states that 'the isolated population of wildcats in the British Isles developed slightly different characteristics from the mainland population in Europe'.

What is the term used to describe the differences between the two populations of wildcat?

..... **[2]**

(iii) Suggest why the Scottish wildcat and the European wildcat **cannot** yet be classified as different species.

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..... **[2]**

(b) By the 19th century, the wildcat population in the British Isles had decreased as it had been under threat from deforestation and hunting. The wildcat could only be found in Scotland.

(i) Suggest one reason why the wildcat was hunted.

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..... **[1]**

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(ii)* Current estimates of the Scottish wildcat population vary. Recent reports by the Scottish Wildcat Association indicate that fewer than 100 individuals, possibly as few as 35, remain in the wild. These individuals occur only in the most remote, uninhabited areas of the Scottish Highlands.

Biodiversity can be considered at several levels. A scientist concluded that the biodiversity of the Scottish Highlands would continue to reduce because of the small population of Scottish wildcats.

Evaluate the scientist's conclusion with reference to genetic biodiversity and species biodiversity.

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(c) With Scottish wildcat numbers at their lowest ever, decisive action has been taken.

In the West Highlands of Scotland, remote land has been targeted to establish a wildcat haven. The land chosen is mostly surrounded by sea, far away from other populations.

Table 3 lists some details of the action that has already been taken and will be taken in the future to protect the Scottish wildcat.

A	The wildcat haven has been established in an area of land mostly surrounded by sea.
B	Over the past few years all domestic cats, wild cats and Scottish wildcats in the area have been neutered.
C	Over the past few years all domestic cats, wild cats and Scottish wildcats in the area have been checked for disease.
D	In the near future, Scottish Natural Heritage and Chester Zoo plan to establish a breeding and release project for pure-bred Scottish wildcats.

Table 3

Indicate which of the **letter or letters**, **A** to **D**, in Table 3 apply to each of the following statements.

(i) An example of ex-situ conservation.

..... **[1]**

(ii) Helps to prevent the domestic and wild cats mixing freely with the Scottish wildcats in the haven.

..... **[1]**

(iii) Contributes to maintaining a healthy population in the wildcat haven.

..... **[1]**

(iv) Contributes to maintaining the genetic purity of the Scottish wildcat.

..... **[1]**

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4 An investigation was carried out into the loss of water from a leafy shoot. The apparatus used is shown in Fig. 4.1.

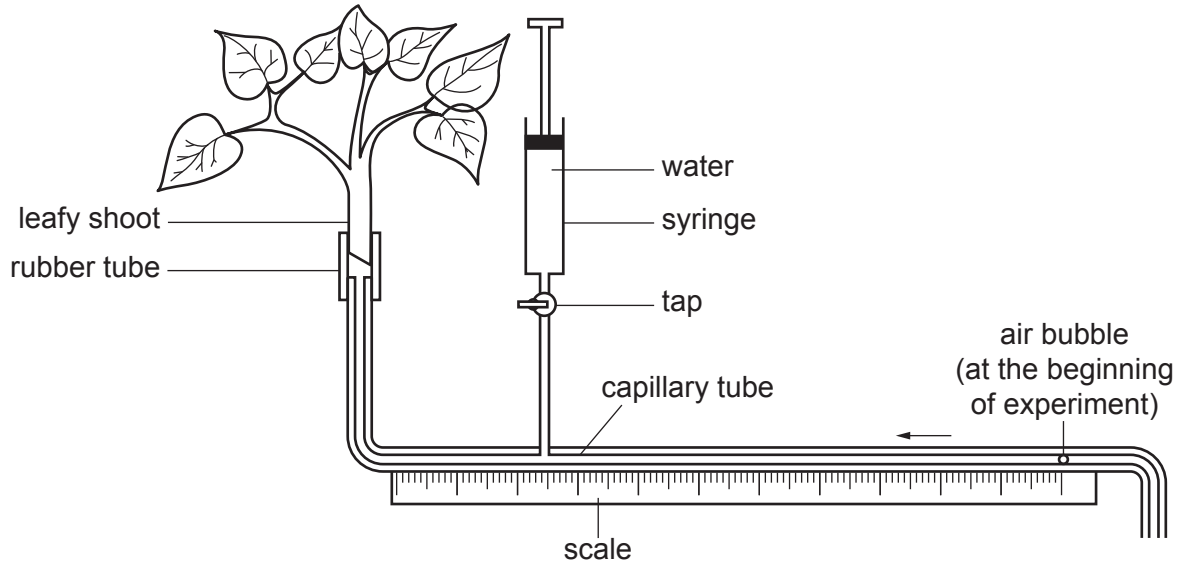


Fig. 4.1

(a) (i) State what assumption is made when using this apparatus to measure the rate of transpiration.

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..... **[1]**

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(ii)* There must be no air in the apparatus in Fig. 4.1 for it to work correctly.

Describe and explain the precautions that need to be taken when setting up and using the apparatus in Fig. 4.1 to ensure that no air is present.

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Additional answer space if required.

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(b) A student obtained replicate readings for the movement of the air bubble during five minutes in three different conditions. The results are shown in Table 4.1.

Condition	Distance moved by bubble in 5 minutes (mm)						
	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	**Trial 6**	**Mean**
In still air	89	84	86	87	85	86	86.2
With an electric fan	142	139	144	138	139	141	140.5
In still air and lower leaf surface covered with petroleum jelly	32	28	31	57	27	29	34.0

Table 4.1

(i) Identify an anomalous reading in the data **and** evaluate the extent to which it has affected the mean that has been calculated.

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..... **[3]**

(ii) Suggest a reason for the reading that you identified as anomalous in **(i)**.

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..... **[1]**

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(iii) The internal diameter of the capillary tubing was 0.7 mm.

Table 4.2 shows the mean rate of transpiration in each of the experimental conditions.

Condition	Mean rate of transpiration ($mm^3 min^{-1}$)
In still air	
With an electric fan	10.81
In still air and lower leaf surface covered with petroleum jelly	2.62

Table 4.2

Calculate the mean rate of transpiration for the leafy shoot in still air.

Use the formula: Volume of a cylinder $= \pi r^2 l$

rate of transpiration = ... $mm^3 min^{-1}$ **[3]**

(iv) The control experiment in this investigation was to measure the mean rate of transpiration in still air.

Explain why the control experiment is carried out in this investigation.

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..... **[1]**

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(c) Another student suggested using an alternative apparatus for measuring the rate of transpiration of a leafy shoot. Fig. 4.2 shows this apparatus.

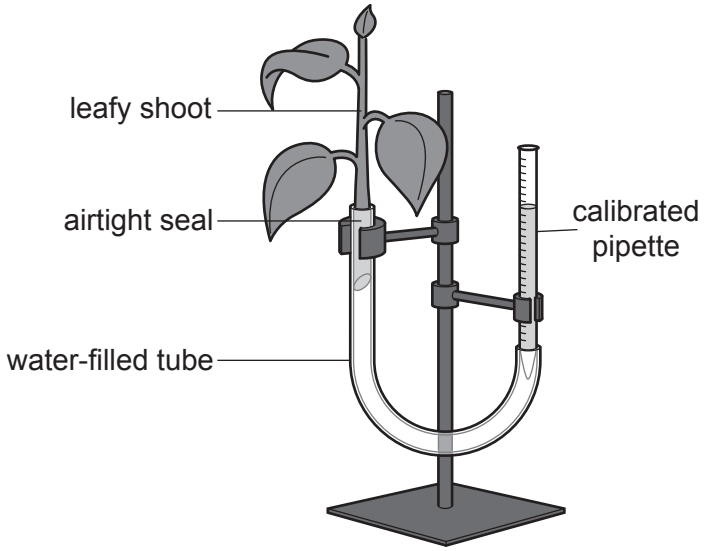


Fig. 4.2

The student stated that this apparatus would be an improvement on the apparatus shown in **Fig. 4.1** because the volume of water taken up could be measured directly.

Suggest why it might be considered better to use a capillary tube rather than a calibrated pipette to measure water uptake.

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..... **[1]**

(d) The student wanted to compare the rates of transpiration of the two leafy shoots shown in Fig. 4.3.



Fig. 4.3

Describe how the student could ensure that a valid comparison could be made between the two leafy shoots.

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5 *Paramecium caudatum* is a protoctist. The structure of this organism is shown in Fig. 5.

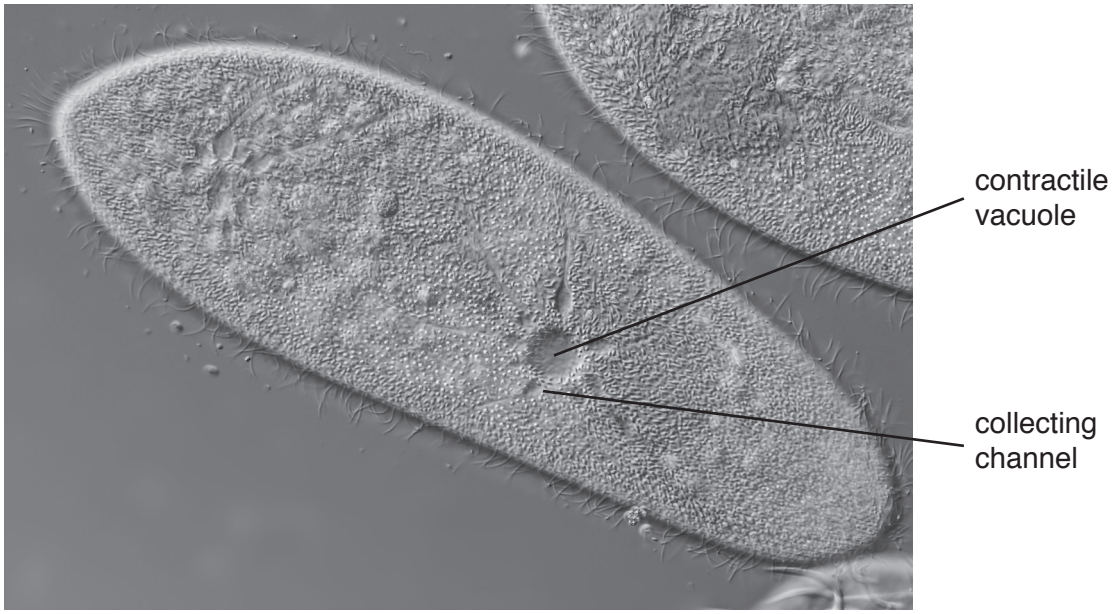


Fig. 5

Most species of *Paramecium* are freshwater organisms. Over a period of time water from the cytoplasm is collected by the collecting channels. They pass the water into the contractile vacuole. Once the contractile vacuole is full, it contracts, expelling the contents from the cell.

(a) Explain why *Paramecium* needs to expel water when in fresh water.

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..... **[2]**

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(b) An experiment was carried out in which the frequency of vacuole contraction was observed when *Paramecium* was bathed in different concentrations of sodium chloride solution. The results are shown in Table 5.

Concentration of sodium chloride solution ($mol\,dm^{-3}$)	Mean number of contractions (min^{-1})
0.00	6.5
0.01	6.2
0.03	5.7
0.05	4.9
0.10	4.4
0.15	3.9
0.20	1.2

Table 5

(i) Calculate the percentage decrease in the mean number of contractions as the concentration of sodium chloride solution increases from $0.00\,mol\,dm^{-3}$ to $0.15\,mol\,dm^{-3}$.

percentage decrease = ... % **[2]**

(ii) Explain why there is a decrease in the activity of the contractile vacuole as the concentration of sodium chloride increases.

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..... **[2]**

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(iii) The cytoplasm of *Paramecium* contains salt crystals. These salt crystals can be used to alter the water potential of the cytoplasm.

Suggest and explain how the water potential can be altered **and** how this could benefit the *Paramecium* living in freshwater.

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(iv) The experiment described in **Table 5** was extended to find out the effect of reducing the dissolved oxygen concentration on the mean number of contractions at each concentration of sodium chloride.

When the dissolved oxygen concentration of the solution was reduced, the mean number of contractions was lower at each concentration of sodium chloride.

Suggest an explanation for these findings.

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..... **[2]**

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6 The sweet potato is a plant that is a staple food in countries such as China. The sweet potato is susceptible to a group of viruses known as potyviruses.

(a) (i) It is difficult for the virus to enter the sweet potato cell.

Suggest a barrier that makes it difficult for potyviruses to enter the sweet potato cell.

..... **[1]**

(ii) Suggest how the potyviruses enter the sweet potato cell.

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..... **[1]**

(b) Sweet potato cells have a mechanism that recognises and destroys incorrectly formed mRNA or non-functional mRNA.

(i) The nucleic acid in potyviruses is RNA.

Suggest why this mechanism in sweet potato cells is able to counteract infection by a potyvirus.

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..... **[2]**

(ii) An enzyme is involved in this process.

Name the bond that is broken by this enzyme.

..... **[1]**

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(iii) Suggest an advantage to a **non-infected** cell of having this process.

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END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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