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

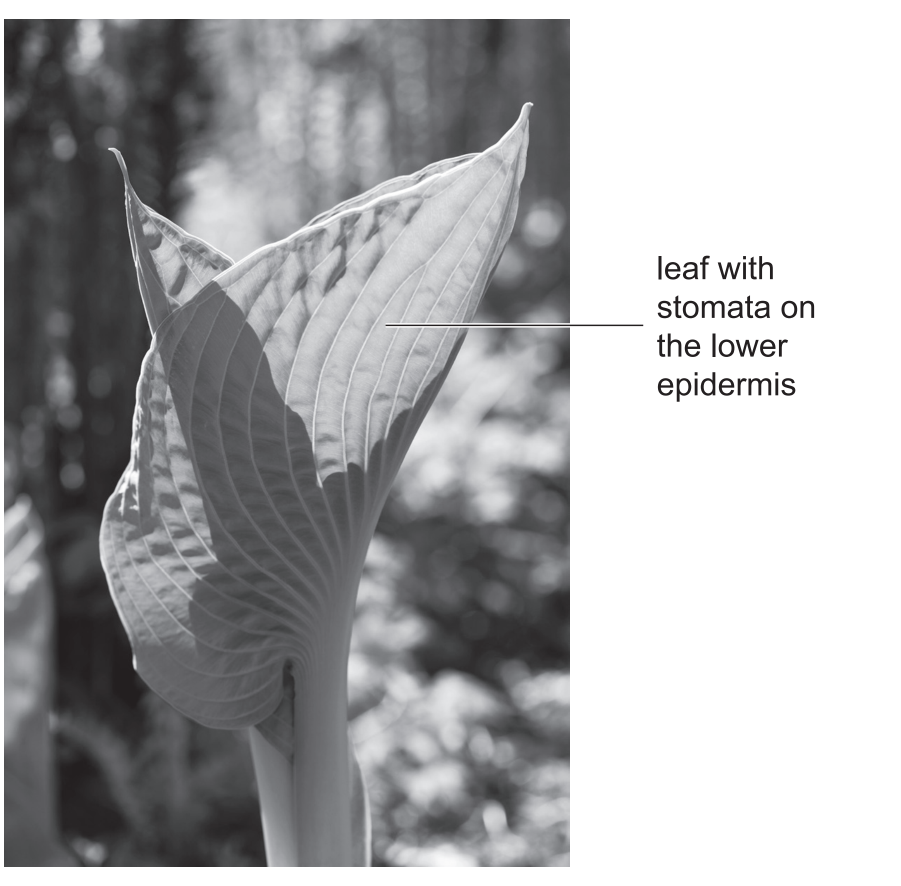

Fig. 1.1

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.

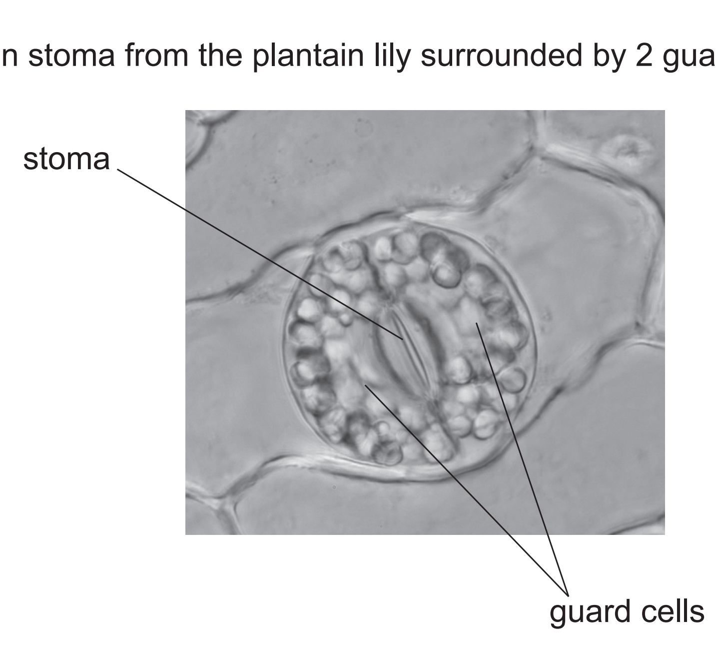

Fig. 1.2

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

The student:

- prepared 5 microscope slides as shown in Table 1.1

Table 1.1

microscope slide number	liquid added to microscope slide
1	large drop of distilled water
2	large drop of 2.5% sucrose solution
3	large drop of 5.0% sucrose solution
4	large drop of 10.0% sucrose solution
5	large drop of 20.0% sucrose solution

- removed the lower epidermis from a leaf of plantain lily
- immersed 1 small piece of lower epidermis in the drop on microscope slide 1
- placed a cover slip over the piece of lower epidermis
- observed the stomata using a light microscope fitted with an eyepiece graticule
- repeated the steps for microscope slides 2, 3, 4 and 5.

(a) **(i)** State the independent and dependent variables in the investigation.

independent ....

....

dependent ....

.... [2]

(ii) The student prepared 20 cm^3 of 2.5%, 5.0% and 10.0% sucrose solutions from a 20.0% w/v stock solution.

Complete the description of the student's dilution method for the 2.5% and 5.0% sucrose solutions by writing the correct volumes in the following sentences.

The student mixed .... cm^3 of 20.0% sucrose stock solution with .... cm^3 of distilled water to produce a 2.5% sucrose solution.

The student mixed .... cm^3 of 20.0% sucrose stock solution with .... cm^3 of distilled water to produce a 5.0% sucrose solution.

[2]

(iii) The student observed stomata on the microscope slides using the high-power objective lens.

Outline a method the student could use to investigate the effect of the sucrose solutions in Table 1.1 on the width of stomata in the leaves of plantain lily.

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 prepare the microscope slides should **not** be included.

....

....

....

.... [5]

(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 ....

....

....

explanation ....

....

.... [2]

(b) Another piece of lower epidermis from a leaf of plantain lily was immersed in a large drop of distilled water on a microscope slide.

Fig. 1.3 shows the lower epidermis viewed using the low-power objective lens.

The student determined the stomatal density on the lower epidermis using Fig. 1.3 only.

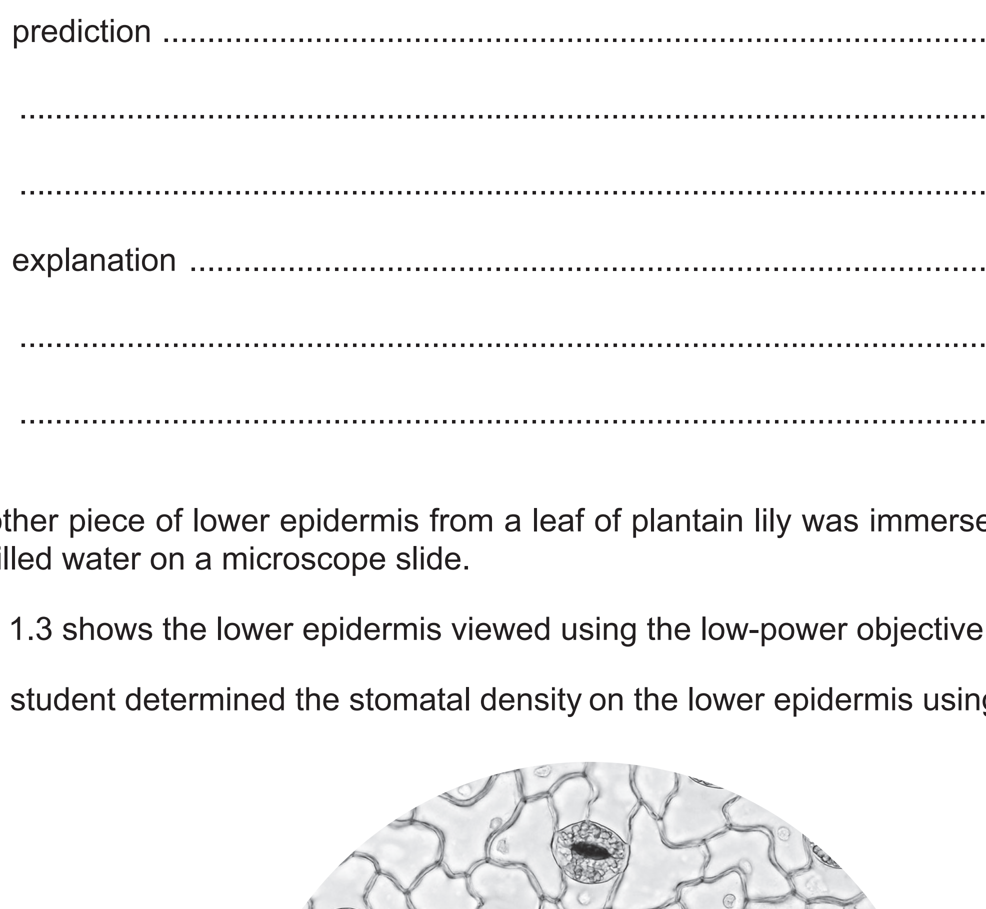

Fig. 1.3

(i) Use Fig. 1.3 to calculate the stomatal density on the lower epidermis.

Use the equation:

area = πr^2 and $\pi = 3.14$

Give your answer to the nearest whole number and show your working.

stomatal density = ... mm^{-2} [4]

(ii) Suggest how this investigation could be improved to increase confidence in your answer in **(b)(i)**.

....

.... [1]

(iii) A different plant species had a lower stomatal density than the value calculated for plantain lily in **(b)(i)**.

Suggest how the environmental conditions of the different plant species may vary from those of the plantain lily.

Explain your answer.

....

....

.... [2]

[Total: 18]