

GCSE Biology B (Twenty First Century Science)
J257/04 Depth in biology (Higher Tier)

Question Set 9

1

Ling and Kai are investigating the stomata of plant leaves.

(a) (i) Ling wants to work out the size of one stoma (one of the stomata of a leaf).

She uses a light microscope to look at the underside of a leaf.

She uses a camera attached to the microscope to take a photograph.



.....stomatal pore

.....guard cells

Complete the labelling of the photograph.

[1]

(ii) The length of the stoma in Ling's photograph is 15 mm.

The photograph has a magnification of $\times 400$.

Calculate the length of the original stoma.

Give your answer in standard form.

$$\begin{aligned} I &= AM \\ 15 &= 400A \\ A &= 0.0375 = 3.75 \times 10^{-2} \end{aligned}$$

Length = 3.75×10^{-2} mm [2]

(b) Kai wants to work out how many stomata are found in each mm² of the leaf's surface.

- He paints clear nail varnish onto a small area of the underside of a leaf.
- When the varnish has dried he peels it off using clear sticky tape.
- He sticks the tape onto a microscope slide.

Kai will use a light microscope to count the impressions of stomata in the varnish. Here is his planned method.

1. Clip the slide on the stage.
2. Rotate the objective lens until it clicks into position above the slide.
3. Place the microscope in direct sunlight and look into the eyepiece lens. Adjust the mirror until the image is as bright as possible.
4. Look into the eyepiece lens and use the coarse focus to move the objective lens towards the slide until the image is in focus.
5. Use the fine focus to move the objective lens away from the slide until the image is as sharp as possible.

Fig. 4.1 shows the light microscope Kai uses.

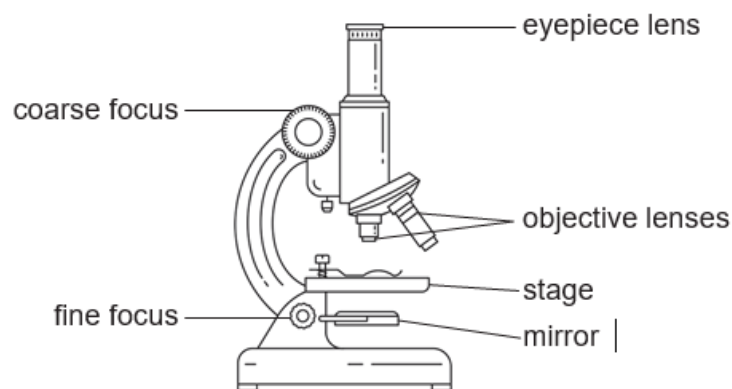


Fig. 4.1

(i) Write down the numbers of **two** steps in Kai's method that have a high risk of causing damage to Kai or the apparatus.

For each of these steps, explain why it is dangerous **and** suggest how to reduce the risk.

- 3 - Placing in direct sunlight and adjusting to high light intensity may be too bright so affect his eyesight (damage retina) Start with lowest light intensity and slowly increase it. [4]
- 4 - the lens might hit the slide so slide might break. Start with the lowest power objective lens then use coarse focus to bring the image into focus without hitting the lens (because it has the greatest distance between the lens and the stage)

(ii) Kai sets up the microscope using a safer method provided by his teacher.

He puts a clear plastic ruler on the stage.

He uses the microscope to look at the millimetre markings on the ruler.

Fig. 4.2 shows what he sees.

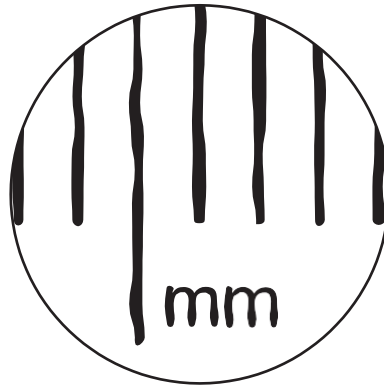


Fig. 4.2

In Fig. 4.2 the distance between each marking is 1 mm.

Calculate the area of the field of view.

In your calculation, assume $\pi = 3.14$.

Give your answer to 3 significant figures.

$$\text{diameter} = 6\text{mm} \quad \text{so radius} = 3\text{mm}$$

$$\text{Area of circle} = \pi r^2 = 3.14 \times 3^2 = 28.26$$

$$\text{Area} = \dots\dots\dots 28.3 \dots\dots\dots \text{mm}^2$$

[3]

- (iii) Kai removes the ruler from the stage and replaces it with the slide showing stomata.

He makes no other changes to the microscope. Fig. 4.3 shows what he sees.

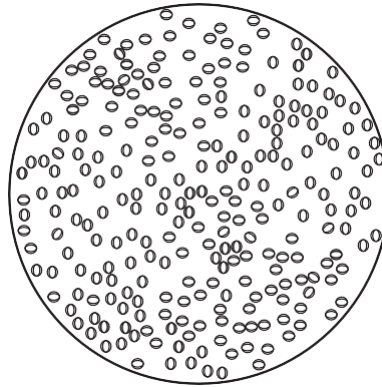


Fig. 4.3

Kai counts 255 stomata in the field of view.

Estimate the density of stomata (how many are found in each mm²) in this field of view.

$$\text{density} = \frac{255}{28.3} = 9.023 \dots$$

Density =⁹..... stomata per mm² [1]

- (iv) Suggest why the density of stomata in this field of view may **not** be the same as the density of stomata over the whole leaf surface.

- (c) Explain the advantages and disadvantages for a plant of opening its stomata. [2]

[2]

[4]

Total Marks for Question Set 9: 16

iv) The distribution of stomata is random and the environment conditions (light or CO₂ availability) may vary across the leaf surface. Hence more stomata may be present where e.g. CO₂ is more available.

c) It would allow ~~more~~ CO₂ to diffuse in and O₂ to diffuse out. Hence promote photosynthesis. But water would evaporate out via transpiration thus lead to water loss.

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