

Microscopy and Magnification

Mark Scheme



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1. Microscopes are essential tools in biology, enabling scientists to observe and study microscopic life.

a) The figure below shows a typical light microscope. Which label is pointing to the objective lenses?

B – is the only correct answer.

1 mark

Total: 1 mark

b) A student labelled a light microscope for a homework assignment. The figure below shows the student's work. Circle the letter of the correct answer.

C – is the only correct answer.

1 mark

Total: 1 mark

c) The figure below shows a phagocytic cell that has been magnified 2500 times.
The image diameter of the cell is 25mm. What is the actual diameter of the cell?

B – is the only correct answer.

1 mark

Total: 1 mark

(Total for Question 1 is 3 marks)

2. The figure below shows the structure of a chloroplast as seen using an electron microscope.

a) What is the function of a chloroplast within a cell?

Accept any answer that states photosynthesis. Accept the site of photosynthesis.

1 mark

Total: 1 mark

b) Convert 85 mm into μm .

85 000 (μm)

1 mark

Total: 1 mark

c) Calculate the actual size of the chloroplast in the figure above.
Give your answer to 3 significant figures.

Converting 100 mm to 100,000 μm

1 mark

Dividing 100,000 by 12500

1 mark

Answer of 8.00

1 mark

Unit = μm

1 mark

Total: 4 marks

(Total for Question 2 is 6 marks)

3. The figure below shows a sample of Escherichia coli (E. coli) as seen under an electron microscope. The image has been magnified 50000 times.

- a) Why is an electron microscope used to see E. coli bacteria rather than a light microscope?

An answer that has one of the following:	
Electron microscopes have a much higher resolution/resolving power than light microscopes.	1 mark
Electron microscopes have a much higher magnification than light microscopes.	1 mark
E. coli bacteria are very small / too small to be seen clearly using a light microscope/ detail of E. coli bacteria are too small to be seen clearly using a light microscope.	1 mark
	Total: 1 mark

The figure shows E. coli bacteria dividing. Some species of bacteria are capable of dividing and doubling their numbers after just 20 minutes.

- b) Identify the process by which bacteria divide and increase in number.

Binary fission.	1 mark
	Total: 1 mark

- c) Calculate the actual size of **one** of the E. coli bacteria in the figure above.

Give your answer to 3 significant figures.

Converting 100 mm to 100,000 μm	1 mark
Dividing 100,000 by 50000	1 mark
Answer of 2.00	1 mark
Unit = μm	1 mark
	Total: 4 marks

(Total for Question 3 is 6 marks)

4. A student is preparing a sample of onion cells to viewed under a light microscope.

Describe the steps the student would need to take to be able to view the onion cells using the light microscope.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple, basic statements showing some understanding of the process. May only identify a few isolated steps. Lacks logical order or detail.
Level 2	3 - 4	More detailed description of some of the key steps. Shows a reasonable understanding of the process. The order may not be perfect, but a sequence can be followed.
Level 3	5 - 6	A clear, detailed, and logical description of the complete process. Covers all the key steps in a correct and understandable order. Demonstrates a strong understanding of the reasons behind each step.

A description to include the following:	
Prepare the slide: - Obtain a clean microscope slide. - Add a drop of water to the centre of the slide. (Importance: to keep the cells hydrated). Obtain the onion sample: - Peel a small, thin layer/epidermal layer/membrane/skin from the inner surface of an onion. (Importance: This layer is only one cell thick). Place the sample: - Carefully place the onion layer/membrane/epidermis onto the drop of water on the slide. (Avoid air bubbles). - Ensure the onion layer is spread out flat. Staining: - Add a drop of stain (e.g., iodine solution or methylene blue) to the onion layer. (Importance: To make the cell structures more visible) - Alternatively, place stain on the slide before adding onion Lower the coverslip: - Carefully lower a coverslip onto the onion layer at an angle (using a mounted needle/forceps to avoid air bubbles). - Lower gently. Microscope setup: - Place the slide on the microscope stage and secure it with the clips. - Select the lowest power objective lens (e.g., x4 or x10). Focusing: - Looking from the side, use the coarse adjustment knob to move the stage up towards the objective lens until it is just below the lens. - Looking through the eyepiece, slowly turn the coarse adjustment knob to move the stage downwards until the cells come into view (starting away from the objective reduces risk of damage). - Use the fine adjustment knob to bring the cells into sharp focus. Observation and magnification: - Observe the cells. - If desired, increase the magnification by changing to a higher power objective lens. Refocus using the fine adjustment knob. Detail: Mentioning of seeing the cell wall and nucleus.	
	Total: 6 marks

(Total for Question 4 is 6 marks)

5. The figure below shows an electron micrograph showing a section through the vascular bundle of a leaf.

a) Xylem tissue is found in the stems and leaves of plants.

State the function of xylem tissue within plants.

Accept any answer that states that <u>xylem transports water</u> in the plant.	1 mark
	Total: 1 mark

b) Calculate the actual diameter of the xylem vessel from the figure above.

Give your answer to 3 significant figures.

Converting 35 mm to 35,000 μm	1 mark
Dividing 35,000 by 6000	1 mark
Answer of 5.83	1 mark
Unit = μm	1 mark
	Total: 4 marks

(Total for Question 5 is 5 marks)

6. The figure below shows a human sperm cell as seen under an electron microscope.

a) What is a haploid nucleus?

An answer to include one of the following:	
- A nucleus containing one set of chromosomes/half the normal number of chromosomes / n chromosomes. - A nucleus containing one chromosome from each homologous pair. - A nucleus with half the number of chromosomes as a body/somatic cell.	
	Total: 1 mark

b) State the type of cell division that produces sperm cells.

Meiosis.	1 mark
	Total: 1 mark

c) Calculate the actual diameter of the head of the sperm cell from the figure above.

Give your answer to 3 significant figures.

Converting 50 mm to 50,000 μm	1 mark
Dividing 50,000 by 46000	1 mark
Answer of 1.09	1 mark
Unit = μm	1 mark
	Total: 4 marks

(Total for Question 6 is 6 marks)

7. A student views some plant cells under a light microscope. The figure below shows the image that the student can see.

a) Calculate the magnification of the image of the plant cells above.

Magnification = eyepiece magnification $\times$ objective lens magnification	1 mark
Magnification = 10×100	
Magnification = 1000	1 mark
	Total: 2 marks

The cells in the image above were stained before the student looked at them.

b) Why were the cells stained?

An answer to include any two of the following:	
To make cell structures / organelles / components / contents more visible.	1 mark
To increase contrast (between cell structures / organelles / components / contents).	1 mark
To differentiate between different cell structures / organelles / components / contents.	1 mark
To help/allow structures/organelles to be seen clearly.	1 mark
	Total: 2 marks

c) Calculate the actual length of the numbered plant cell in the figure above.

Give your answer to 3 significant figures.

Converting 15 mm to 15,000 μm	1 mark
Dividing 15,000 by 1000	1 mark
Answer of 15.0	1 mark
Unit = μm	1 mark
	Total: 4 marks

(Total for Question 7 is 8 marks)