

## Structured Questions

# Cell Structure

Cell Theory / Cell Theory: Skills / Microscopes / General Cell Structure / Prokaryotic Cell Structure / Eukaryotic Cell Structure / Functions of Life / Eukaryotic Cell Structure: Comparisons & Atypical Examples / Cell Types & Structures: Skills / Drawing Cells: Skills / Endosymbiotic Theory (HL) / Cell Differentiation (HL) / Multicellularity (HL)

Easy (9 questions)	/45
Medium (9 questions)	/60
Hard (8 questions)	/44
<b>Total Marks</b>	<b>/149</b>

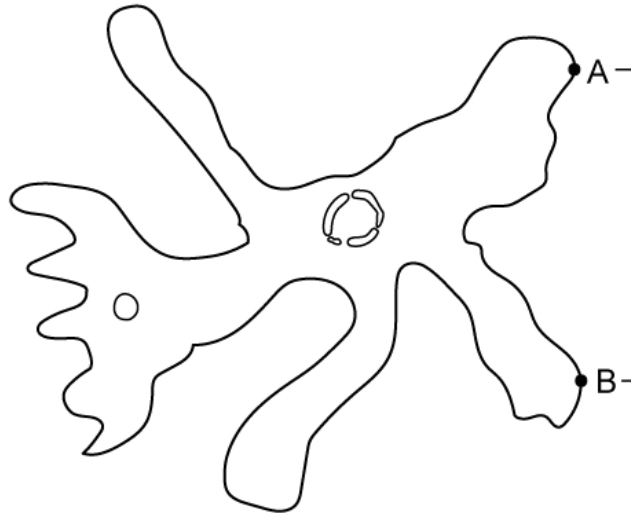
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# Easy Questions

- 1 (a) The diagram below is of an *Amoeba*. The actual size, measured between points **A** and **B**, is  $320\ \mu\text{m}$ .

When a student measured the same distance using an image from a microscope they determined the size to be  $128\ 000\ \mu\text{m}$ .



Calculate the magnification of this *Amoeba*. Show your working.

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(2 marks)

- (b) Whilst examining the *Amoeba* the student also measured the length of the organelles present, including the nucleus. The length of the nucleus on the microscope image was  $28\ 000\ \mu\text{m}$ .

Assuming the same magnification as part (a), calculate the actual size of the nucleus. Give your answer in mm.

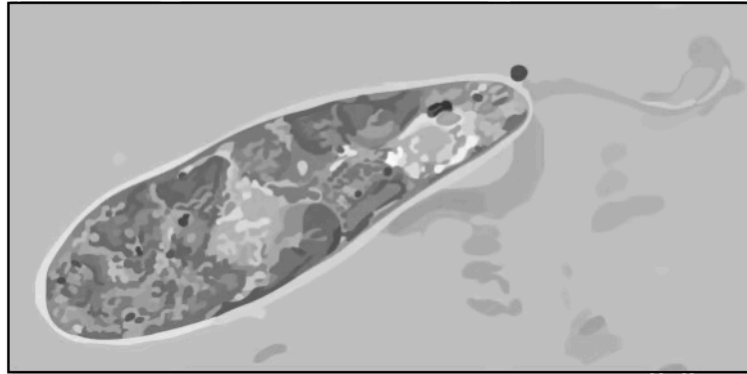
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(2 marks)

2 (a) The micrograph below shows a single-celled organism known as *Euglena*.

Draw a biological drawing of the *Euglena*.



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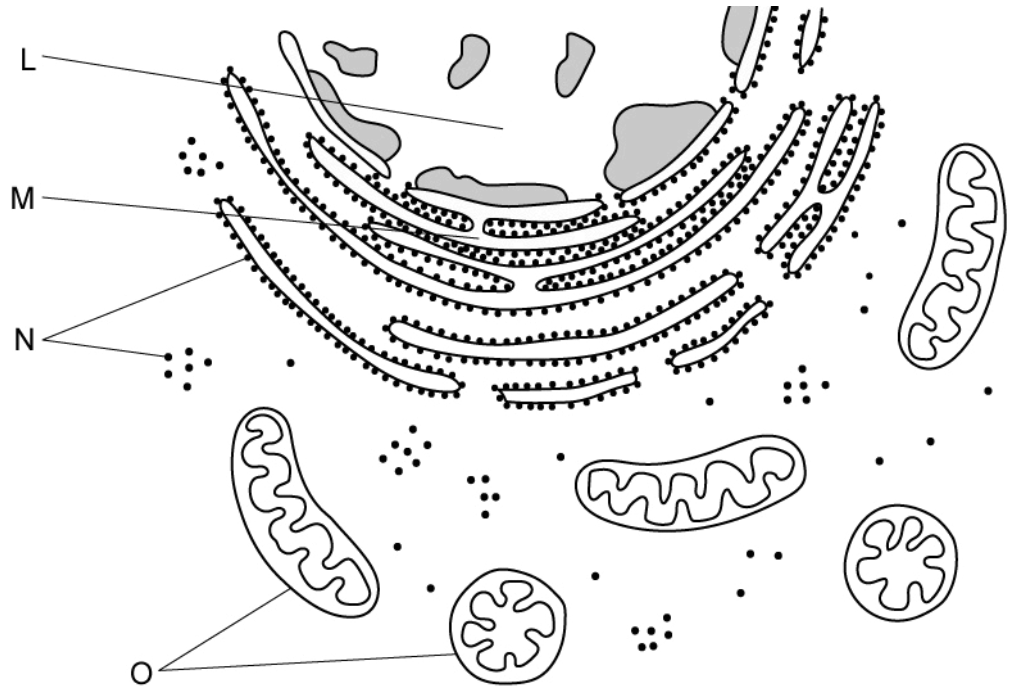
**(4 marks)**

(b) State an addition to any biological drawing that would be necessary to allow the viewer to ascertain the true size of the object being pictured.

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**(1 mark)**

3 (a) The diagram below shows a magnified view of a cell.



State the names of structures **L** and **N**.

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.....

**(2 marks)**

(b) Another structure that would likely be present in the cell seen in part (a) is the Golgi apparatus.

State the function of the Golgi apparatus.

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**(1 mark)**

(c) State, with a reason, the type of cell (prokaryotic or eukaryotic) featured in part (a).

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**(2 marks)**

(d) Scientists have established a theory that explains the origin of eukaryotic cells.

State the name of this theory.

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(1 mark)

**4 (a)** In order to be considered living, organisms carry out the functions of life.

Define the following:

i) Homeostasis

ii) Excretion

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**(2 marks)**

**(b)** The unicellular group known as the dinoflagellates can be found in fresh water, where they prey upon other protozoa.

Dinoflagellates contain eyespots and two flagella, enabling them to find and move towards prey. Every day they undergo mitosis and in some cases this forms 'red tides'.

Identify the functions of life that have been described in this passage on dinoflagellates.

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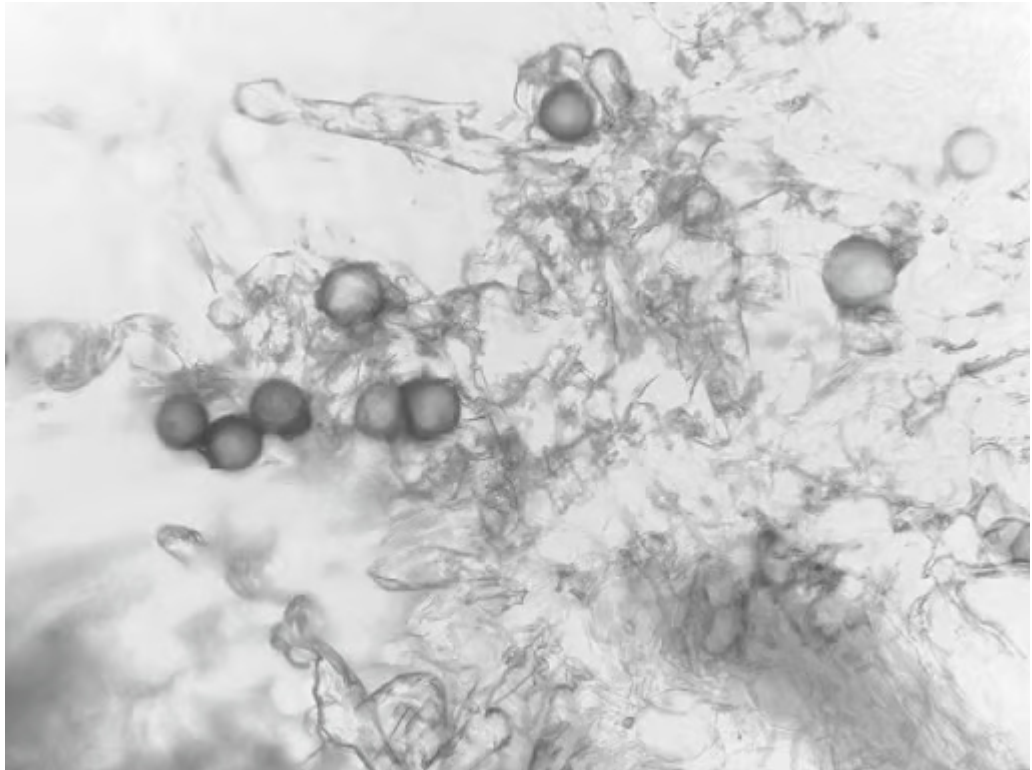
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**(4 marks)**

5 (a) The image below shows pollen grains viewed under a light microscope.



*Ergriffi, CC BY 4.0, via Wikimedia Commons*

State the type of microscope that would enable scientists to examine the pollen grains in more detail.

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(1 mark)

(b) List **two** advantages of the type of microscope stated in part (a).

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.....  
(2 marks)

(c) List three differences between prokaryotic and eukaryotic cells.

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(3 marks)



6 (a) The image shows an internal cellular structure as viewed under an electron microscope.

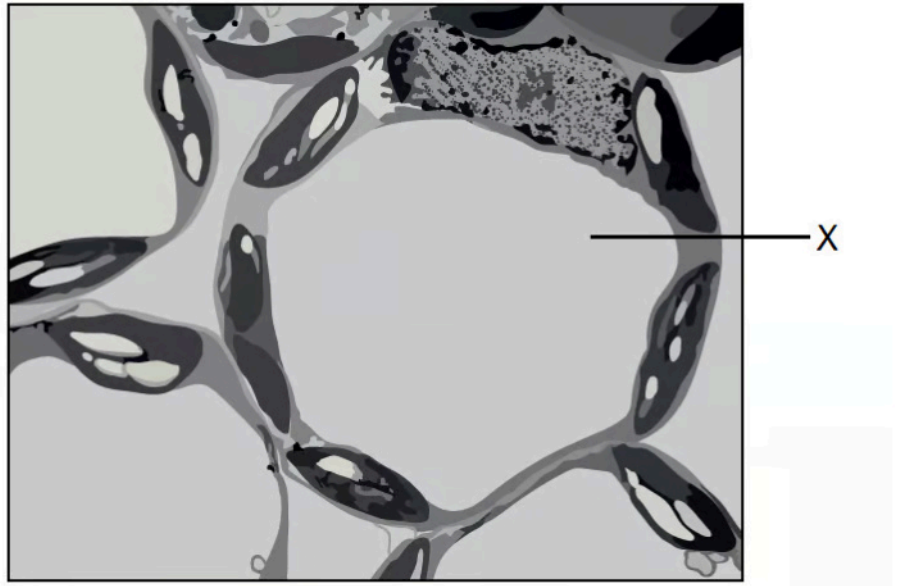


Identify the cell structure shown.

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(1 mark)

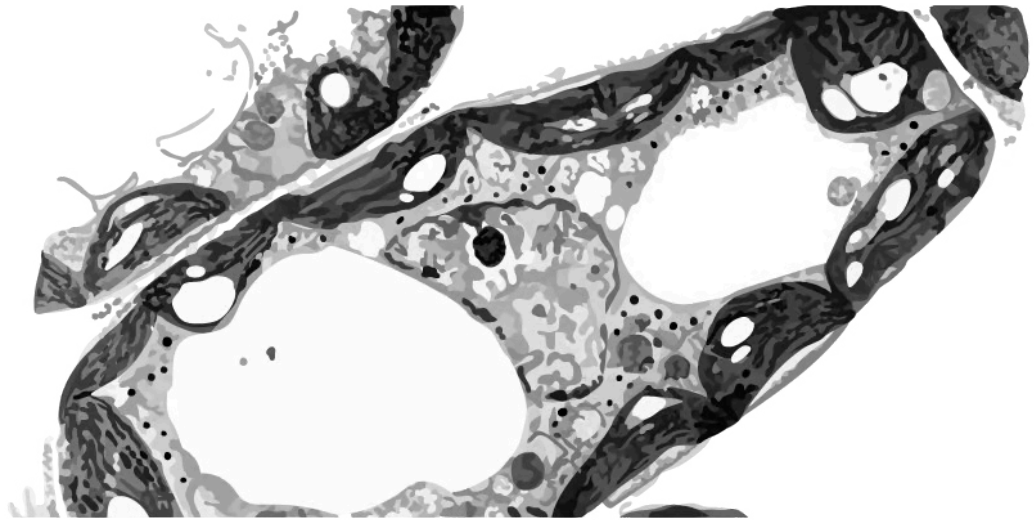
(b) State the name the structure labelled X.



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(1 mark)

7 (a) The image below shows an electron micrograph of a palisade mesophyll cell.



Draw a labelled diagram of this cell.

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(5 marks)

(b) (i) State the main function of the palisade cell.

(ii) Name the organelle that the palisade cell contains many of in order to carry out its main function.

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(2 marks)

**8 (a)** Outline the evidence that scientists have provided to explain the origin of eukaryotic cells.

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**(4 marks)**

**(b)** State the type of ribosomes found in organelles such as chloroplasts.

Justify your answer.

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**(2 marks)**

**9** Explain the advantages of using an electron microscope to analyse muscle tissue.

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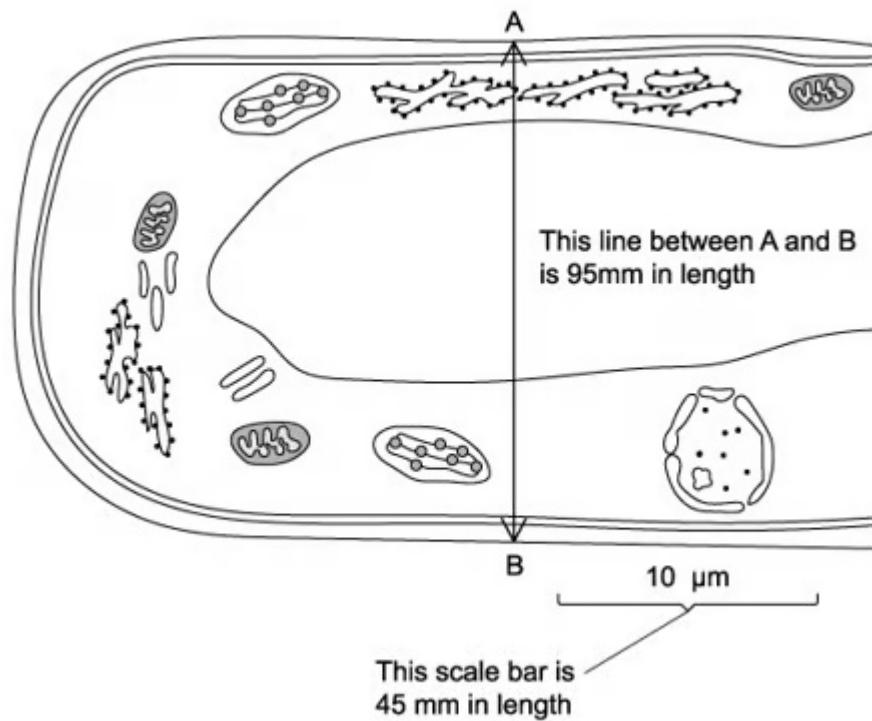
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**(3 marks)**

# Medium Questions

- 1 (a) The drawing below shows part of a plant cell as seen with an electron microscope. The scale bar (measuring 45 mm in length) on this drawing represents a length of  $10\ \mu\text{m}$ .



Calculate the magnification of the drawing.

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**(2 marks)**

- (b) Calculate the actual width of the cell in part (a) between **A and B**.

Give your answer in micrometres ( $\mu\text{m}$ ).

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**(2 marks)**

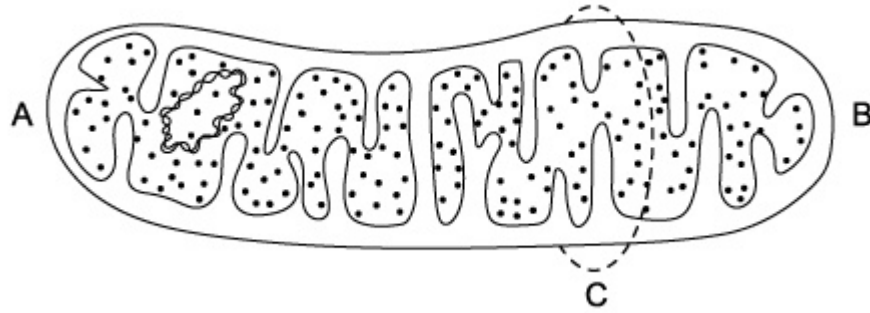
(c) Identify **two** ways in which striated muscle fibres (fused muscle cells) differ from the cell shown in part (a).

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(2 marks)

- 2 (a) The diagram below is of a mitochondrion at a magnification of  $\times 20\,000$ . The distance between points **A** and **B** in the diagram is 6.4 cm.



Calculate the actual length of this mitochondrion in micrometres ( $\mu\text{m}$ ).

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..... (2 marks)

- (b) The circumference of a mitochondrion, labelled **C** in the diagram in part (a), is  $1.5\ \mu\text{m}$ . A student is making an accurate scale model of a mitochondrion for a school science project and wants to magnify a mitochondrion 50,000 times.

What will the circumference of the student's model be, in cm?

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..... (2 marks)

- (c) The mitochondrion in part (a) is responsible for the process of cell respiration.

Identify the 'function of life' of which respiration is an example.

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(1 mark)

- (d) Briefly outline the key ideas that make up cell theory.

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(2 marks)



**3 (a)** Describe how a student would prepare a microscope slide containing a sample of cells from a piece of plant tissue, and how the student would view this sample under a light microscope.

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**(6 marks)**

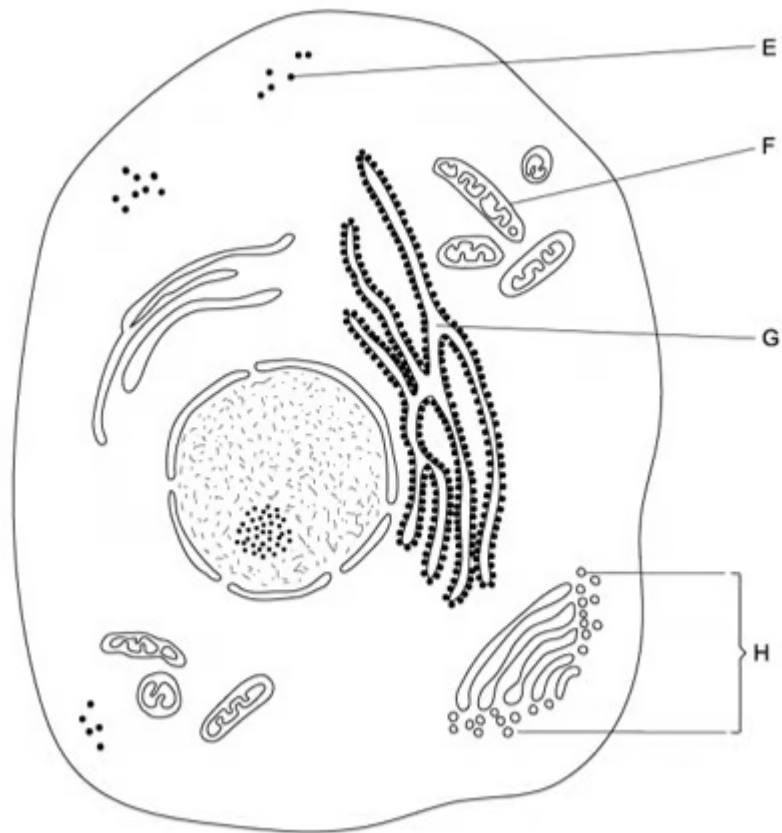
**(b)** Name the two pieces of equipment, used as accessories to a standard light microscope, to measure the size of the specimen being viewed.

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**(2 marks)**

4 (a) A student drew a eukaryotic cell from an electron micrograph.



Identify **F** and **H** in the student's drawing.

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(2 marks)

(b) The student concluded that the eukaryotic cell in part (a) was not a plant cell.

Explain why they came to this conclusion.

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(3 marks)

(c) A scientific theory suggests that mitochondria evolved from prokaryotic cells.

Outline **two** pieces of evidence from mitochondria that support this theory.

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(3 marks)

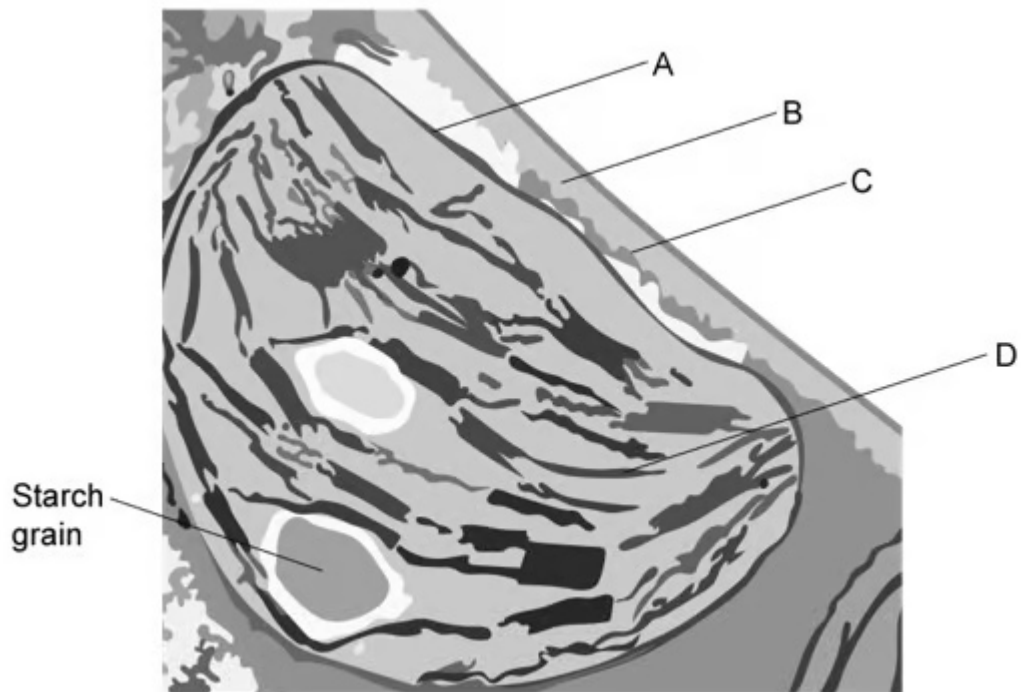
(d) State the function of mitochondria.

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(2 marks)

5 (a) The electron micrograph below shows part of a palisade mesophyll cell.



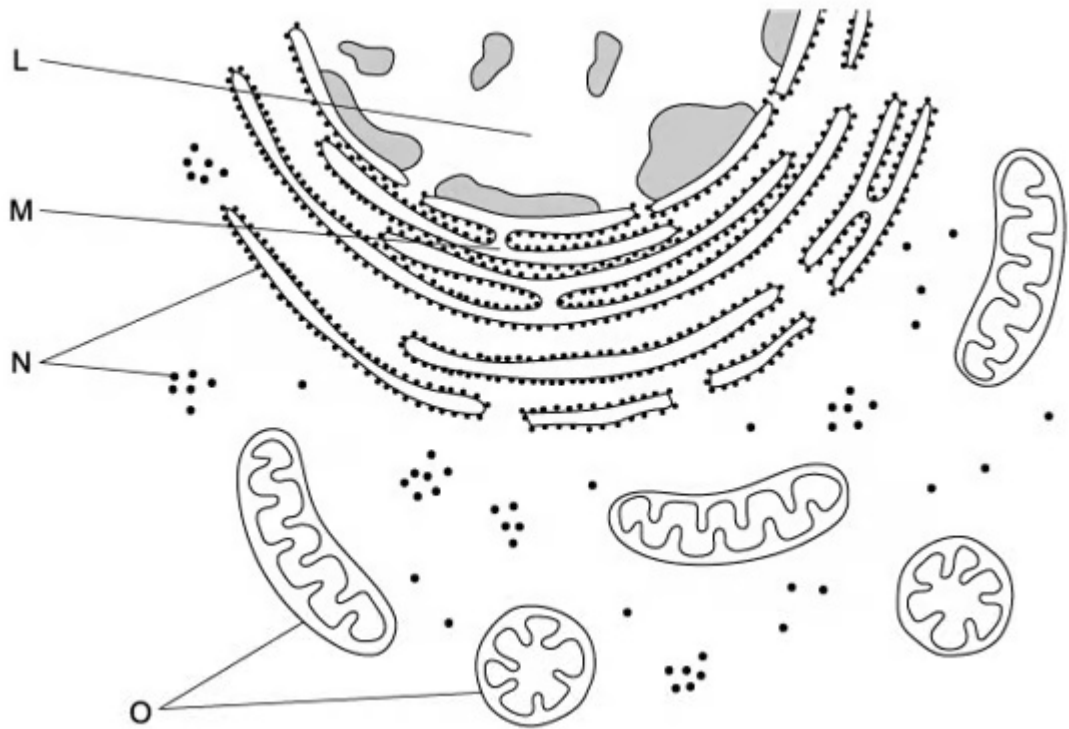
Identify structures **A** and **D**.

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**(2 marks)**

(b) The diagram below shows a drawing of part of an animal cell as seen through an electron microscope.



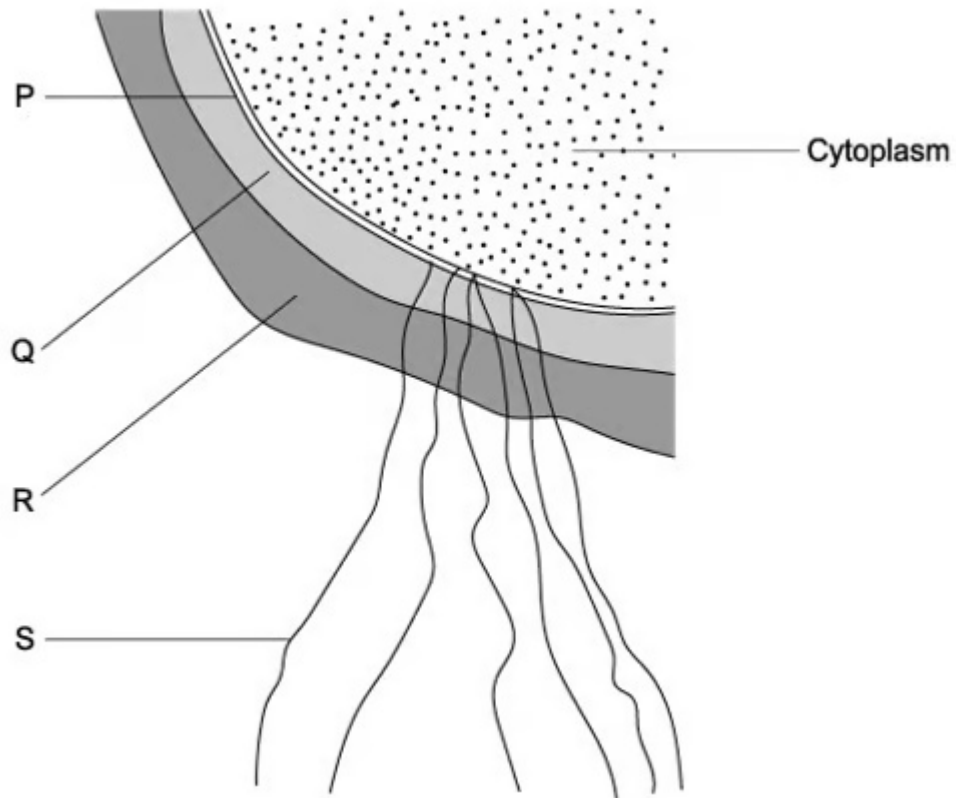
Suggest why the shapes of the two organelles labelled **O** in the diagram appear different.

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**(1 mark)**

**(c)** Describe the function of organelle **N** in the diagram in part (b).

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 .....  
**(2 marks)**

6 (a) Phospholipids and peptidoglycan are two biological molecules found in prokaryotic cells. The drawing below shows part of a prokaryotic cell.



- (i) Identify (**P**, **Q**, **R**, or **S**) and name the structure in which phospholipids are the main biological molecule.
  
- (ii) Identify (**P**, **Q**, **R**, or **S**) and name the structure in which peptidoglycan is the main biological molecule.

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(4 marks)

**(b)** In certain conditions some prokaryotic cells can divide every 25 minutes.

With a starting population of  $2.45 \times 10^3$  cells, and assuming that each cell divides every 25 minutes, calculate the number of cells present after 3.75 hours. Assume that no cells die during this time.

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**(2 marks)**

**(c)** Identify structure **R** in the diagram in part (a).

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**(1 mark)**

- 7 (a) Scientists used an electron microscope to study the structure of a unicellular, eukaryotic organism known as an amoeba.

Explain why scientists used an electron microscope to study the structure of an amoeba.

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(2 marks)

- (b) State **three** structures in an amoeba cell that the scientists would not have been able to view using a light microscope.

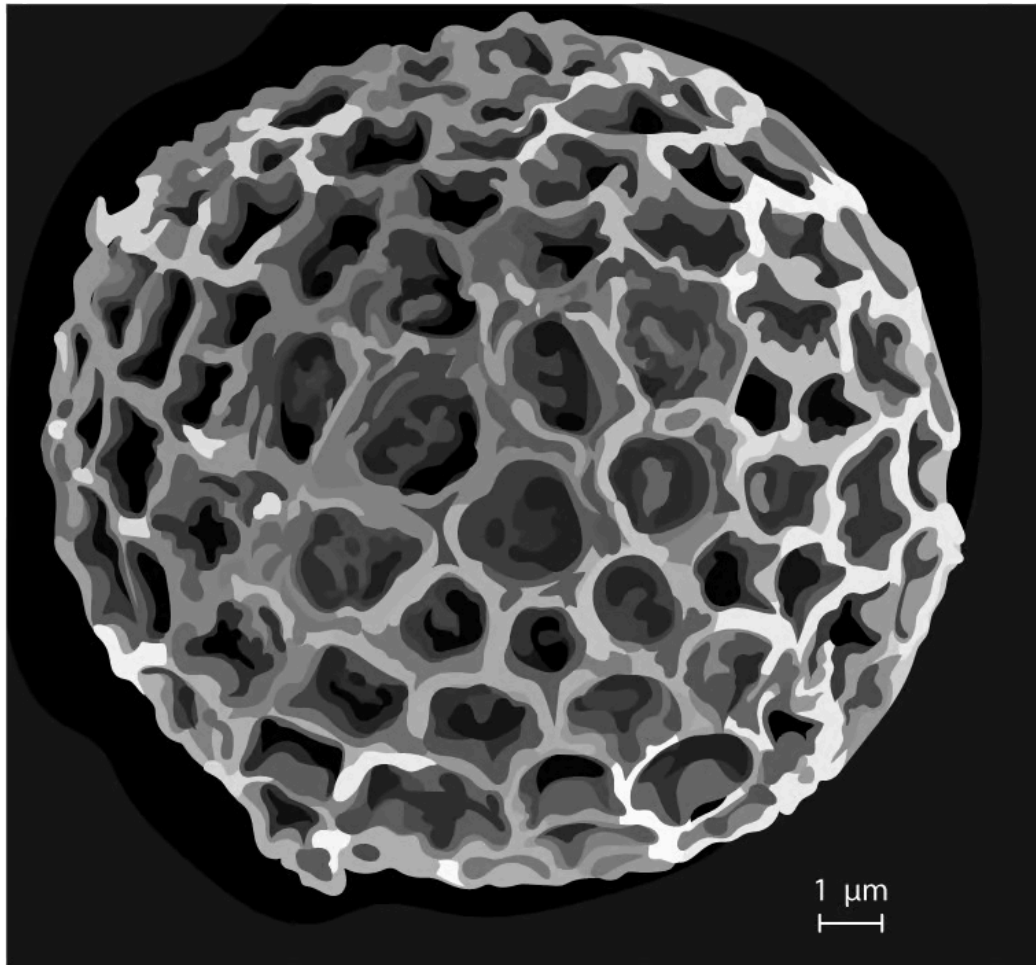
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(3 marks)

- (c) The electron micrograph below shows a spore from a fungus (*Tilletia controversa*) that affects wheat crops.





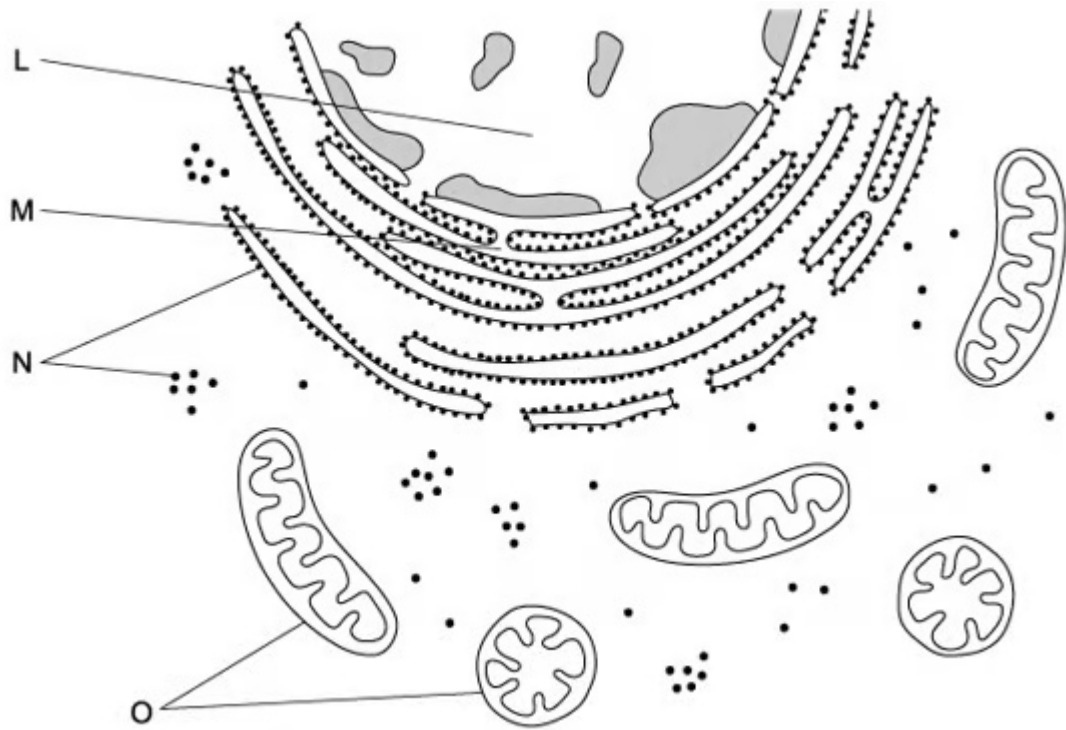
State, with a reason, the type of electron microscope used to produce the micrograph above.

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**(2 marks)**

- 8 The diagram below shows a drawing of part of an animal cell as seen through an electron microscope.



Large numbers of organelle **O** are found in small intestine epithelial cells.

Explain why these cells are adapted in this way.

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**(3 marks)**

9 Compare and contrast the structures of prokaryotic and eukaryotic cells.

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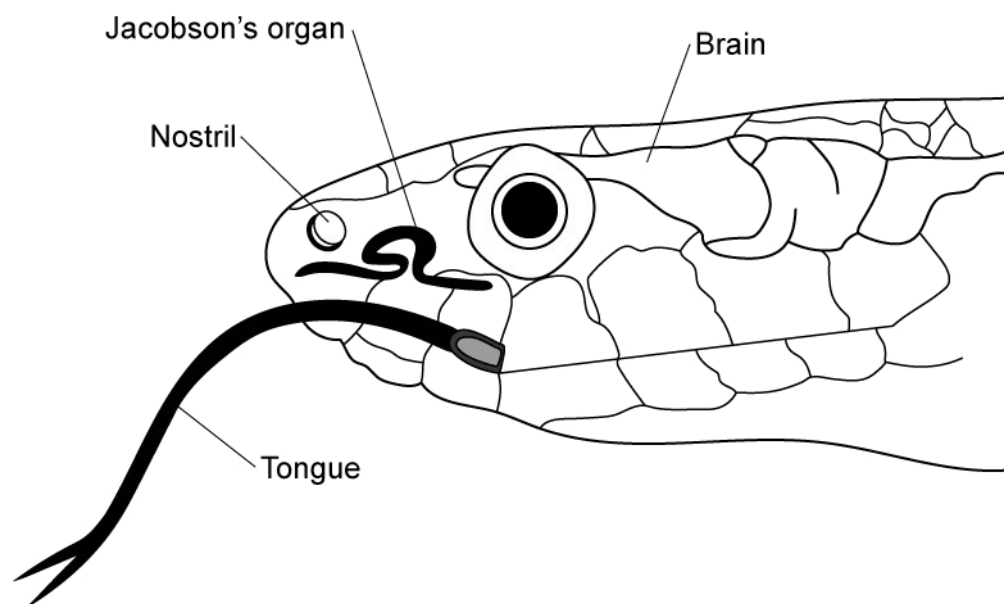
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(7 marks)

# Hard Questions

- 1 (a) The Jacobson's organ in *Pseudonaja textilis* (the eastern brown snake) is a pair of crescent-shaped chambers where odour molecules are deposited by the tongue when it retracts back into the mouth.



Suggest why Jacobson's organ is crescent-shaped rather than straight.

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(2 marks)

- (b) Scientists studying the expression of olfactory receptor (OR) genes in four snake species found that fewer than 3% were non-functional genes compared to humans, who have up to 67% non-functioning OR genes. These genes code for olfactory receptor proteins located in the cilia of the nostrils.

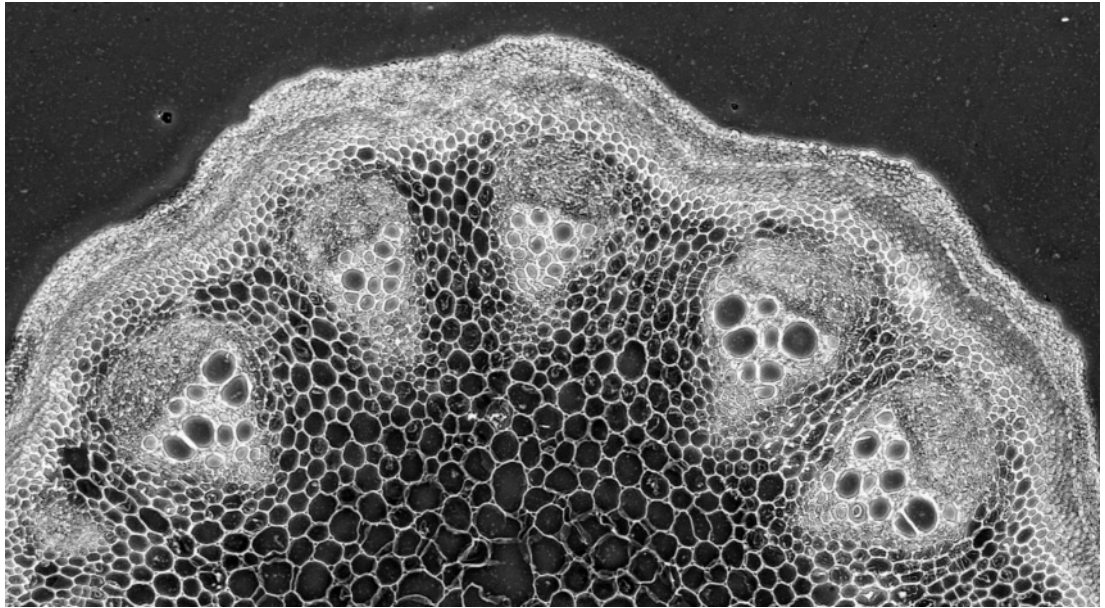
Outline why the expression of certain genes, like the OR genes in nostrils, is beneficial to multicellular organisms.

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(2 marks)

2 (a) The image below is a photomicrograph of a transverse section through part of a stem.



*Doc. RNDr. Josef Reischig, CSc., CC BY-SA 3.0, via Wikimedia Commons*

Draw a large tissue plan diagram of this part of the stem.

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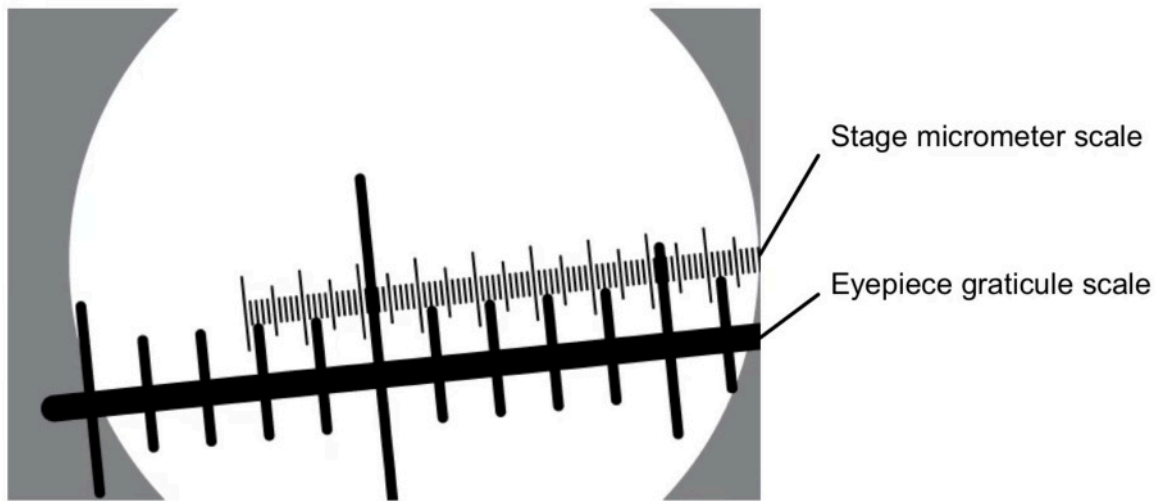
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**(4 marks)**

(b) A student used a light microscope to study the plant stem pictured in part (a). The diagram below shows the stage micrometer scale that was used to calibrate an eyepiece graticule.

The length of one division on this stage micrometer is **0.01 mm**.

Note that one division is the distance between two adjacent vertical lines.



Using this stage micrometer, calculate the actual length of one eyepiece graticule division.

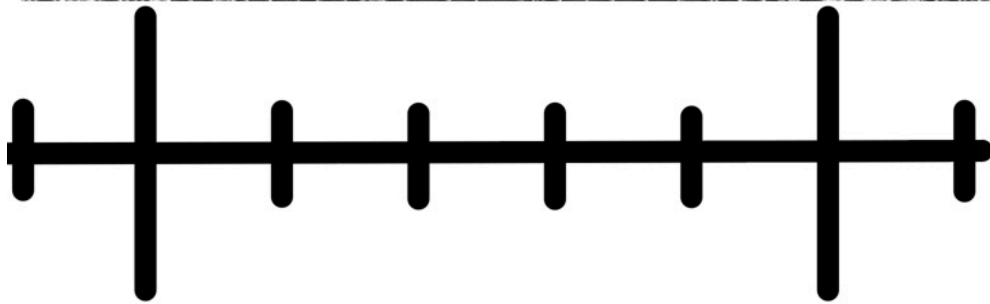
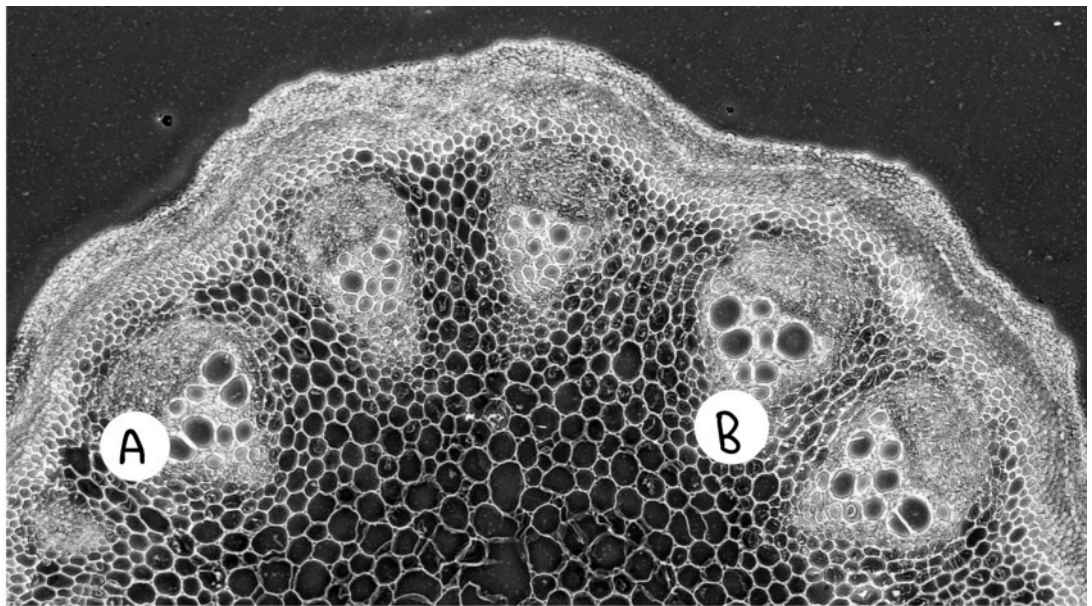
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**(2 marks)**

**(c)** The photomicrograph below was taken using the same lenses as part (b).

The same eyepiece graticule was also used; a section of that graticule is shown under the image below.



Use the calibration of the eyepiece graticule unit from part (b) and the information in the photomicrograph to estimate the actual length of the plant tissue from **A** to **B**. Give your answer in  $\mu\text{m}$ .

(1 mark)

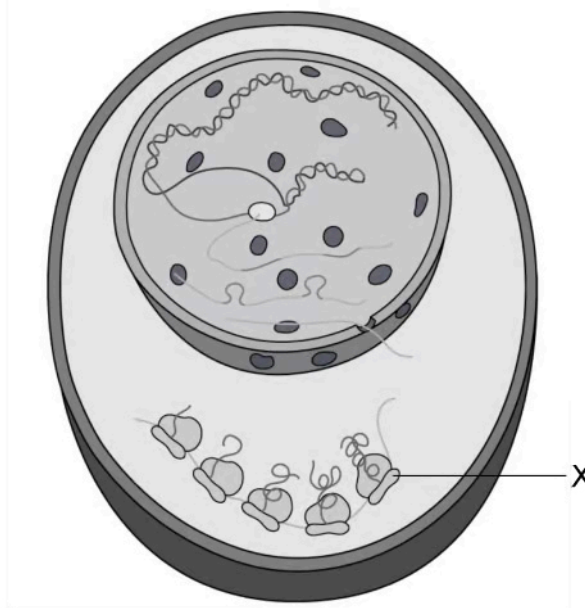
- 3 Creutzfeldt-Jakob disease is a rare neurodegenerative disease caused by abnormally-folded proteins found in the brain. Proteins that trigger abnormal folding are called prions.

Suggest why scientists have not classified prions as living.

(2 marks)



4 (a) The diagram below shows a cell.



Determine, with a reason, whether or not the cell is a eukaryotic cell.

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.....  
**(2 marks)**

(b) Outline why compartmentalisation is an advantage for this cell.

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.....  
**(2 marks)**

(c) A student suggested that they would be able to view structure X at the highest magnification with their light microscope.

Explain why the student is not correct.

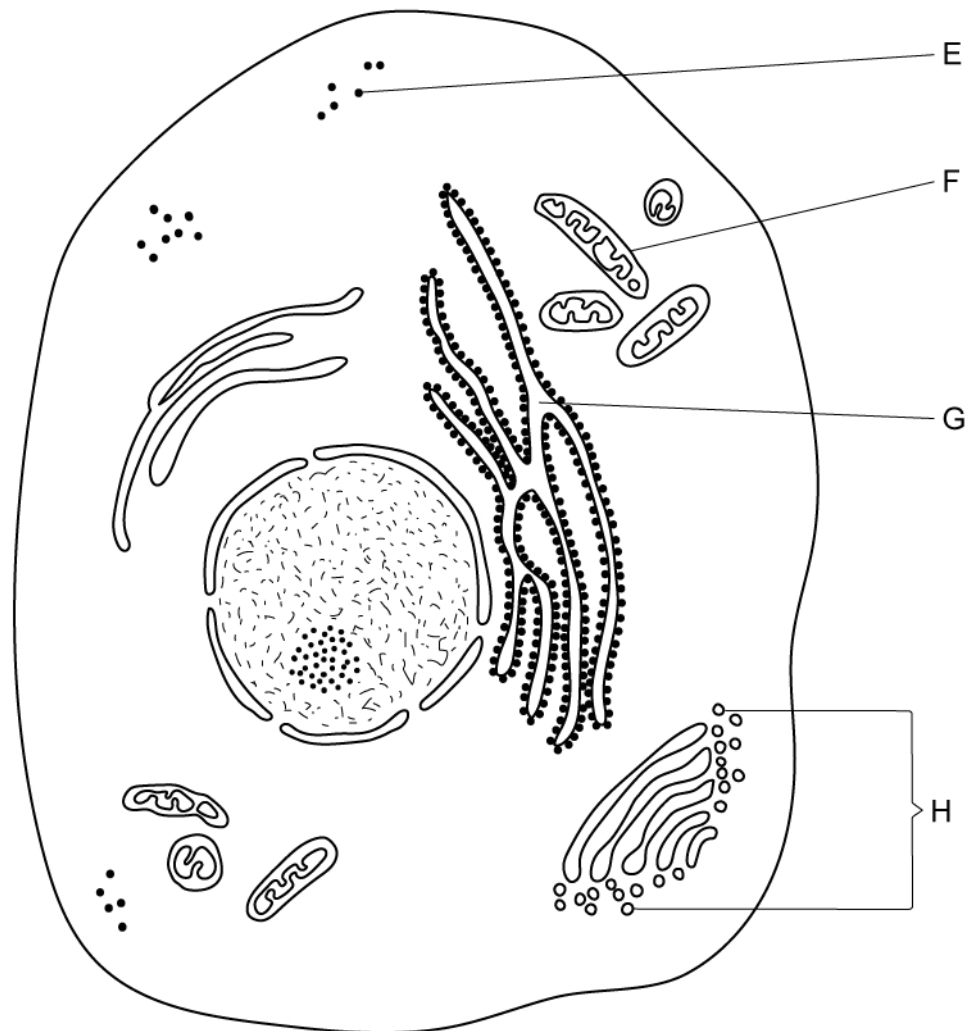
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**(2 marks)**

(d) Identify **one** specific process taking place inside the cell in part (a).

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(1 mark)

5 (a) A student drew this eukaryotic cell.



Identify structures **E** and **G**.

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(2 marks)

(b) Distinguish between the function of the structures identified in part (a).

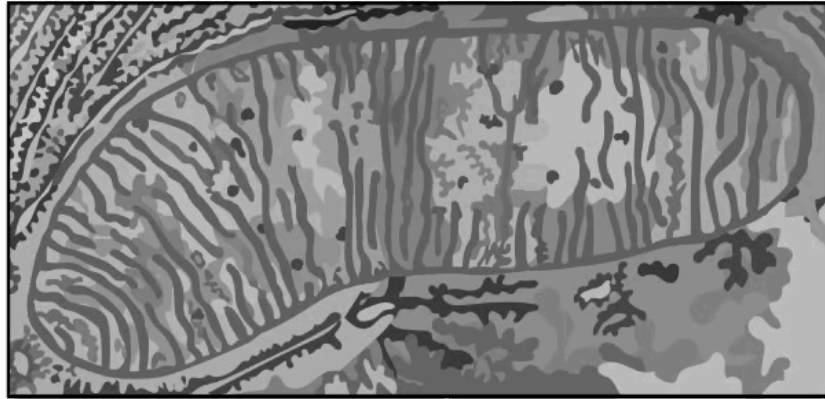
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(2 marks)

6 (a) Below are three electron micrographs showing organelles found within a cell.

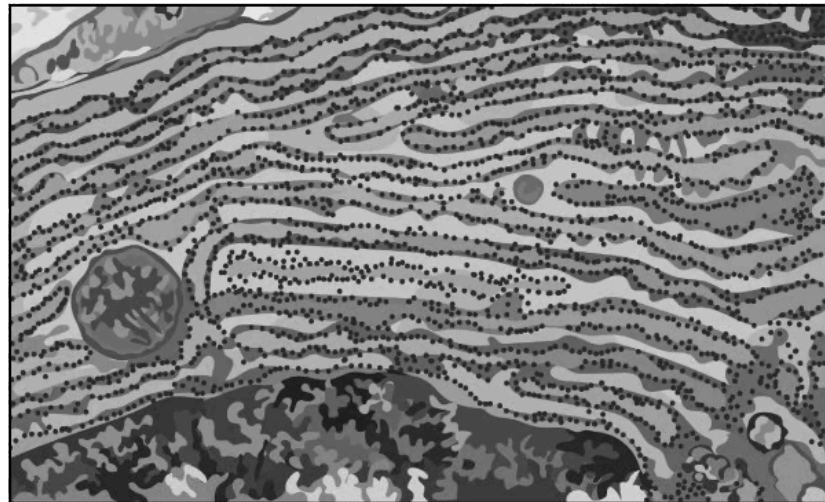
J



K



L



(i) Identify the organelles J, K, and L.

[3]

(ii) Identify **one** structural feature of these organelles that enables them to function efficiently.

[1]

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**(4 marks)**

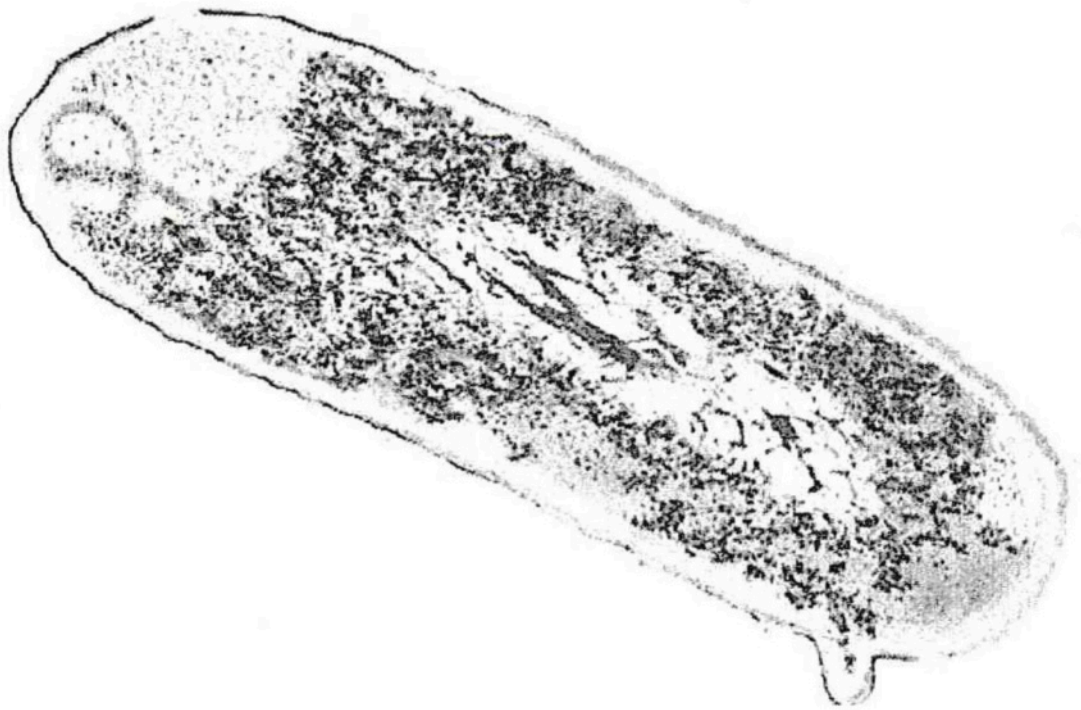
**(b)** Compare the structure and function of the organelles in micrographs **K** and **L**.

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**(2 marks)**

7 (a) Draw a labelled biological diagram of the bacterial cell below.



*Pradana Aumars, CC0, via Wikimedia Commons*

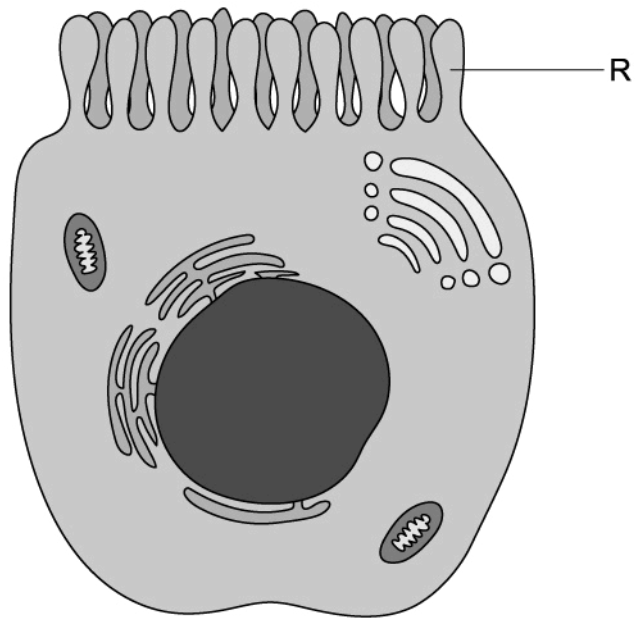
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**(3 marks)**

(b) The image shows a cell of the immune system.



(i) Identify structure R

[1]

(ii) Deduce, with a reason, the function of this cell.

[3]

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**(4 marks)**

**8** *Euglena gracilis* is a unicellular eukaryotic cell. It can gain nutrients from its surroundings by endocytosis and is also capable of carrying out photosynthesis.

Discuss the theory that explains how *Euglena* could have evolved.

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**(7 marks)**