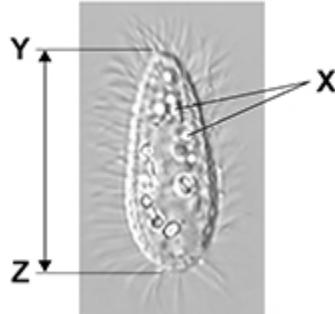


Q1.

Uronema marinum is a single-celled eukaryotic organism. The diagram below is a photograph of *U. marinum* taken through an optical microscope.



- (a) Explain why it is not possible to determine the identity of the structures labelled **X** using an optical microscope.

(2)

- (b) *U. marinum* cells ingest bacteria and digest them in the cytoplasm. Describe the role of **one** named organelle in digesting these bacteria.

(3)

- (c) Calculate the actual length of the cell shown between **Y** and **Z** in the diagram above.

The magnification of the image is $\times 900$

Give your answer in μm **and** to **2** significant figures.

Show your working.

Answer _____ μm

(2)

Q2.

- (a) Give **two** structures found in all prokaryotic cells and in all eukaryotic cells.

1 _____

2 _____

(2)

All prokaryotic cells contain a circular DNA molecule and some prokaryotic cells contain plasmids.

- (b) Scientists have found that the rate of plasmid replication is faster in cells growing in a culture with a high concentration of amino acids than in a culture with a lower concentration of amino acids.

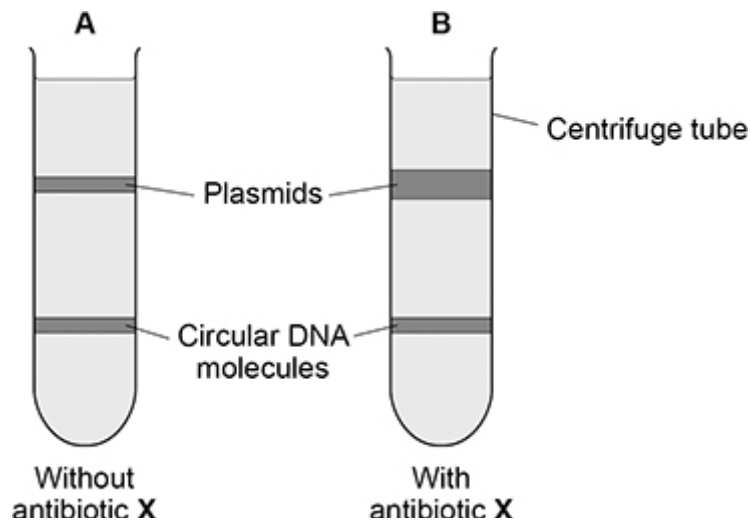
Suggest **one** explanation for the faster rate of plasmid replication in cells growing in a culture with a high amino acid concentration.

(2)

A scientist prepared a culture of a bacterial species.

- She extracted the plasmids and the circular DNA molecules from a sample of cells taken from this culture (**A**).
- She then added antibiotic **X** to the culture and let the cells divide for 4 hours.
- She then extracted the plasmids and the circular DNA molecules from a sample of these cells (**B**).
- The scientist separated the plasmids from the circular DNA molecules in **A** and in **B** using ultracentrifugation.

The figure below shows her results.



- (c) What can you conclude from the figure above about a structural difference between the plasmids and the circular DNA? Explain your answer.

(2)

Give **one** feature of the chloroplast that allows protein to be synthesised inside the chloroplast **and** describe **one** difference between this feature in the chloroplast and similar features in the rest of the cell.

Feature _____

Structural
difference _____

(2)

- (c) The ratio of protein to chlorophyll in control plants is 9:1

Use the information in the table above to calculate the ratio of protein to chlorophyll in iron-deficient plants.

Ratio _____

(1)

The image below is a transmission electron micrograph of a plant cell.



(b) Suggest why a nucleus is **not** visible in above image.

(1)

(c) Name the organelles labelled **S** and **T** in the image above.

Organelle **S** _____

Organelle **T** _____

(1)

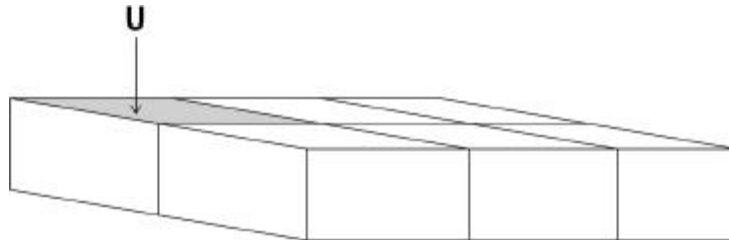
(d) Give **one** advantage of viewing a biological specimen using a transmission electron microscope compared with using a scanning electron microscope.

(1)

- (e) The cells in the diagram below are part of a continuous layer of cells forming the upper surface of a leaf.

The shaded area of cell **U** is $150 \mu\text{m}^2$

The total area of the upper surface of the leaf is 70.65 cm^2



Calculate the number of cells in the upper surface of the leaf.

Give the answer in standard form.

Assume that all these cells are identical in size.

Show your working.

Number of cells _____

(2)

(Total 9 marks)

Q6.

- (a) Place a tick (✓) in the box next to the sequence that shows the correct order of magnitude of these measurements.

50 nm < 0.5 μm < 5 × 10⁻² mm < 0.5 × 10⁻⁵ m

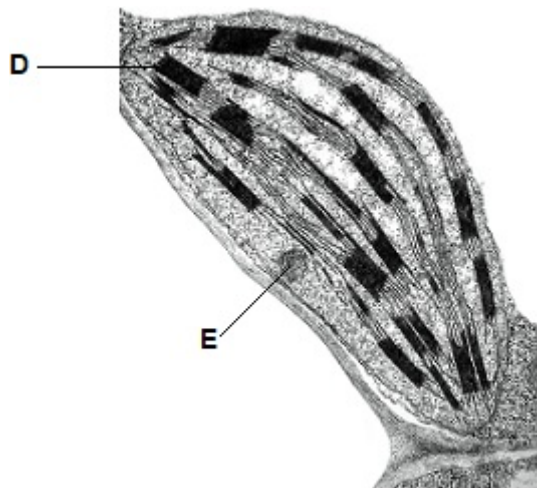
50 nm < 0.5 μm < 0.5 × 10⁻⁵ m < 5 × 10⁻² mm

0.5 μm < 50 nm < 0.5 × 10⁻⁵ m < 5 × 10⁻² mm

0.5 μm < 50 nm < 5 × 10⁻² mm < 0.5 × 10⁻⁵ m

(1)

The diagram below is an electron micrograph of a chloroplast.



- (b) Identify structures labelled **D** and **E**.

D _____

E _____

(2)

- (c) The detail shown in the diagram above would not be seen using an optical microscope.

Explain why.

(2)

(d) Name an organelle found in both a chloroplast and a prokaryotic cell.

(1)

(e) A scientist determined the volume of a plant cell and the volume of organelles it contained.

They found:

- the volume of a plant cell is $17\,500\ \mu\text{m}^3$
- the volume of all the mitochondria in a plant cell is $262.5\ \mu\text{m}^3$
- the volume of all the mitochondria and all the chloroplasts in a plant cell is 44.1% of the volume of a plant cell.

Use this information to calculate the volume of all the chloroplasts in a plant cell.

Answer = _____ μm^3

(2)

(f) A biologist separated cell components to investigate organelle activity. She prepared a suspension of the organelles in a solution that prevented damage to the organelles.

Describe **three** properties of this solution and explain how each property prevented damage to the organelles.

Property 1 _____

Explanation

Property 2 _____

Explanation

Property 3 _____

Explanation

(3)

(Total 11 marks)

Q7.

- (a) The table shows cell wall components in plants, algae, fungi and prokaryotes. Complete the table by putting a tick (✓) where a cell wall component is present.

Cell wall component	Plants	Algae	Fungi	Prokaryotes
Cellulose				
Murein				
Chitin				

(3)

Q8.

- (c) **Figure 2** shows a photograph of part of a mitochondrion from a mouse liver cell taken using a transmission electron microscope at $\times 62\,800$ magnification.

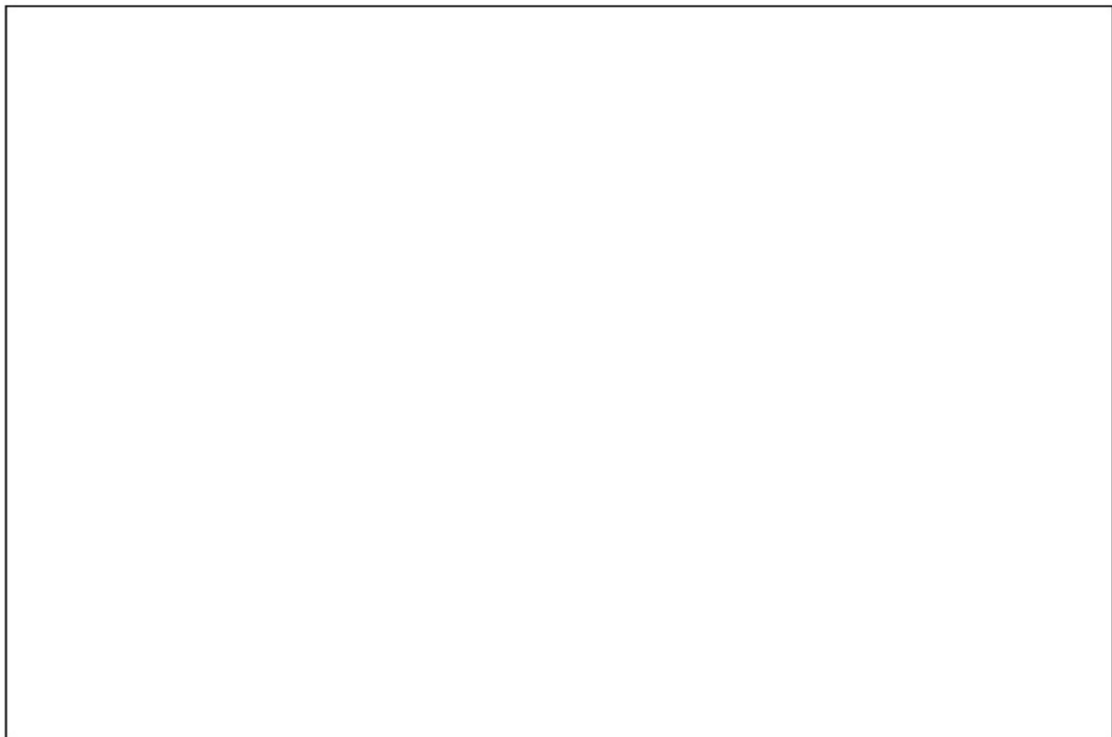
Figure 2



Produce a scientific drawing of the mitochondrion in **Figure 2** in the box below.

Label the following parts of the mitochondrion on your drawing.

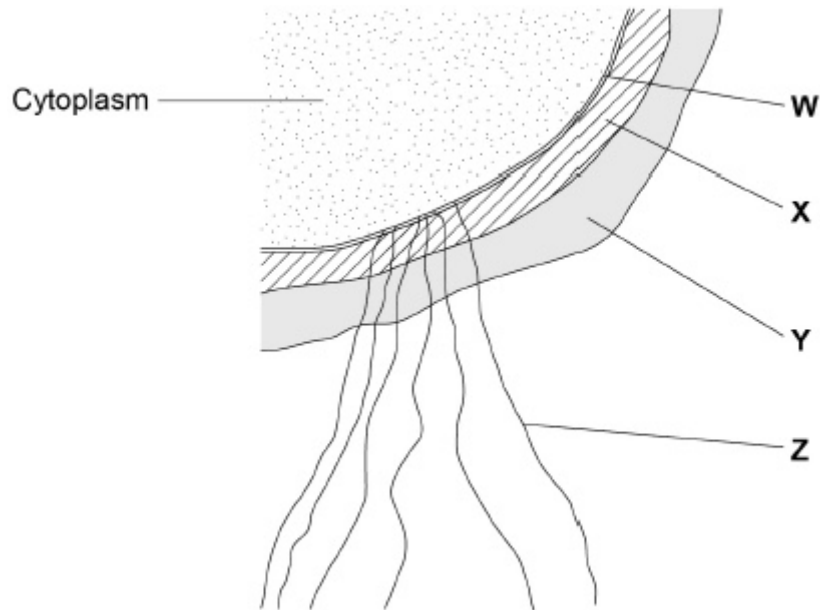
- Matrix
- Crista



(4)

Q9.

The diagram shows part of a prokaryotic cell.



(a) Name the structures labelled **W** to **Z** in the diagram.

W _____

X _____

Y _____

Z _____

(2)

(b) Name the main biological molecule in:

W _____

X _____

(2)

(c) Name the process by which prokaryotic cells divide.

(1)

Q10.

(a) Structures **A** to **E** are parts of a plant cell.

- A** Cell Wall
- B** Chloroplast
- C** Nucleus
- D** Mitochondrion
- E** Golgi apparatus

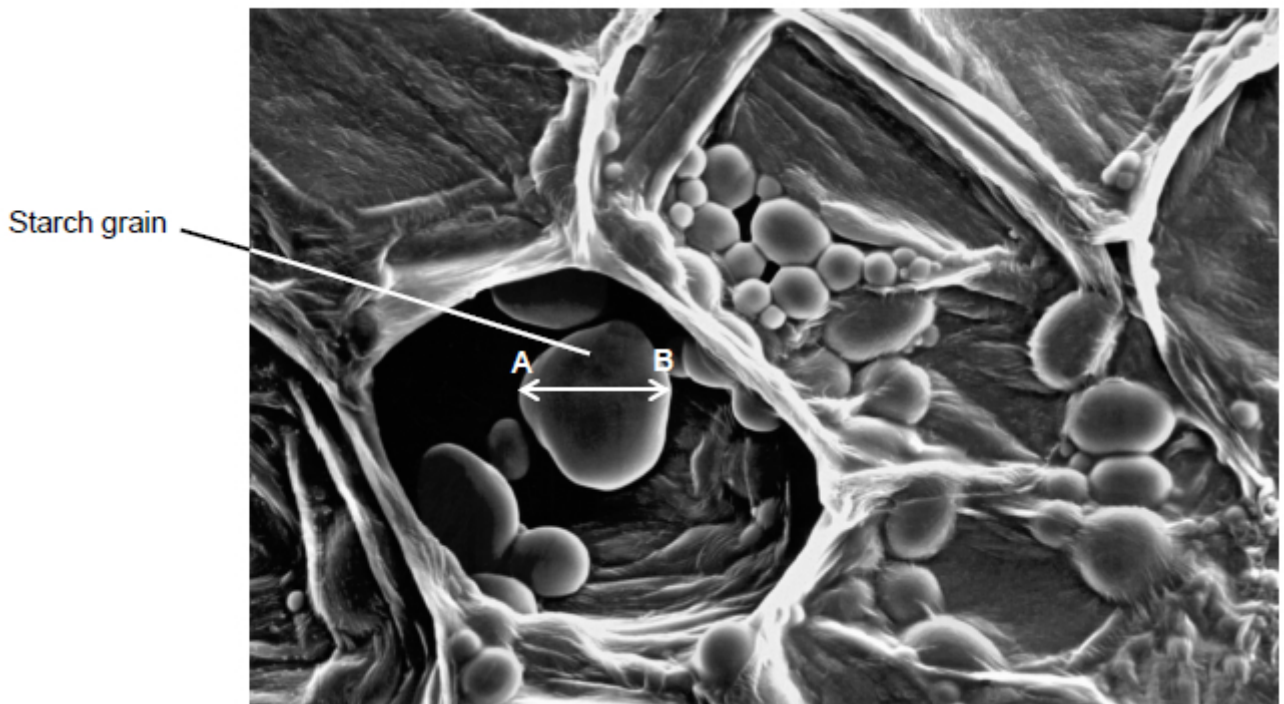
Complete the table by putting the correct letter, **A**, **B**, **C**, **D** or **E** in the box next to each statement.

Statement	Letter
Has stacked membranes arranged in parallel and contains DNA.	
Is made of polysaccharide.	
Is an organelle and is not surrounded by two membranes.	

(3)

Q11.

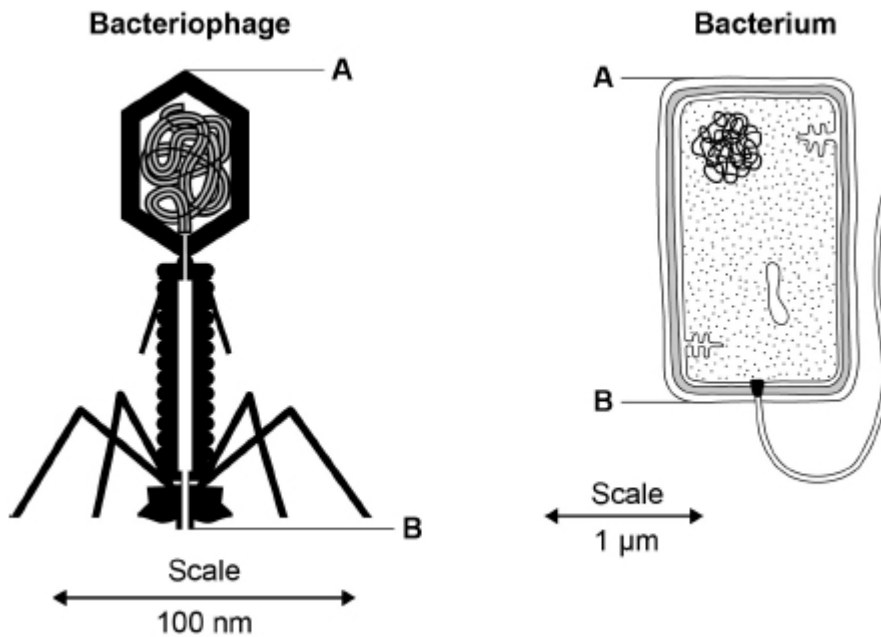
(d) The diagram shows a section through a plant tissue at a magnification of $\times 500$.



Q13.

Bacteriophages are viruses that kill bacteria.

The diagram below shows drawings of a bacteriophage and a bacterium.



(a) Using the diagram and your own knowledge, put a tick (✓) in the box next to the **only** correct statement about the structures of the bacteriophage and the bacterium

Both have ribosomes.

Both have a cell-surface membrane.

The bacteriophage has a capsid and the bacterium has a cell-surface membrane.

The bacteriophage has a cell wall and the bacterium has a capsid.

(1)

- (b) Using the scales in the diagram above, calculate how many times longer the bacterium is than the bacteriophage.

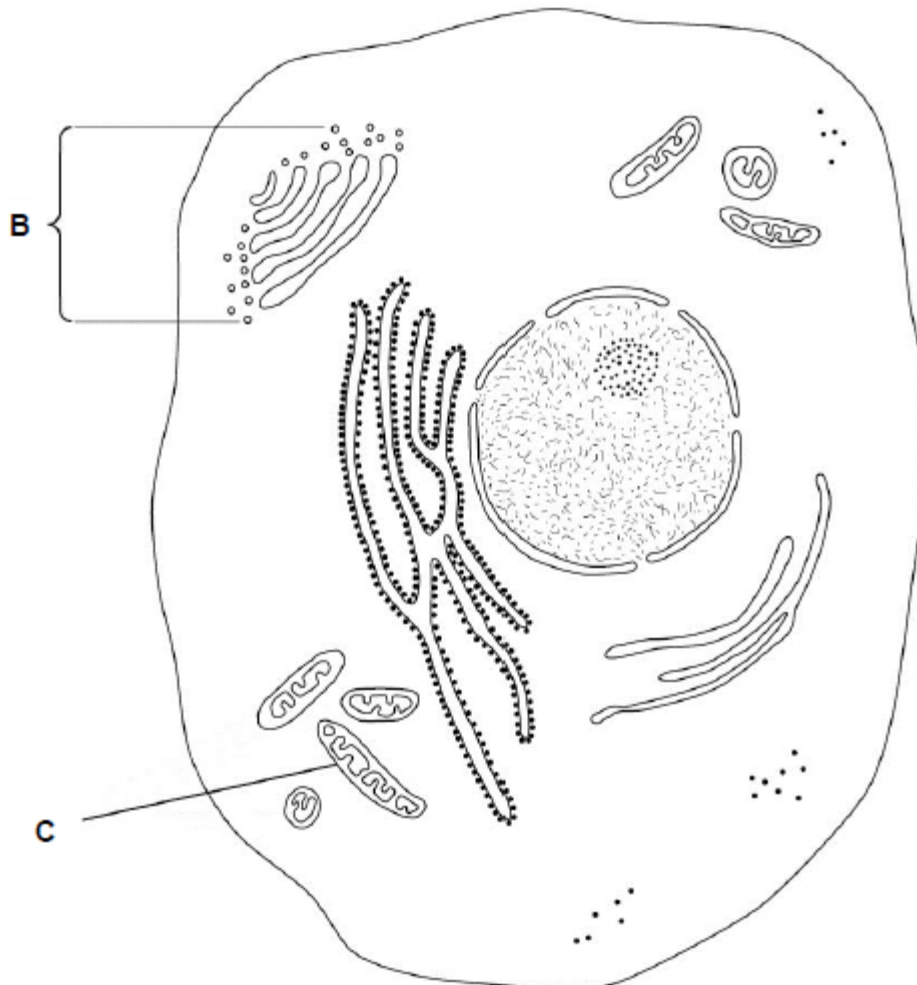
Use the distance between the points labelled **A** and **B** on each drawing in your calculations. Show your working.

The bacterium is _____ times longer

(2)

Q14.

Below is a diagram of an animal cell.



- (a) Name the organelles labelled:

B _____

C _____

(2)

(b) Name **two** structures present in plant cells that are **not** present in animal cells.

1. _____

2. _____

(1)

A biologist prepared a sample of organelles labelled **C** from liver. He used the following method.

1. Added to the liver tissues an ice-cold, buffered solution with the same water potential as the liver tissue.
2. Mixed the liver and solution in a blender.
3. Filtered the mixture from the blender.
4. Spun the filtered liquid in a centrifuge at a low speed. A pellet appeared in the bottom of the centrifuge tube.
5. Poured off the liquid above the pellet into a second centrifuge tube and spun this at a higher speed to obtain the sample of organelles labelled **C**.

(c) Explain why the solution the biologist used was ice-cold, buffered and the same water potential as the liver tissue (step 1).

Ice-cold _____

Buffered _____

Same water potential _____

(3)

(d) Explain why the biologist used a blender and then filtered the mixture (steps 2 and 3).

(2)

- (e) Name the organelle that made up most of the first pellet after centrifuging at a low speed (step 4).

(1)

- (f) The second centrifuge tube was spun at a higher speed to obtain the sample of organelles labelled **C** in the diagram (step 5).

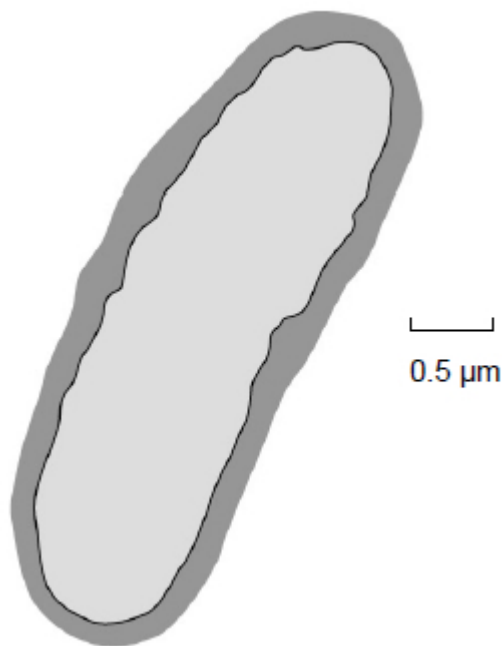
Suggest why.

(1)

(Total 10 marks)

Q15.

A bacterium is shown in the diagram.



- (a) Calculate the magnification of the image.

Magnification = _____

(1)

(b) Complete the table to show the features of a bacterium and a virus.

Put a tick (✓) in the box if the feature is shown.

Surface	Bacterium	Virus
Cell-surface membrane		
Nucleus		
Cytoplasm		
Capsid		

(2)

(c) DNA and RNA can be found in bacteria.

Give **two** ways in which the nucleotides in DNA are different from the nucleotides in RNA.

1. _____

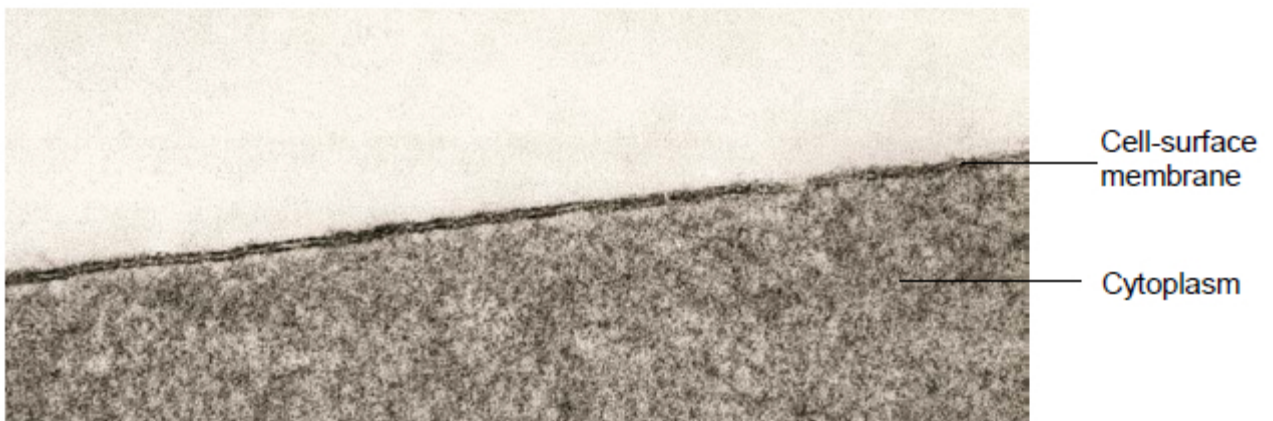
2. _____

(2)

(Total 5 marks)

Q16.

The image below shows the cell-surface membrane of a red blood cell seen with a transmission electron microscope.



(a) The cell-surface membrane can be seen with a transmission electron microscope but **not** with an optical microscope.

Explain why.

(1)

(b) No organelles are visible in the cytoplasm of this red blood cell.

Suggest why.

(1)

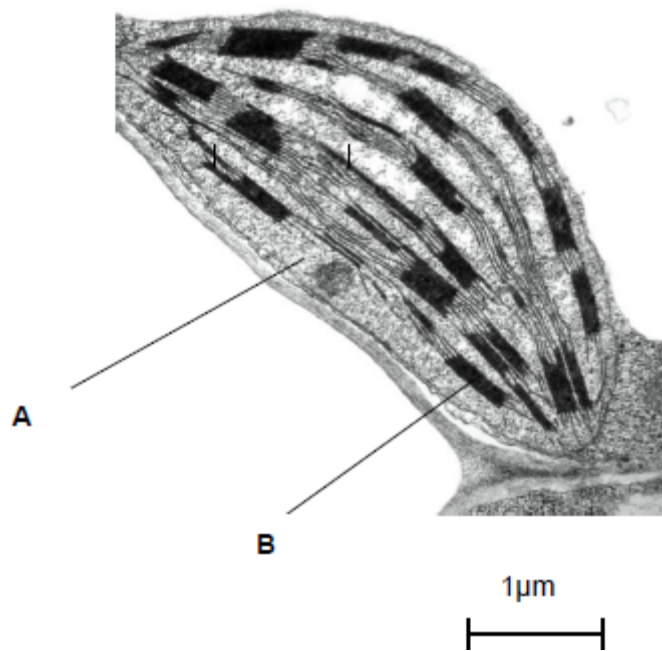
(c) Before the cell was examined using the electron microscope, it was stained. This stain caused parts of the structure of the cell-surface membrane to appear as two dark lines.

Suggest an explanation for the appearance of the cell-surface membrane as two dark lines.

(3)

Q17.

The figure below shows a photograph of a chloroplast taken with an electron microscope.



© Science Photo Library

- (b) Name the parts of the chloroplast labelled **A** and **B**.

Name of **A** _____

Name of **B** _____

(2)

- (c) Calculate the length of the chloroplast shown in the figure above.

Answer _____

(1)

(d) Name **two** structures in a eukaryotic cell that **cannot** be identified using an optical microscope.

1. _____

2. _____

(1)

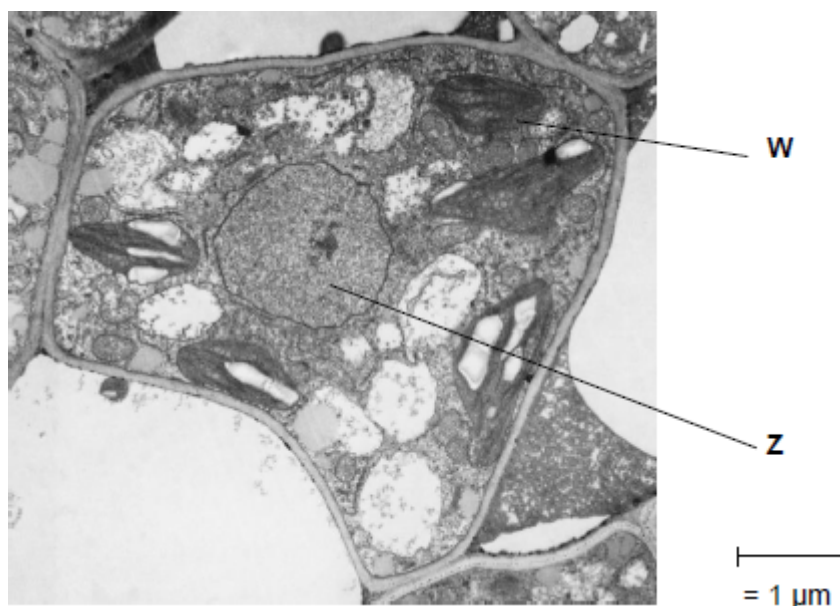
(Total 7 marks)

Q18.

(a) Describe how you could make a temporary mount of a piece of plant tissue to observe the position of starch grains in the cells when using an optical (light) microscope.

(4)

The figure below shows a microscopic image of a plant cell.



© Science Photo Library

- (b) Give the name and function of the structures labelled **W** and **Z**.

Name of **W** _____

Function of **W** _____

Name of **Z** _____

Function of **Z** _____

(2)

- (c) A transmission electron microscope was used to produce the image in the figure above.
Explain why.

(2)

- (d) Calculate the magnification of the image shown in the figure in part (a).

Answer = _____

(1)

(Total 9 marks)