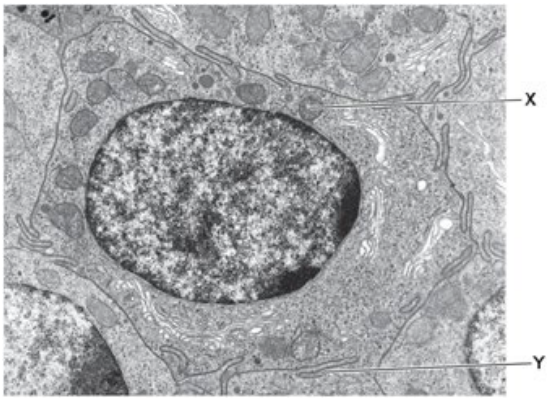
1. This is an electron micrograph of an intestine cell.



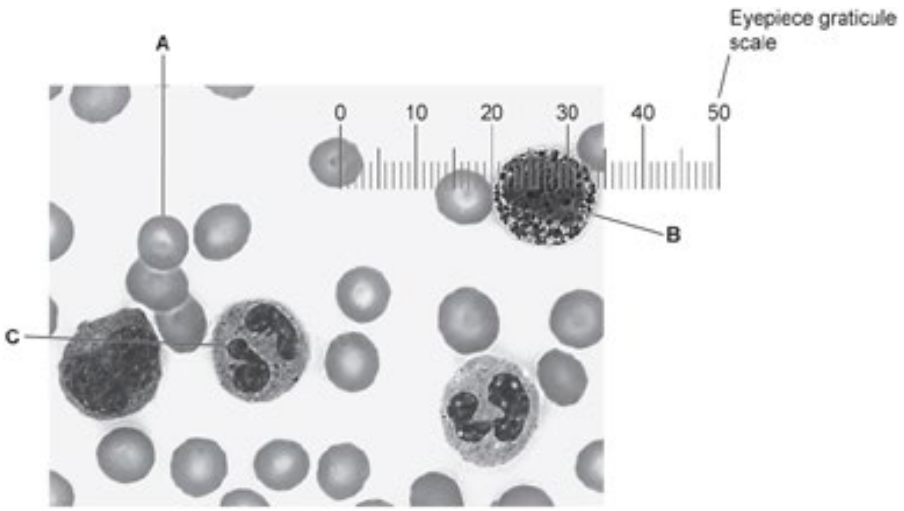
Use the image to answer the question.

Identify the structure labelled **Y**.

A Cell wall
B Cilium
C Plasma membrane
D Smooth ER

Your answer ☐ **[1]**

2. This is a light micrograph of a human blood smear.



i. The cell labelled **A** is sometimes known as a red blood cell.

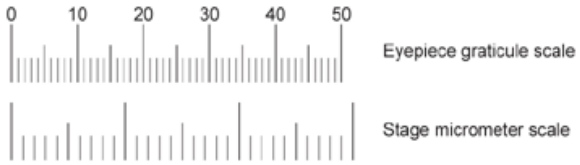
Name cell **A**.

_____ **[1]**

ii. In the space below, draw a labelled diagram of cell **C**.

[4]

iii. The image was taken using a × 40 objective lens. The eyepiece graticule scale for the × 40 objective lens was calibrated using the stage micrometer shown below.



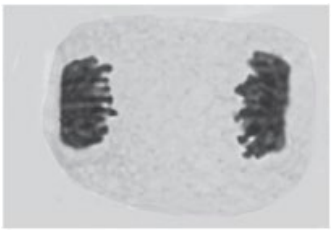
Each of the three large divisions on the stage micrometer scale measured exactly 0.01 mm.

Calculate the diameter of cell **B**.

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

Diameter = ... μm [3]

3. The image shows an onion cell undergoing mitosis.



i. Name the stage of mitosis shown in the image.

[1]

ii. Describe how the image would look different if the cell was in interphase.

[2]

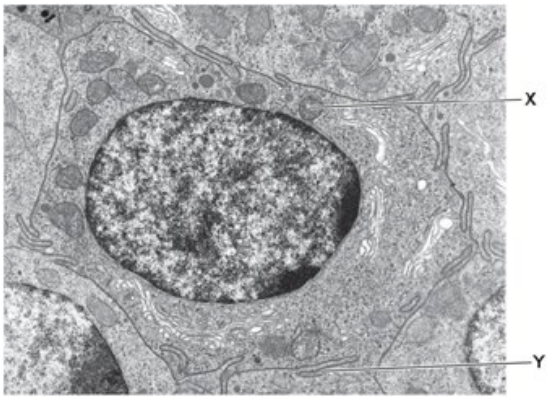
iii. The cell in the image is from the root of an onion.

State why root tissue is frequently chosen to study mitosis.

_____

[1]

4. This is an electron micrograph of an intestine cell.



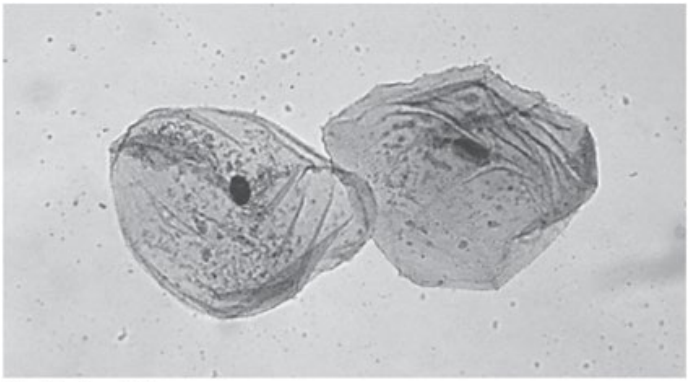
Use the image to answer the question.

Identify the structure labelled **X**.

A Centriole
B Lysosome
C Mitochondrion
D Nucleolus

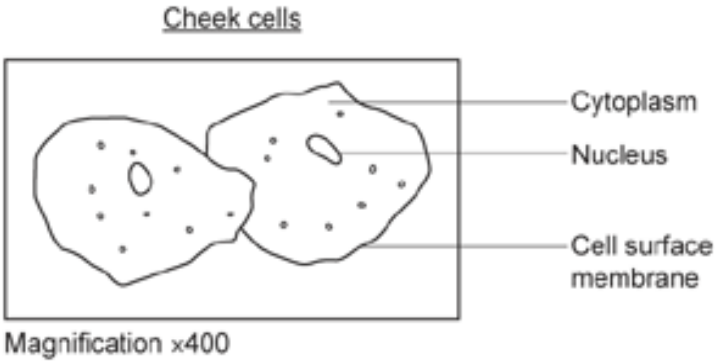
Your answer ☐ **[1]**

5(a). The figure shows a photomicrograph of human cheek cells observed by the students under a light microscope.



Magnification ×400

The figure shows a drawing made by a student of the cells from this photomicrograph.



A student said the figure of the drawn cheek cells was a correct biological drawing.

Identify **two** pieces of evidence from both figures that support the student's comment.

1 _____

_____

_____

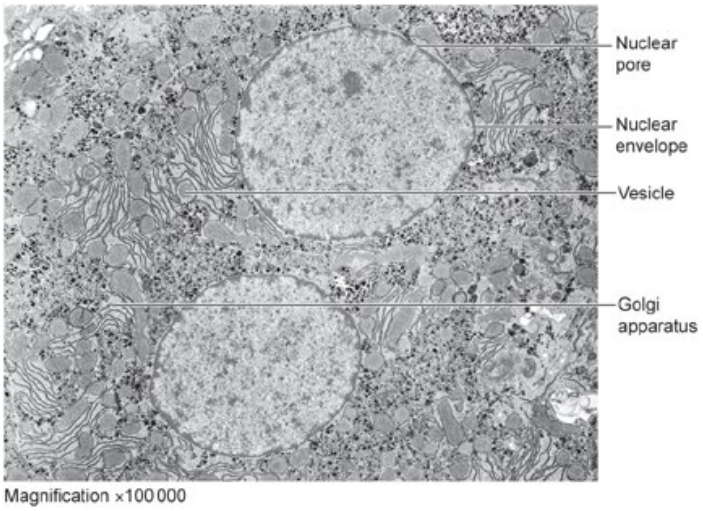
2 _____

_____

[2]

(b).

i. The figure shows a photomicrograph of a liver cell taken from a transmission electron microscope (TEM).



Identify **two** pieces of evidence that indicate that the image in the figure was taken using a TEM.

1 _____

_____

_____

2 _____

_____

[2]

ii. Describe how the rough endoplasmic reticulum and the Golgi apparatus are involved in the production of a secretory vesicle that contains protein.

_____

_____

_____

_____

_____

_____

_____

_____

_____

[4]

iii. The secretory vesicles remove proteins from the cell by a process called exocytosis.

Explain why exocytosis is described as an active process.

_____

[1]

(c). Outline the importance of the cytoskeleton.

[3]

6. Most digestive enzymes are extracellular.

Complete the sentences about the synthesis and secretion of a typical digestive enzyme using the most appropriate terms.

The polypeptide chain is assembled at ribosomes on the ..... .

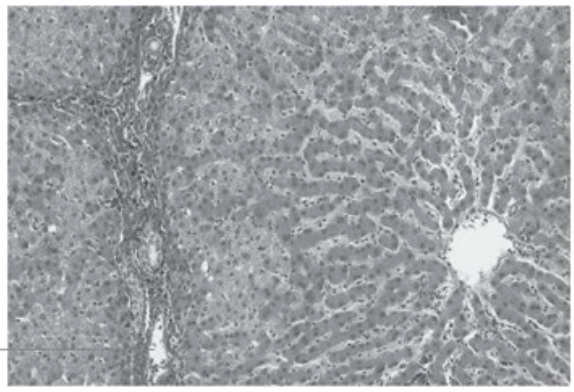
After this, the protein is transported to the ..... where

further processing occurs. The final protein is packaged into .....

for transport to the plasma membrane where the protein is released by exocytosis.

[3]

7. The photomicrograph shows a stained section of liver tissue.



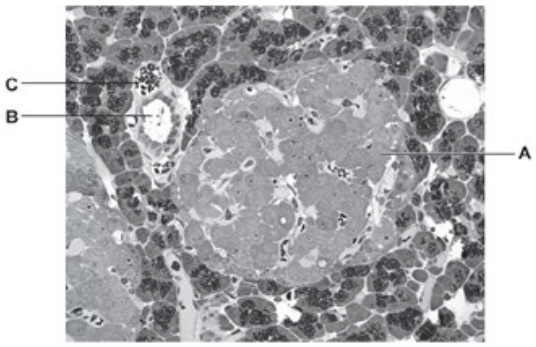
What is the structure labelled **J**?

A Hepatic artery
B Hepatic portal vein
C Hepatic vein
D Sinusoid

Your answer ☐ **[1]**

8. Insulin is secreted from cells in the pancreas.

This is a photomicrograph of pancreatic tissue.



Identify the structures labelled **A**, **B** and **C**.

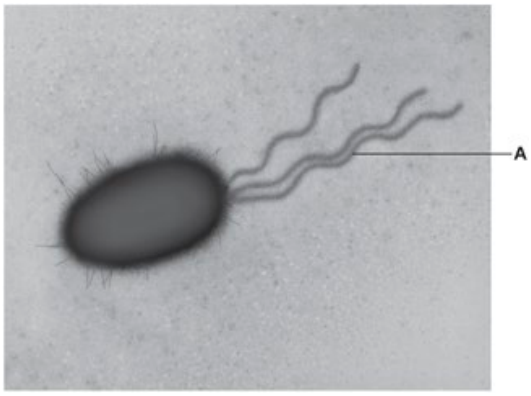
A _____

B _____

C _____ **[3]**

9. *Escherichia coli* is a bacterium that is used widely in scientific experiments and in biotechnology.

This is a transmission electron micrograph of *E. coli*.



i. Name the structure labelled **A**.

A _____ **[1]**

ii. Based on your knowledge, **estimate** the diameter of the *E. coli* cell.

Give your answer in μm.

Diameter = ... μm **[1]**

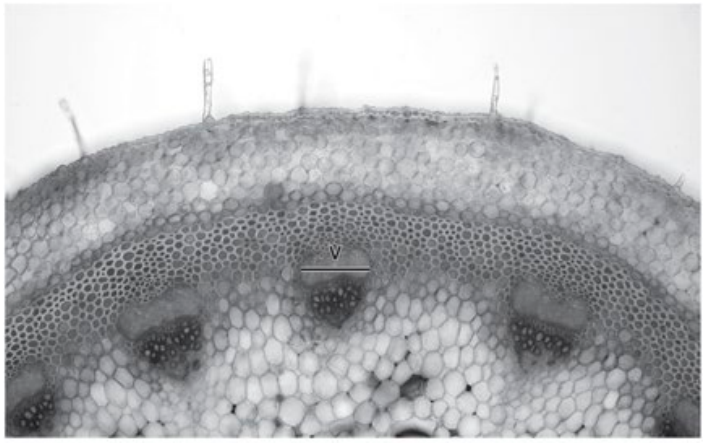
10. Xylem vessels maintain the transpiration stream by transporting water up plant stems.

A pair of students dissect the vascular tissue of the primrose plant, *Primula vulgaris.*

i. State **and** explain **one** safety precaution that the students should take when dissecting the vascular tissue.

[2]

ii. This is a light micrograph of a transverse section through the stem of *P. vulgaris.*



× 90

The diameter of one of the vascular bundles is shown by the line labelled **V**.

Calculate the actual diameter of the vascular bundle labelled **V**.

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

Diameter of the vascular bundle **V** = ... mm **[2]**

11. *Bacillus thuringiensis* (Bt) is a species of bacterium that lives in soil. Bt makes proteins that are toxic to some insects when eaten.

Which process does **not** occur in Bt?

A Bt modifies and packages toxic proteins in the Golgi apparatus
B Bt reproduces by asexual reproduction to pass on the gene for the toxic protein
C Bt transcribes the gene for the toxic protein using RNA polymerase
D mRNA is translated to make the toxic protein

Your answer ☐ **[1]**

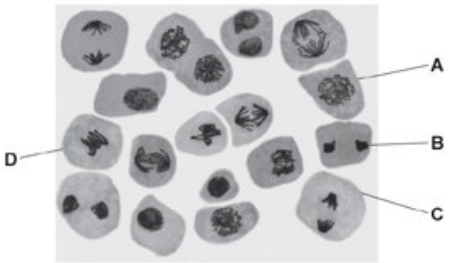
12. Chloramphenicol is an antibiotic that works by binding to bacterial ribosomes.

What process stops when chloramphenicol is present?

A Cytokinesis
B Endocytosis
C Transcription
D Translation

Your answer ☐ **[1]**

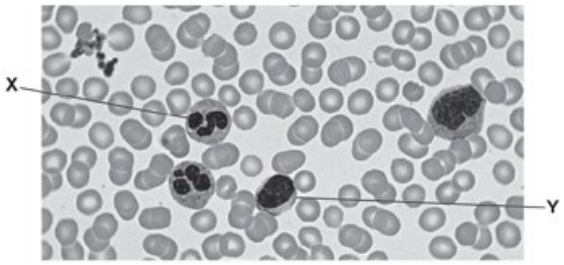
13. The photomicrograph shows a group of cells prepared from an onion root tip squash.



Which of the label lines shows a cell that is in metaphase?

Your answer ☐ **[1]**

14. The image shows a photomicrograph of a blood smear.



Which row in the table below correctly identifies cell **X** and cell **Y**?

	X	Y
A	neutrophil	erythrocyte
B	neutrophil	lymphocyte
C	lymphocyte	neutrophil
D	platelet	neutrophil

Your answer ☐ **[1]**

15. Four organelles are listed in the table below.

Complete the table.

For each organelle place a tick (✓) in the box for a correct description and leave the box empty if the description is incorrect.

Organelle	A membranebound organelle	Found in both animal and plant cells	Has a role in lipid production
Rough endoplasmic reticulum			
Smooth endoplasmic reticulum			
Ribosome			
Mitochondrion			

[4]

16. What is the pathway taken by a protein that has been made and is to be secreted from a cell?

A Ribosome → vesicle → Golgi apparatus → cytoplasm
B Ribosome → vesicle → rough ER → vesicle → smooth ER → vesicle → plasma membrane
C Rough ER → vesicle → Golgi apparatus → vesicle → plasma membrane
D Rough ER → vesicle → smooth ER → vesicle → Golgi apparatus → vesicle → plasma membrane

Your answer ☐ **[1]**

17. What are the roles of the cytoskeleton in a human skin cell?

A Movement of the cell through its environment and providing mechanical strength to the cell
B Movement of the cell through its environment and transport of organelles within the cell
C Providing mechanical strength to the cell and transport of organelles within the cell
D Supporting the cell wall and synthesis of collagen

Your answer ☐ **[1]**

18. Which feature is associated with a prokaryotic cell?

A Cell walls made of chitin
B Extrachromosomal DNA that is circular
C Linear DNA that can form plasmids
D 70S ribosomes present in endoplasmic reticulum

Your answer ☐ **[1]**

19. Mutations in genes coding for proteins in the cytoskeleton have been associated with several diseases of the nervous system, including neurodegenerative disorders.

i. Give **three** functions of the cytoskeleton.

1 _____

_____

2 _____

_____

3 _____

_____ **[3]**

ii. Suggest how a mutation in cytoskeleton genes could cause a disease of the nervous system.

[2]

20. Some students investigated the effect of time on the growth of bacterial populations.

The students prepared a large flask of bacterial culture.

They divided this large culture into a number of smaller flasks each containing 50 cm^3 of bacterial culture.

They then incubated the smaller flasks at 20 °C for up to 48 h.

Every 4 h the students removed one of the flasks and counted the bacteria.

The students recorded the total number of bacteria and the number of viable bacteria in each flask.

When counting the number of bacteria, the students performed serial dilutions on samples removed from each small flask. In each serial dilution, the students removed 0.1 cm^3 and added it to 9.9 cm^3 of water.

To estimate the total number of bacteria, the students used a light microscope to count the number of bacterial cells in a 0.01 cm^3 sample of the final serial dilution.

To estimate the number of viable bacteria, the students spread 0.1 cm3 of the final serial dilution on an agar plate and counted the number of colonies that had grown after 24 h.

i. The students shook each flask before they removed the samples for counting.

Suggest why the students shook the flasks.

[1]

ii. It can be more difficult to count bacterial cells using a light microscope than it is to count human cells.

Suggest **one** reason why bacterial cells are difficult to count using a light microscope.

[1]

iii. In one 0.01 cm3 sample the students counted 52 bacterial cells under the microscope.

Describe the calculation steps the students would then need to make to estimate the total number of bacteria in the small flask.

[3]

21. Some white blood cells have a high concentration of lysosomes.

i. State the role of lysosomes in white blood cells.

[1]

ii. A scientist calculated two values for the lysosomes in a white blood cell:

- mean volume of a lysosome = 6.5×10^{-14} cm^3
- mean number of H^+ ions per lysosome = 1.3×10^{-21} mol

Use these values to calculate the mean H^+ ion concentration per lysosome in this white blood cell.

Give your answer in mol dm^{-3}.

Mean H^+ ion concentration = ... mol dm^{-3} **[2]**

iii. The formula used to calculate pH is

$pH = -\log [H^+]$
where $[H^+]$ is H^+ ion concentration in mol dm^{-3}.

Use your answer from **part (ii)** to calculate the mean pH of the lysosomes in this white blood cell.

Give your answer to **2** significant figures.

pH = ... **[1]**

iv. The scientist stained the lysosomes in a sample of living white blood cells.

The table shows the properties of five stains, **A** to **E**.

Stain	Properties
A	Suitable to stain alkaline components.Taken up by active cells.
B	Suitable to stain acidic components. Taken up by active cells.
C	Suitable to stain neutral components. Taken up by active cells.
D	Suitable to stain alkaline components. Can be used to stain fixed sections of tissue.
E	Suitable to stain acidic components. Can be used to stain fixed sections of tissue.

Select the most appropriate stain for the scientist to use, based on your answer from **part (iii)**.

---------- **[1]**

22. Erythrocytes are formed from bone marrow stem cells. During this process they lose most of their organelles.

Which statement about respiration in erythrocytes is correct?

A Oxygen bound to haemoglobin is used by erythrocytes in aerobic respiration.
B They do not respire because their cell surface membrane is impermeable to glucose.
C They respire aerobically because they always have adequate supplies of oxygen.
D They respire anaerobically because they do not have mitochondria.

Your answer ☐ **[1]**

23. A student is studying three unicellular organisms: the bacterium *Escherichia coli*, the protoctist *Euglena gracilis* and the fungus *Saccharomyces cerevisiae*.

Which feature is common to all three unicellular organisms?

A Cell wall
B Mitochondria
C Nucleus
D Ribosomes

Your answer ☐ **[1]**

END OF QUESTION PAPER