Cell Structure

1. Which of the following statements is / are true?

Statement 1:	Microtubules are part of the '9 + 2' formation in bacterial flagella.
Statement 2:	Microtubules can be prevented from functioning by a respiratory inhibitor.
Statement 3:	Microtubules are involved in moving chromosomes from the equator to the poles of the cell during mitosis.

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

[1]

2. Which of the following statements describes an organelle which is **not** membrane bound?

A. contains cristae
B. modifies and packages proteins
C. contains digestive enzymes
D. is made of rRNA and protein

Your answer ☐

[1]

3. Which of the following structures, **A** to **D**, are found in prokaryotes **and** in eukaryotes?

A. a cell wall made of peptidoglycan
B. circular genomic DNA
C. a nucleus surrounded by a nuclear membrane
D. ribosomes

Your answer ☐

[1]

4. Which of the options, **A** to **D**, occurs in the nucleus of a cell?

A synthesis of enzymes
B synthesis of RNA
C modification of polypeptides
D synthesis of carbohydrates

Your answer ☐ **[1]**

5. Fig. 22.1 shows a transverse section of the stem of a typical pondweed viewed using a × 10 objective lens. Part of a graticule is shown below the stem. The markings on the graticule are 0.1 mm apart.

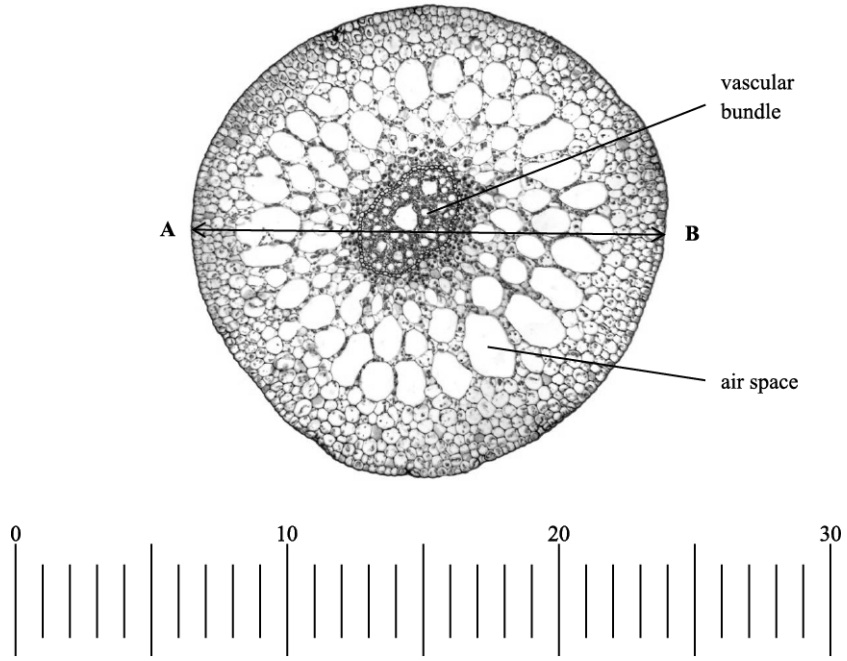

Fig. 22.1

A student was asked to view cells from the phloem in transverse section using a high power objective lens. **Fig. 22.2** shows two diagrams of phloem tissue.

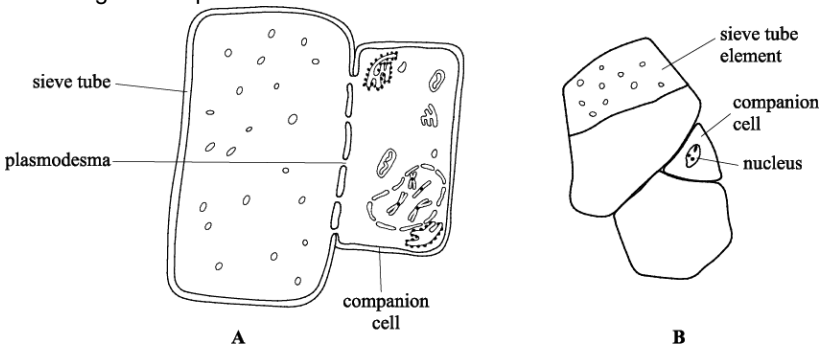

Fig. 22.2

i. Which diagram is the more accurate representation of what the student could see?
Justify your decision using **two** separate features of the diagrams.

---

[2]

ii. State what is meant by the *resolution* of a microscope.

---

[1]

iii. The slide viewed to draw the diagrams in **Fig. 22.2** had been stained.

Table 22.1 shows a list of stains and the cell feature that can be stained.

Stain	Cell feature stained
Nile blue	nuclei
eosin	cytoplasm
Sudan red	cell membrane
iodine	starch

Table 22.1

Which stain had the student used? Explain your answer.

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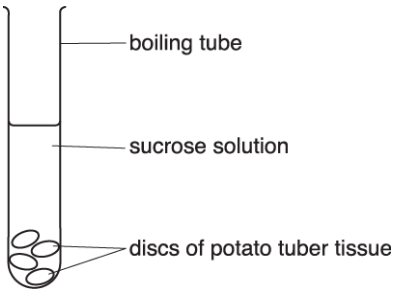
[2]

6. The figure shows some of the apparatus used in an experiment investigating water potential in potato tuber tissue.

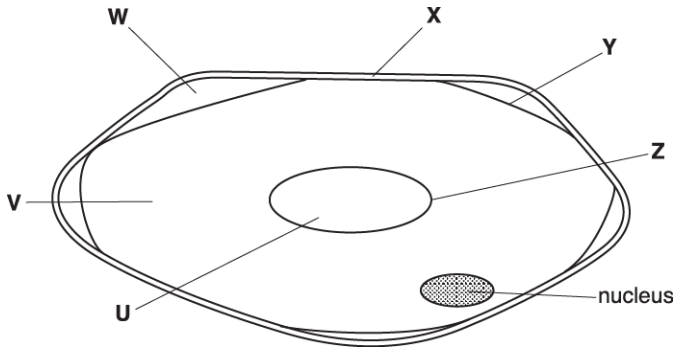


The discs were placed in boiling tubes containing sucrose solutions of different concentrations for four hours. The percentage change of mass was then calculated.

The results are shown in the table.

Concentration of sucrose solution (mol dm^{-3})	Change in mass of potato discs (%)
0.00	+18.00
0.10	+12.50
0.20	+2.50
0.30	− 3.00
0.40	− 8.00
0.45	−11.50

The figure shows a diagram of a cell from a potato tuber disc that was placed in 0.45 mol dm^{-3} sucrose solution.



i. Identify the parts of the cell labelled **X**, **Y** and **Z**.

X .....

Y .....

Z .....

[3]

ii. What will be found at **W** in the immersed cell?

.....

[1]

7. One theory about the evolution of organelles is the endosymbiotic theory. This theory suggests that the mitochondria and chloroplasts found in eukaryotic cells represent formerly free-living bacteria that were absorbed into a larger cell.

The following list describes a number of features of mitochondria and chloroplasts.

Place a tick (✓) next to the **three** statements that could be used as evidence for the endosymbiotic theory.

mitochondria contain ribosomes that are smaller than those found in the cell cytoplasm	☐
chloroplasts contain chlorophyll and other photosynthetic pigments	☐
mitochondria are a similar size to bacteria	☐
the inner membrane of a mitochondrion is folded to form cristae	☐
chloroplasts contain many disc-shaped membranes called thylakoids	☐
chloroplasts have their own circular DNA	☐

[3]

8. The onion plant, *Allium cepa*, is grown as a food crop around the world.

The table below contains statements about the root cells of an onion.

Place ticks (✓) in the boxes in the table to indicate whether the statements are true or false.

Statement about onion root cells	True	False
contain chloroplasts		
contain mitochondria		
contain 70S ribosomes in the cytoplasm		
have pili		
have cellulose cell walls		

[2]

9. Please refer to Fig. 2 in Insert H020/02, Depth in biology, June 2019, which is a photomicrograph of a mammalian blood smear.

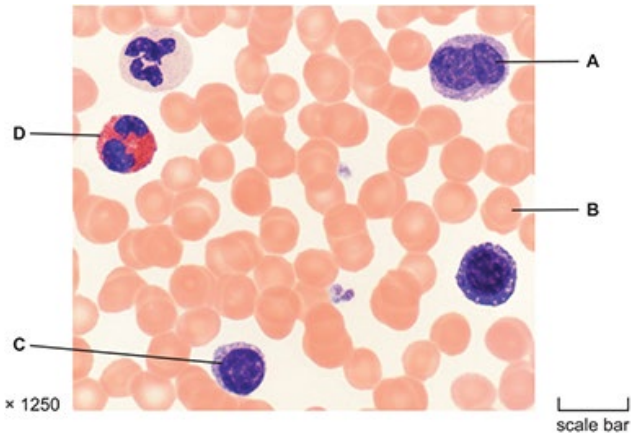


Fig 2

i. Name the cell labelled **B**.

_____ **[1]**

ii. Cells **A**, **C** and **D** work together to carry out an important function.

State the function that cells **A**, **C** and **D** perform.

_____ **[1]**

10. Sago pondweed is an underwater plant that grows in many regions of the world.

Fig. 1.1 shows a transmission electron micrograph of a sago pondweed cell.

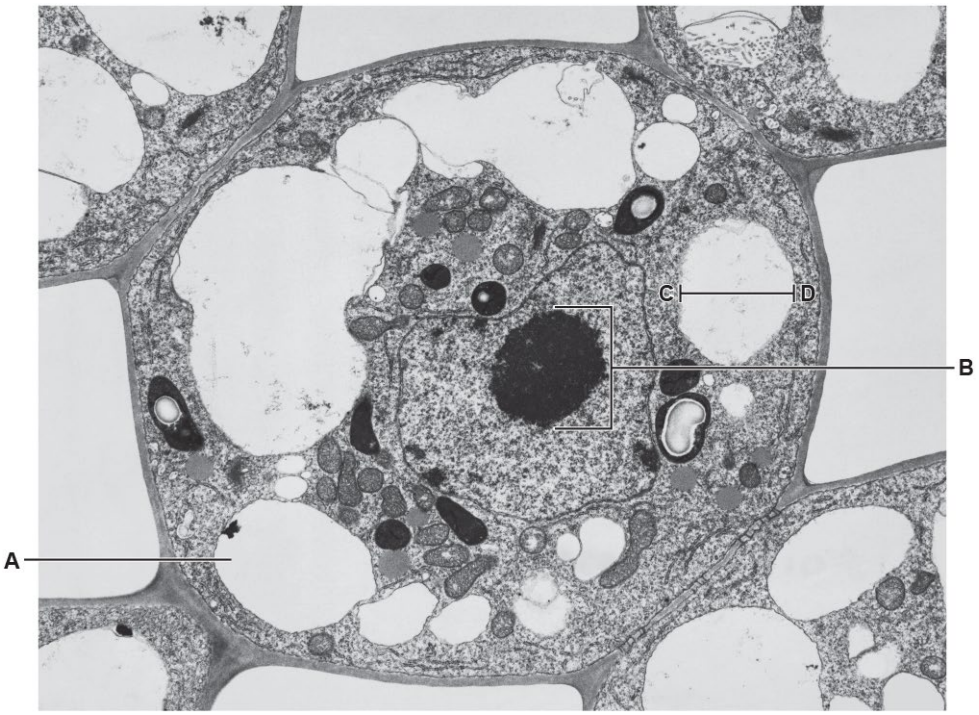


Fig. 1.1

i. Identify the **cellular components** shown at **A** and **B**.

A

B

---

[2]

ii. The real size of the line between **C** and **D** on Fig. 1.1 is 1.4×10^{-6} m.

Calculate the magnification that was used to produce the image in Fig. 1.1.

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

magnification = ... **[2]**

iii. Fig. 1.2 shows a student's drawing of another sago pondweed cell, which was observed under a light microscope. The student used a sharp pencil but did not label the drawing.

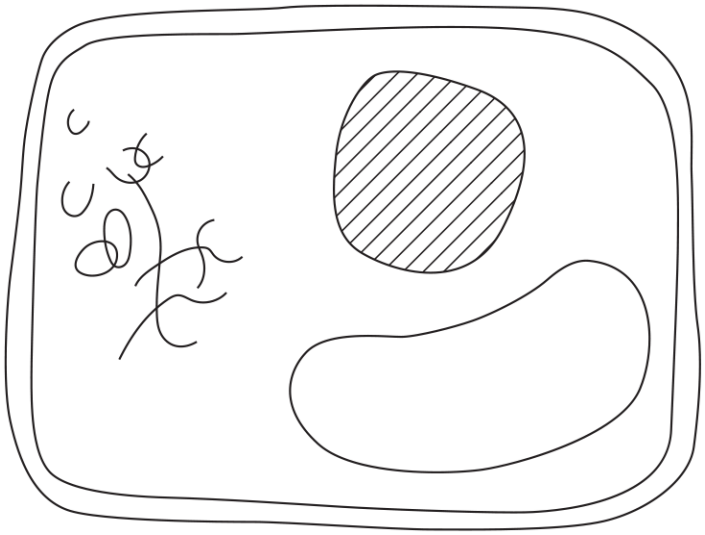


Fig. 1.2

Describe **two other** ways in which the drawing could be improved.

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[2]

iv. The student stained a sago pondweed sample to improve the contrast between cellular components when viewed under a microscope.

The student used the following procedure to stain the sample:

- Use forceps to place the sample on a glass slide.
- Use a pipette to place two drops of the stain in the centre of the sample.
- Carefully lower a cover slip onto the sample, ensuring that the cover slip is parallel with the slide as it is lowered.

1

2

---

[2]

11. The rough endoplasmic reticulum is where translation of some proteins takes place in a eukaryotic cell.

Explain the role of the membrane in the rough endoplasmic reticulum.

_____

_____

_____

_____

_____ **[2]**

12. A student was observing onion epithelial cells using a light microscope. They photographed these cells and the image obtained is shown in Fig. 1.1. The student then made a drawing of a few cells from this image. The drawing is shown in Fig. 1.2.

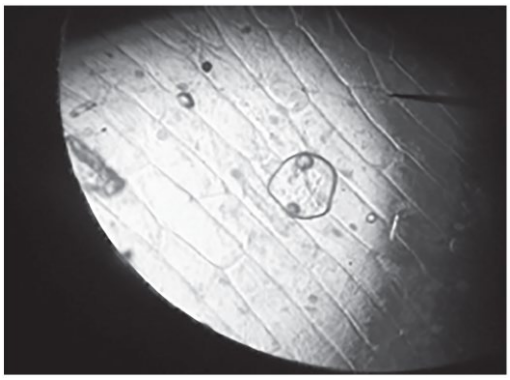

Fig. 1.1

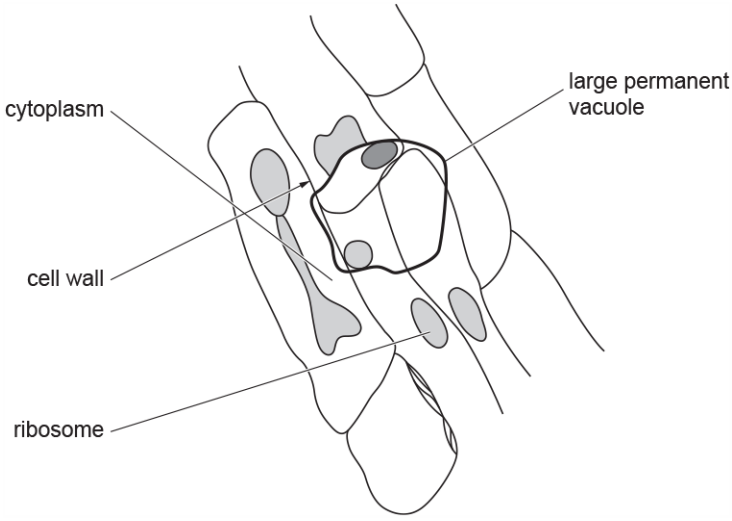

Fig. 1.2

The teacher stated that two of the labels on the drawing Fig. 1.2 were incorrect, and also that it was a poor quality biological drawing.

i. Identify **one** incorrect label and explain your answer.

Incorrect label

Explanation

---

[3]

ii. State **three** changes, other than to the labels, to Fig. 1.2 that the student would need to make to improve the biological drawing.

1

2

3

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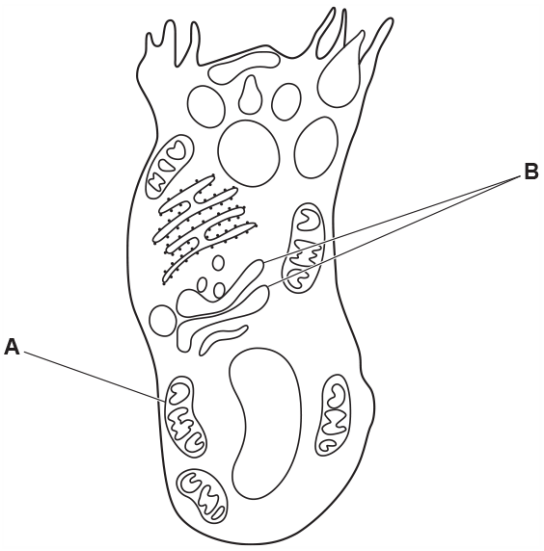
[3]

13. Mucus is composed of water, carbohydrates, proteins and triglycerides.

Mucus is secreted by goblet cells.

Below is a diagram of a goblet cell as seen under an electron microscope.



i. Suggest why goblet cells have large numbers of the cellular component labelled **A**.

---

[1]

ii. Suggest how the role of the cellular component labelled **B** is relevant to the function of the goblet cell.

---

[2]

14. Table 2.1 compares some features of animal cells, plant cells, yeast cells and bacterial cells.

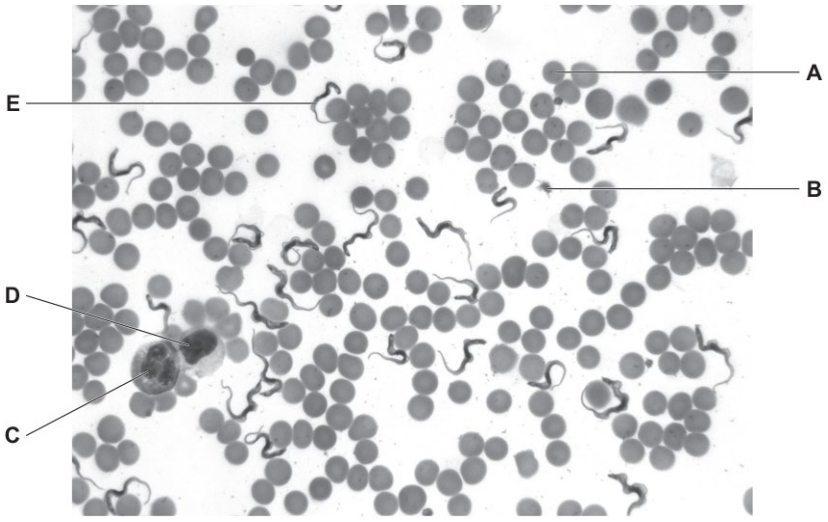
Complete the table.

Feature	Animal	Plant	Yeast	Bacterium
Means of cell division	cytokinesis	cytokinesis		binary fission
Presence of nucleus				
Material in cell wall	none		chitin	
Presence of ribosomes				

Table 2.1

[4]

15. The image below shows a human blood smear.



The cell labelled **E** shows a parasite called *Trypanosoma*.

Which of the following statements is/are evidence that *Trypanosoma* is a eukaryote?

1 a nucleus is present
2 it is a similar size to blood cells
3 the presence of flagella

A 1, 2 and 3
B only 1 and 2
C only 2 and 3
D only 1

Your answer ☐ **[1]**

16. The endosymbiosis theory suggests that mitochondria may have evolved from bacteria that were taken inside other cells.

These cells then evolved into eukaryotes.

i. Give **two** structural features of mitochondria that support this theory.

1 _____

_____

2 _____

_____

[2]

ii. Explain why early eukaryotes were able to grow more quickly than cells that did not possess mitochondria.

_____

_____

_____

_____

_____

_____

_____

_____ **[3]**

17. The bacterium *Sorangium cellulosum* and the fungus *Armillaria mellea* are both found in soil.

Which of the rows, **A** to **D**, correctly shows the structures present in each organism?

	Free ribosomes incytoplasm	**Membrane bound nucleus**	**DNA in a single loop**	**Cell wall present**
A	*S. cellulosum* and *A. mellea*	*A. mellea*	*S. cellulosum*	*S. cellulosum* and *A. mellea*
B	*S. cellulosum* and *A. mellea*	*A. mellea*	*S. cellulosum* and *A. mellea*	*S. cellulosum* and *A. mellea*
C	*S. cellulosum*	*S. cellulosum* and *A. mellea*	*S. cellulosum*	*A. mellea*
D	*A. mellea*	*S. cellulosum*	*S. cellulosum* and *A. mellea*	*S. cellulosum*

Your answer ☐ **[1]**

18(a). Fig. 20.1 shows a transmission electron micrograph of part of a eukaryotic cell.

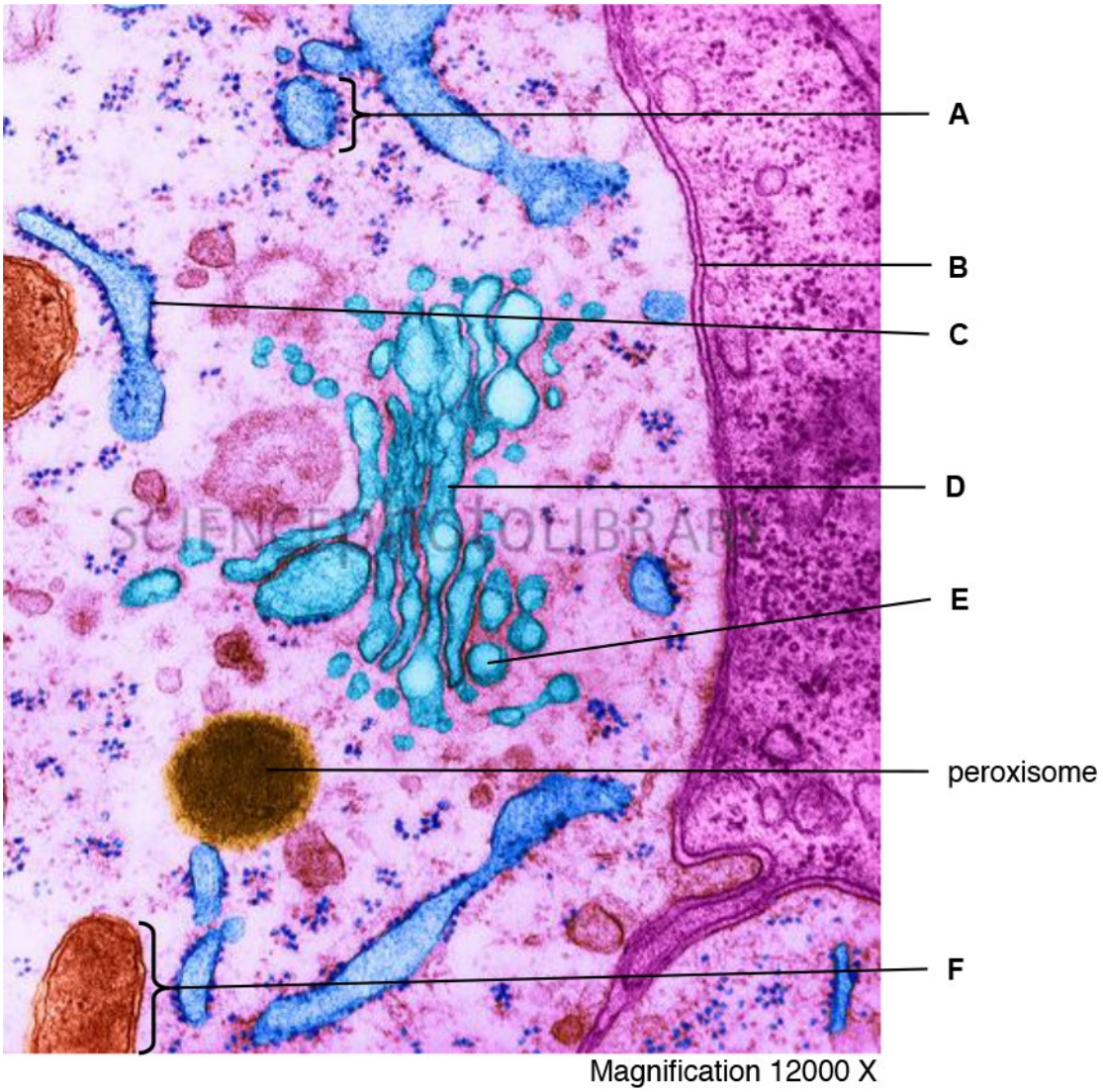


Fig. 20.1

i. Identify **one** feature inside the cell that would also be seen in a prokaryotic cell.

[1]

ii. Identify **two** features of this cell that confirm it is **not** a prokaryotic cell.

In each case state the letter and the name of the feature.

Letter……

Name……

……

Letter……

Name……

……

[2]

(b). The cell shown in **Fig. 20.1** is capable of synthesising and secreting proteins.

Using **only** the letters from **Fig. 20.1**, list the correct sequence of the organelles involved in synthesis and secretion of a protein.

[3]

19. Which of the options describes the path taken by proteins, such as digestive enzymes, that are exported from a cell?

A Golgi apparatus → rough endoplasmic reticulum → secretory vesicle
B ribosome → smooth endoplasmic reticulum → Golgi apparatus
C rough endoplasmic reticulum → Golgi apparatus → secretory vesicle
D smooth endoplasmic reticulum → ribosome → Golgi apparatus

Your answer ☐ **[1]**

20. Which organelle, **A** to **D**, is **not** involved in the production and secretion of enzymes in eukaryotes?

A golgi apparatus
B ribosomes
C smooth endoplasmic reticulum
D vesicle

Your answer ☐ **[1]**

21. Humans use the enzyme α-amylase to break down polysaccharides in food for absorption into the blood.

The gene for human α-amylase is found on chromosome 1.

The gene is transcribed in the nucleus and translation occurs on the rough endoplasmic reticulum in cells of the salivary gland.

Describe how the molecule is prepared and secreted by cells of the salivary gland after translation has taken place.

[3]

22. The plasma membrane contains proteins, which are made within the cell.

Outline the process and organelles involved in the translation of these proteins from RNA.

[4]

23. Fig. 8.1 shows an animal cell.

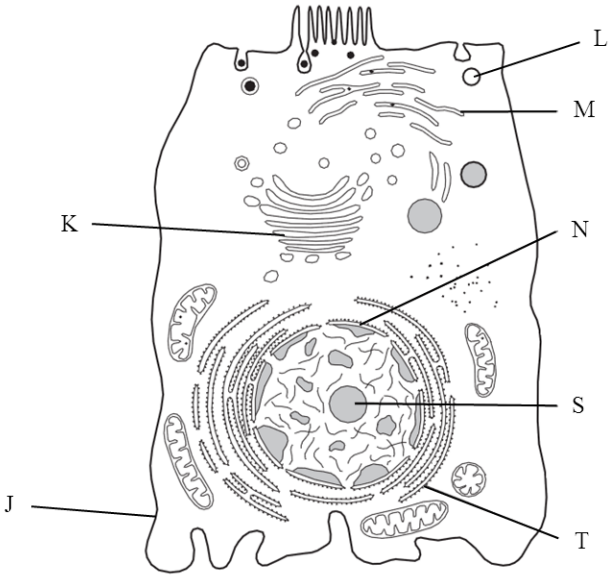


Fig. 8.1

Which option describes the correct sequence of organelles involved during the production and secretion of a protein from this cell?

A S, K, L, J **B** T, K, L, J **C** T, M, L, J **D** S, T, K, L

Your answer ☐

[1]

24.

DNA is a polymer of nucleotides that contains the genetic code needed for a protein to be made.
Tubulin is a protein that is found in all eukaryotes and some prokaryotes.

i. Explain how the genetic code in the gene for tubulin codes for the protein tubulin.

---

[2]

ii. Tubulin is a globular protein that can polymerise to form the cell cytoskeleton.

One example of this is the formation of microtubules, which form the spindle fibres to move chromatids during mitosis and meiosis.

Describe **three** other cellular functions of the cytoskeleton.

---

[3]

iii. Suggest **two** ways tubulin is essential to protein synthesis and protein secretion in eukaryotic cells.

1

2

---

[2]

25. Peroxisomes are vesicles that usually contain enzymes such as catalase.

Explain how peroxisomes can be moved around inside the cell.

---

[2]

26. Prokaryotic cells have cytoskeletons. The molecules in prokaryotic cytoskeletons are different from the molecules in eukaryotic cytoskeletons.

Table 4.1 lists three molecules present in a prokaryotic cytoskeleton.

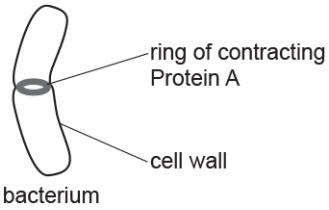
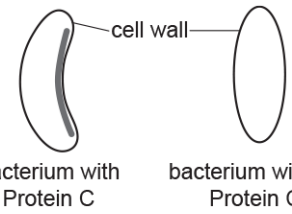
Prokaryotic cytoskeleton molecule	Information
Protein A	
Protein B	Similar structure to actin.
Protein C	

Table 4.1

i. Suggest the function of Protein A.

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[1]

ii. Suggest the function of Protein C.

---

[1]

iii. An antibiotic called A22 binds irreversibly to Protein B. Despite its antibiotic properties, A22 is not used in humans.

Suggest why scientists have advised that A22 should not be used in humans.

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[1]

27(a). A cytoskeleton is present in all eukaryotic cells. One of its functions is to control the movement of organelles.

State how the cytoskeleton moves organelles around the cell.

_____

_____ **[2]**

(b). Epithelial cells in the airways of mammals play an essential role in defences against pathogens.

Explain the function of epithelial cells in the airways of mammals in the defence against pathogens and suggest the importance of the cytoskeleton in carrying out this function.

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**