Cambridge Assessment International Education

AS Level | 9700

BIOLOGY

TOPICAL P2

With Mark Scheme
All Variants
Question Bank from 2016 to 2023
Classified in 11 Chapter and 23 Sub-topics
Questions Order New to Old
References of repeated Questions added

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CONTENT TOPICAL PAPER 2

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CHAPTER 1

CELL STRUCTURE

A Level Biology Topical Paper 2

Iram Habib Malik

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In this chapter

You will practice the following topics:

1.1: The microscope in cell studies

1.2: Cells as the basic units of living organisms

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Topic 1.1: The Microscope in Cell Studies

2022

9700/21/O/N/22/Q1

1 **(a)** Fig. 1.1 is a transmission electron micrograph showing a section of a human liver cell.

Fig. 1.1

(i) Name organelles **A** and **B** shown in Fig. 1.1.

A .....

B .....
[2]

(ii) In liver cells, enzymes are attached to the membrane of smooth endoplasmic reticulum.

With reference to the functions of smooth endoplasmic reticulum, suggest the advantages of having enzymes attached to the membrane rather than free in the lumen.

.....

.....

.....

..... [3]

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(b) Explain the advantages of using a transmission electron microscope compared with a light microscope when viewing a liver cell.

.....

.....

.....

.....

..... [3]

[Total: 8]

2021

9700/21/O/N/2021/Q1(a)

2 Fig. 1.1 is a transmission electron micrograph of cells from the leaf of a plant.

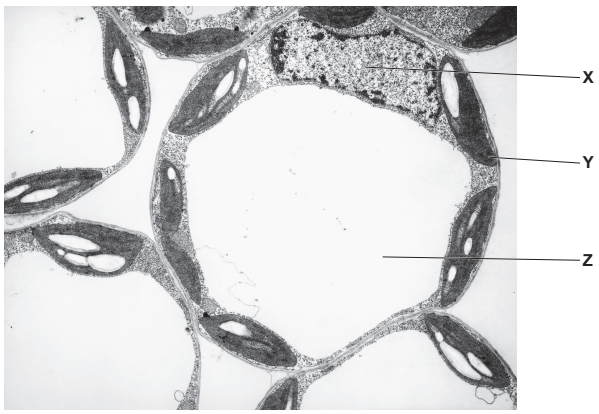

Fig. 1.1

(i) Name the cell structures **X**, **Y**, and **Z**.

X .....

Y .....

Z .....

[3]

(ii) State **two** ways in which the structure of an animal cell differs from plant cells such as those shown in Fig. 1.1.

1 .....

.....

2 .....

.....

[2]

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9700/22/M/J/2021/Q5(a)

3 Fig. 5.1 is a transmission electron micrograph showing parts of two plant cells. The function of the middle lamella is cell-to-cell adhesion. The middle lamella is composed of a polysaccharide known as pectin.

Pectin interacts with the polysaccharides cellulose and hemicellulose in the cell walls of the plant cells so that the cell walls are held close together, as shown in Fig. 5.1.

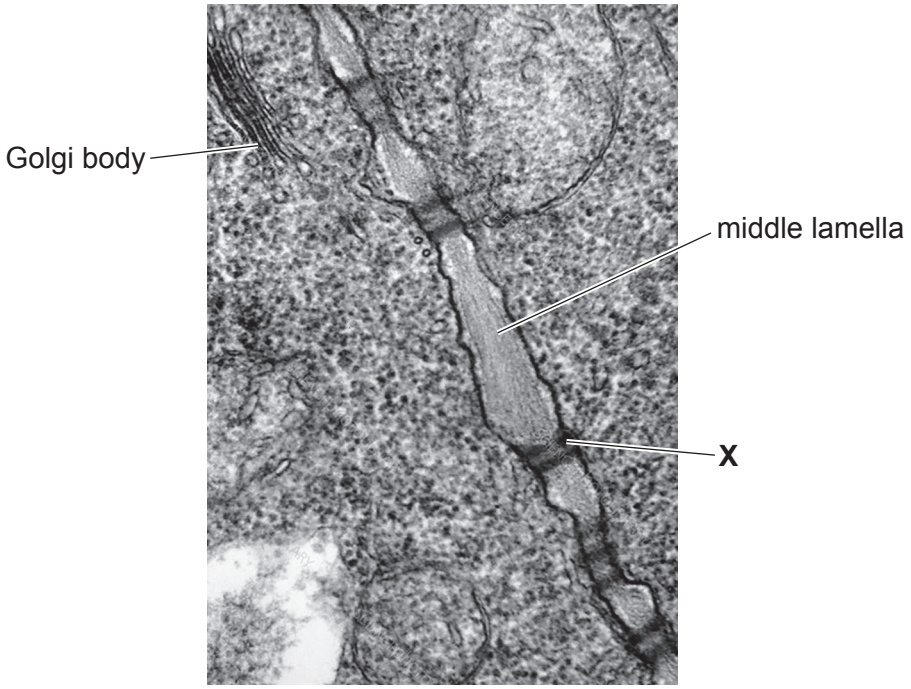

Fig. 5.1

Cell structure **X** in Fig. 5.1 is a cytoplasmic channel with strands of cytoplasm passing through the cell walls of the two cells.

Name cell structure **X and** state **one** function of this cell structure.

name .....

function .....

..... [2]

STUDENTS RESOURCE

9700/21/M/J/2021/Q1

4 Fig. 1.1 is a transmission electron micrograph of cells from duckweed, *Spirodela oligorrhiza*.

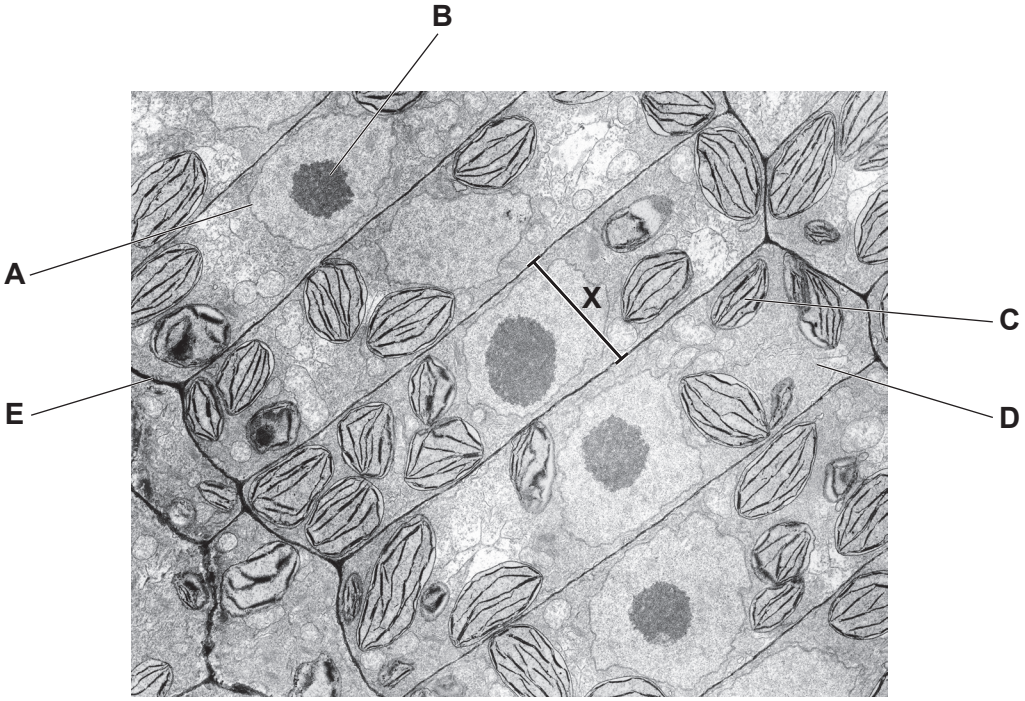

Fig. 1.1 magnification ×4275

(a) Calculate the actual width of the cell labelled **X**.

Write down the formula you will use to make your calculation.

Show your working and give your answer in micrometres to one decimal place.

formula

..... μm [3]

(b) (i) Table 1.1 lists some biological molecules found in plant cells.

Complete Table 1.1 by choosing **one** letter from Fig. 1.1 that indicates a cell structure where each biological molecule is found.

Table 1.1

biological molecule	letter from Fig. 1.1
DNA	
cellulose	
phospholipid	
histone proteins	

[4]

(ii) State the name of a cell structure, **visible in Fig. 1.1**, where ATP is synthesised.

..... [1]

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(iii) Name a cell structure that produces mRNA.

..... [1]

(c) Describe the evidence from Fig. 1.1 that shows that the image is a transmission electron micrograph.

.....

.....

.....

.....

..... [2]

2020

9700/22/O/N/2020/Q4(a)

5 In the immune system, a plasma cell develops from an activated B-lymphocyte. Mature plasma cells synthesise and secrete antibody molecules.

(a) Fig. 4.1 is a diagram of a transmission electron micrograph of a plasma cell.

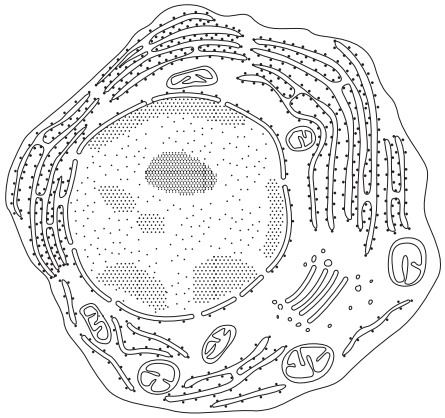

Fig. 4.1

The plasma cell can be seen in greater detail using an electron microscope compared with using a light microscope.

(i) Describe the **extra** detail of the nucleus that can be seen using an electron microscope.

.....

.....

.....

.....

.....

..... [3]

STUDENTS RESOURCE

(ii) Explain why cell structures, such as ribosomes and the rough and smooth endoplasmic reticulum, cannot be seen using a light microscope.

.....

.....

.....

..... [2]

2019

9700/21/O/N/2019/Q1(b,c)

6 **(a)** Plasma cells synthesise and secrete antibodies.
Fig. 1.3 is a transmission electron micrograph showing a plasma cell.

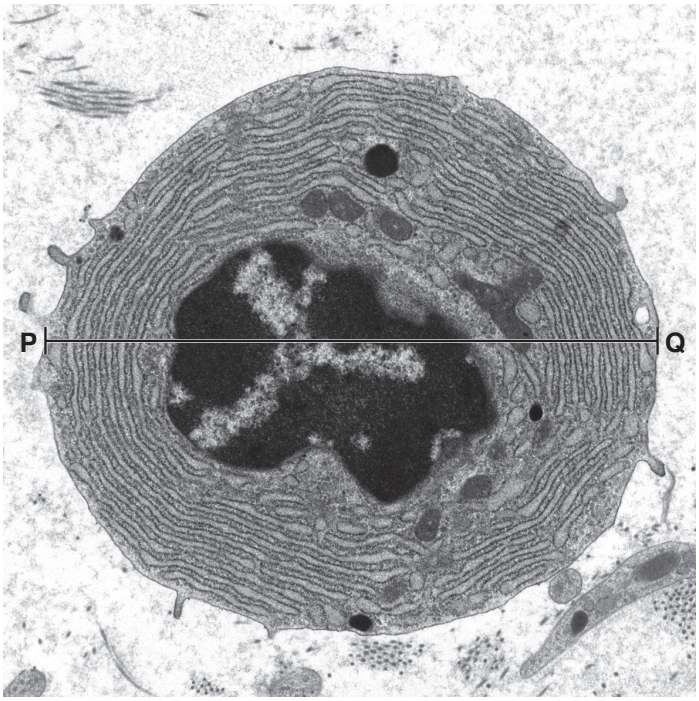

Fig. 1.3

magnification ×6000

(i) Use a label line and the label **T** on Fig. 1.3 to identify where the genes coding for the polypeptide chains of the antibodies are located. [1]

(ii) Calculate the actual diameter of the plasma cell shown by the line **P**–**Q**.
Write down the formula used to make your calculation.
Show your working and give your answer to the nearest micrometre (μm).

formula

actual diameter = ...μm [2]

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(iii) The plasma cell in Fig. 1.3 is very metabolically active.

Suggest why there are very few mitochondria visible in the electron micrograph in Fig. 1.3.

.....

.....

..... [1]

(b) Sieve tube elements in plants have very few organelles such as mitochondria.

Explain how having very few organelles is an adaptation of the sieve tube element to its function.

.....

.....

.....

.....

..... [2]

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2018

9700/21/O/N/2018/Q4(a)

7 Fig. 4.1 is a photomicrograph of a cross-section of a tubular structure in the kidney made from epithelial cells.

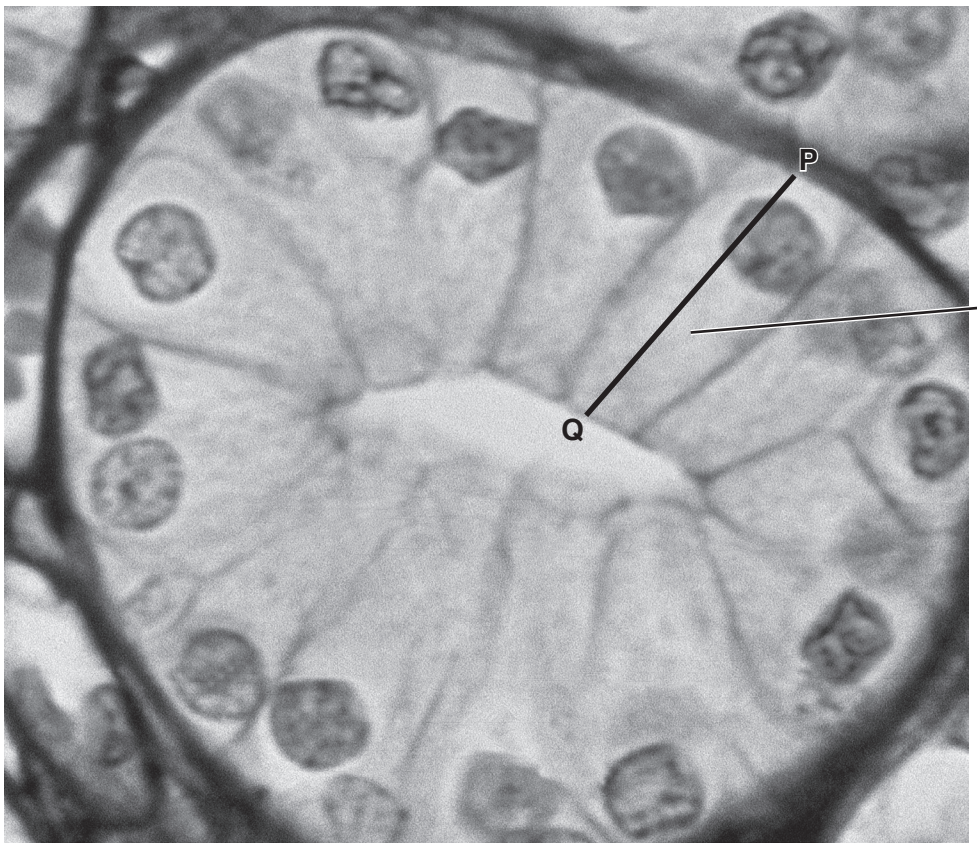

Fig. 4.1

The actual length of epithelial cell **A** along the line **P–Q** is 35 μm.

Calculate the magnification of the image shown in Fig. 4.1. Write down the formula and use it to make your calculation. Show your working.

formula

magnification × ..... [2]

STUDENTS RESOURCE

9700/23/M/J/2018/Q2(a,b)

8 Adipose tissue, which is composed of cells known as adipocytes, stores large quantities of triglycerides and functions as an energy storage tissue.

Fig. 2.1 is a photomicrograph of adipose tissue.

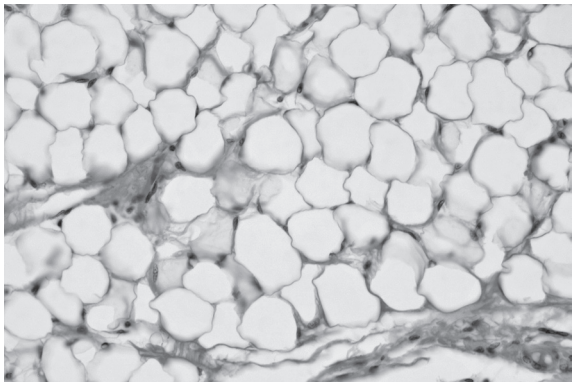

Fig. 2.1

(a) Adipocytes can be very large in size compared to other body cells. This is due to a large lipid droplet within the cell.

The largest adipocyte in Fig. 2.1 has a mean diameter of 35 μm. A person with good eyesight can see cells of 0.05 mm or greater diameter without a magnifying glass or any other optical aid.

State whether the person can see this adipocyte without any optical aid. Show your working to justify your answer.

.....

.....

.....[1]

(b) Only some of the organelles within the adipocyte can be seen using a high quality light microscope set at the highest magnification.

Organelles such as rough endoplasmic reticulum, smooth endoplasmic reticulum and ribosomes are only visible using an electron microscope.

Explain why these organelles are **not** visible using a light microscope.

.....

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.....

.....[2]

STUDENTS RESOURCE

Topic 1.2: Cells as the Basic Units of Living Organisms

2023

9700/21/M/J/23Q1

1 Fig. 1.1 is a transmission electron micrograph of a cell from the stem of sago pondweed, *Stuckenia pectinata*.

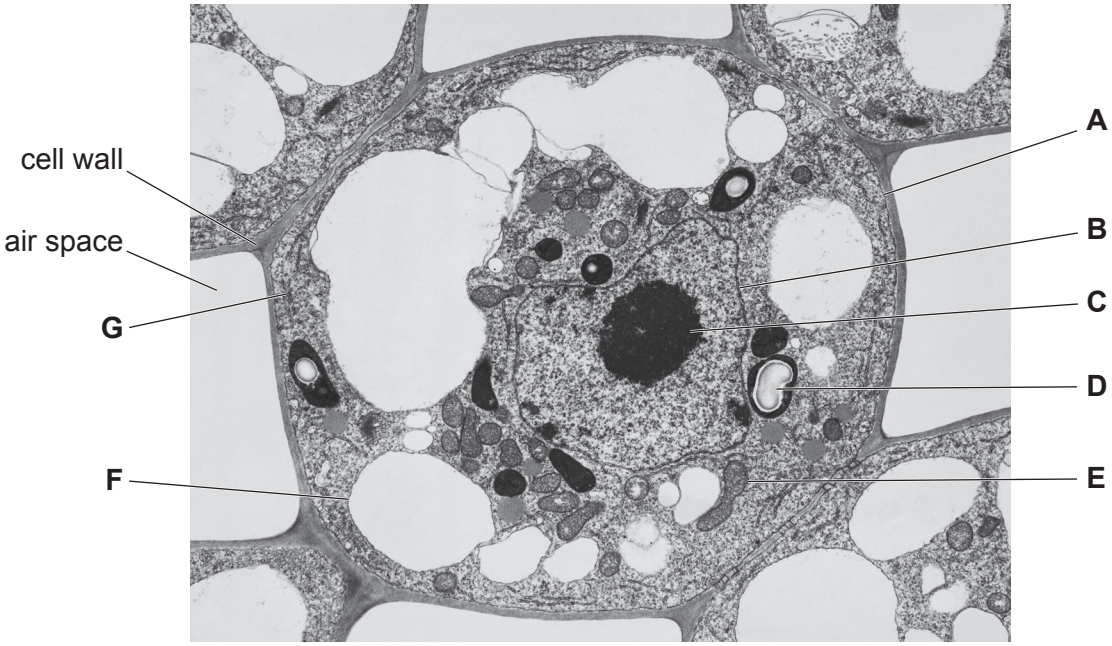

Fig. 1.1

(a) (i) State the evidence from Fig. 1.1 that shows that the cell is from the stem of *S. pectinata* and **not** from the mesophyll of a leaf.

.....

..... [1]

(ii) Complete each row in Table 1.1 to identify a cell structure shown in Fig. 1.1 that carries out the function listed.

Table 1.1

function	name of cell structure	letter on Fig. 1.1
gas exchange		
production of subunits of ribosomes		
active transport of ions		
aerobic respiration		

[4]

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(b) Plant vacuoles develop when vesicles fuse together. The vacuoles increase in size as more vesicles fuse.

Fig. 1.2 shows the movement of vesicles within a plant cell during the development of a vacuole.

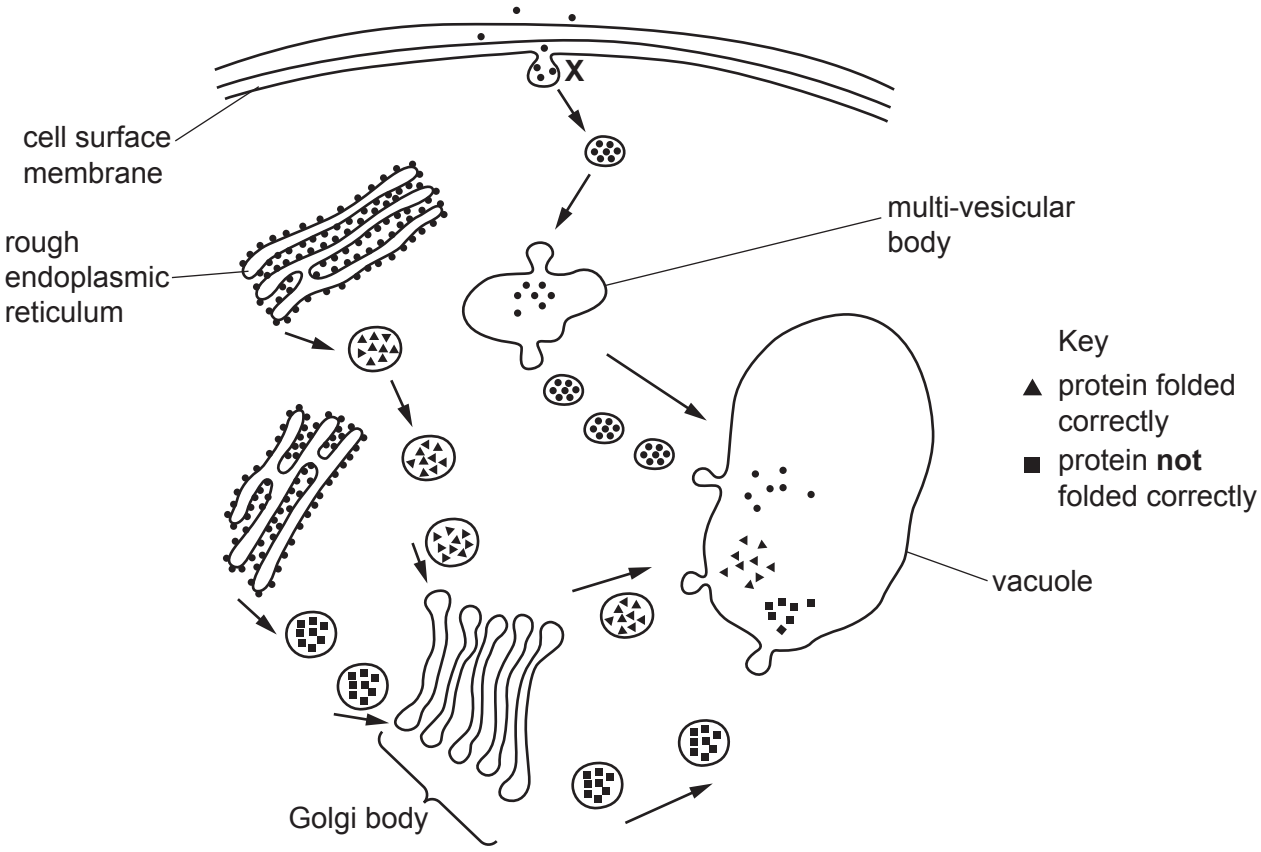

Fig. 1.2

(i) Name the process that is occurring at **X**.

..... [1]

(ii) Some of the vesicles formed by the Golgi body pass to the vacuole. These vesicles contain proteins that have been folded correctly and some that have **not** folded into their correct shapes. The proteins that have **not** folded correctly pass to the vacuole where they are broken down.

Explain how proteins that have **not** folded correctly are broken down in the vacuole.

.....

.....

.....

.....

..... [3]

STUDENTS RESOURCE

(c) Small vacuoles in *S. pectinata* may have roles similar to lysosomes in animal cells.
Describe the role of lysosomes in animal cells in defence against pathogens.

.....

.....

.....

..... [2]

[Total: 11]

2021

9700/22/O/N/2021/Q1(a,c)

2 There are two types of cell, prokaryotic and eukaryotic. Bacterial cells are prokaryotic and plant cells are eukaryotic.

(a) There are differences in the structural features that are common to bacterial cells and plant cells. For example, the cell surface membrane in a plant cell contains cholesterol, but in a bacterial cell the membrane contains molecules known as hopanoids. Cholesterol and hopanoids have the same function.

Some of the main structural features common to both types of cell are shown in Table 1.1.

Complete Table 1.1 by giving **one** difference between a bacterial cell and a plant cell for each structural feature listed.

The difference between the cell surface membranes of the two types of cell has been completed for you.

Table 1.1

feature common to bacterial and plant cells	bacterial cell	plant cell
cell surface membrane	contains hopanoids	contains cholesterol
ribosome		
DNA		
cell wall		

[3]

(b) Fig. 1.1 is a photomicrograph showing chloroplasts in plant leaf cells.

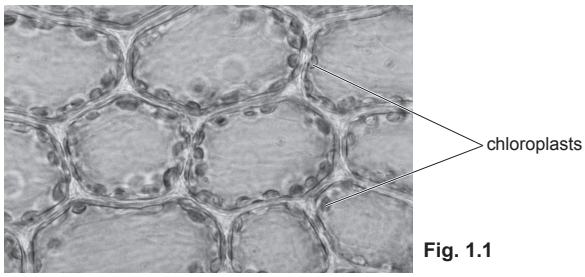

Fig. 1.1

Explain why the chloroplasts are seen only around the periphery (edge) of each plant cell.

.....

..... [1]

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9700/23/M/J/2021/Q1

3 The Golgi body, rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER) form part of the internal membrane system of a cell. The membranes have a fluid mosaic structure.

Fig. 1.1 is a transmission electron micrograph of one area of a liver cell showing a region with RER and a region with SER. Mitochondria are also visible in the image.

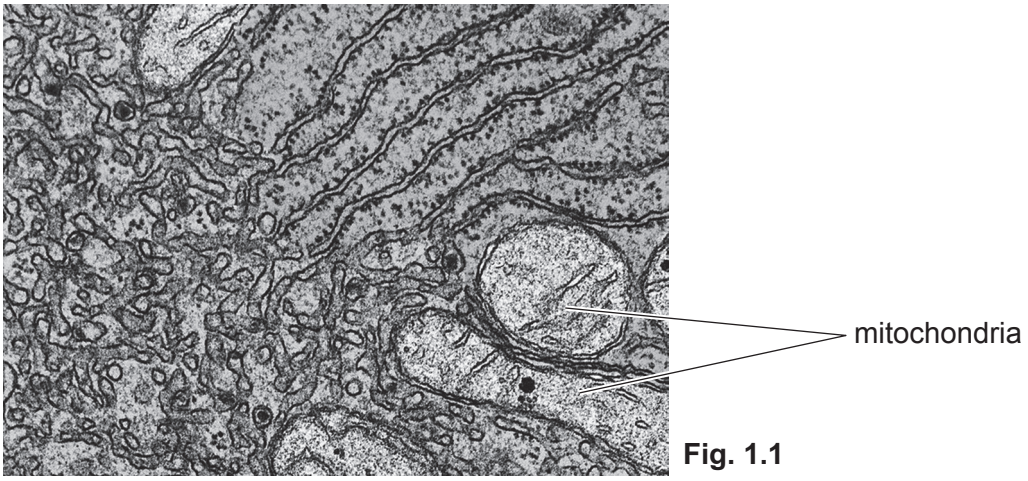

Fig. 1.1

(a) Describe the differences in structure **and** function between RER and SER.

.....

.....

.....

.....

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.....

.....

..... [3]

(b) Phospholipids are one of the main components of membranes.
Describe the structure of a phospholipid molecule.

.....

.....

.....

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..... [2]

STUDENTS RESOURCE

(c) One function of a Golgi body is to package molecules into Golgi vesicles.

(i) A Golgi body and Golgi vesicles are **not** visible in Fig. 1.1.

Describe the features, **other than** the presence of Golgi vesicles, that would help you identify a Golgi body in a transmission electron micrograph of another area of the same liver cell.

.....

.....

.....

.....

..... [2]

(ii) Some Golgi vesicles contain secretory proteins for release from the cell.

Describe the sequence of events that occurs following the packaging of a secretory protein into a Golgi vesicle to its release from the cell.

.....

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.....

.....

..... [3]

(iii) Some Golgi vesicles contain glycoproteins or glycolipids to be added to the cell surface membrane.

Outline the role of **glycolipids** in the cell surface membrane.

.....

.....

..... [1]

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9700/21/M/J/2021/Q6

4 Lysosomes are cell structures that contain enzymes known as acid hydrolases.

Fig. 6.1 shows some processes that occur in animal cells.

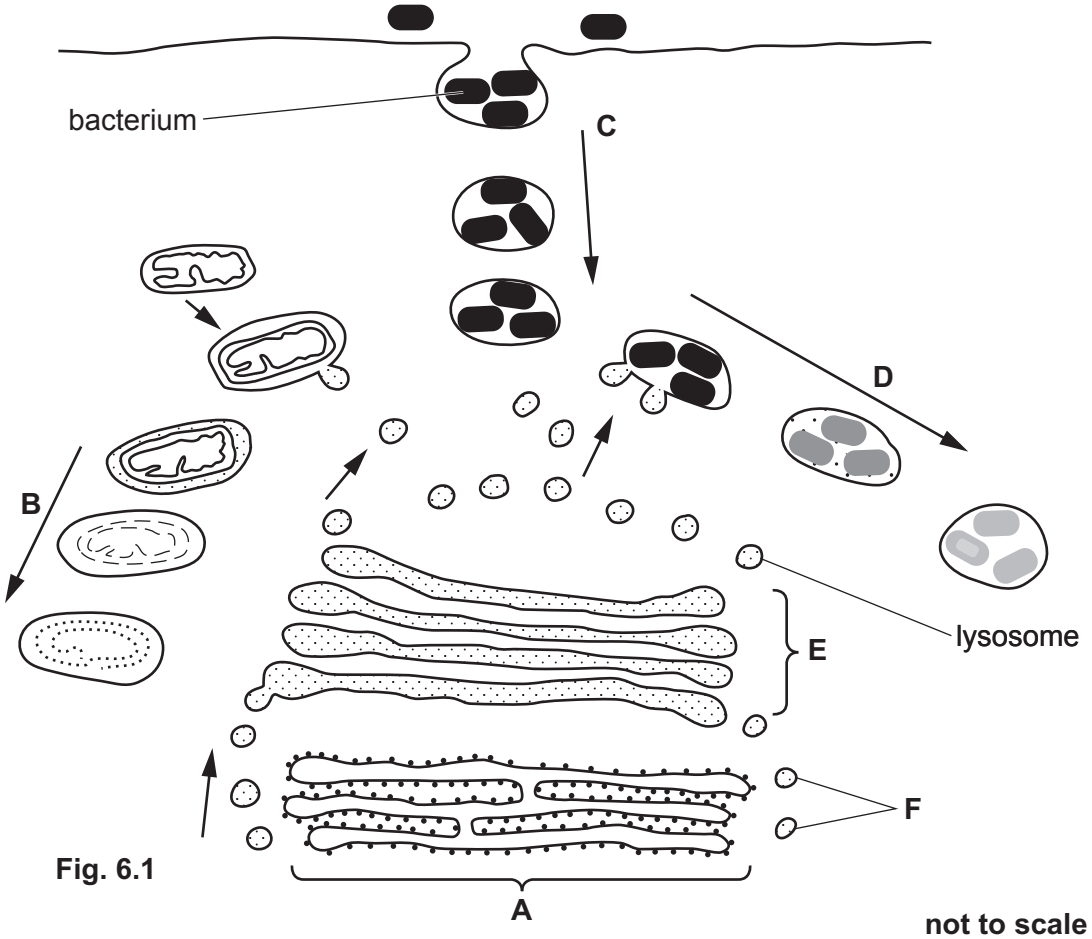

Fig. 6.1

(a) Name the cell structures labelled **A** and **E**.

A .....

E .....

[2]

(b) State the function of the structures labelled **F**.

.....

..... [1]

(c) Name the process by which bacteria are taken into the cell at **C**.

..... [1]

STUDENTS RESOURCE

(d) With reference to the processes occurring at **B** and at **D** in Fig. 6.1, outline the role of acid hydrolases in lysosomes.

.....

.....

.....

.....

.....

..... [3]

(e) Carrier proteins in the membranes of lysosomes maintain a lower pH than the surrounding cytoplasm by moving hydrogen ions.

Suggest how the carrier proteins maintain the lower pH within the lysosomes.

.....

.....

.....

..... [2]

9700/22/F/M/2021/Q4(a)

5 Using a light microscope at a magnification of ×400, it is possible to identify different types of blood cell in prepared slides of mammalian blood.

Fig. 4.1 is a key to identify different types of blood cell in prepared slides of mammalian blood.

In Fig. 4.1, letters **C**, **D**, **E** and **F** represent four different types of blood cell.

key

1a	nucleus present	go to 2
1b	nucleus absent	**C**
2a	large rounded (spherical) nucleus	**D**
2b	nucleus not rounded	go to 3
3a	nucleus is kidney shaped	**E**
3b	nucleus is lobed	**F**

Fig. 4.1

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(i) Identify the cell types **C**, **D**, **E** and **F** in Fig. 4.1.

C .....

D .....

E .....

F .....

[3]

2020

9700/23/O/N/2020/Q6

6 **(a)** Fig. 6.1 shows *Vorticella*, which is a single-celled organism that lives in freshwater. *Vorticella* has many cilia which it uses for feeding.

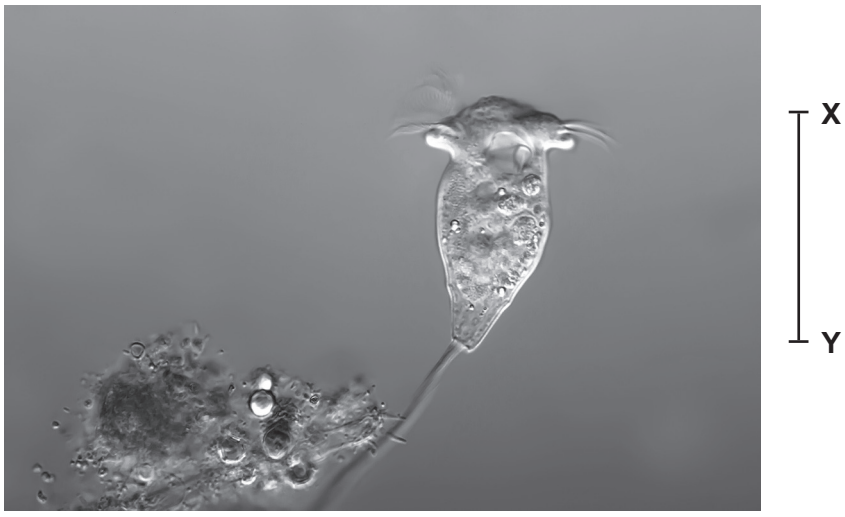

Fig. 6.1

The distance shown by **X**–**Y** on Fig. 6.1 is 150 μm.

Calculate the magnification of Fig. 6.1.

State the formula that you will use and show your working.

Write your answer to the nearest whole number.

formula

..... [3]

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(b) The food particles are taken into the gullet by a current of water created by movement of cilia. Any particles suspended in the water, such as bacteria, are taken into the cell as shown in Fig. 6.2.

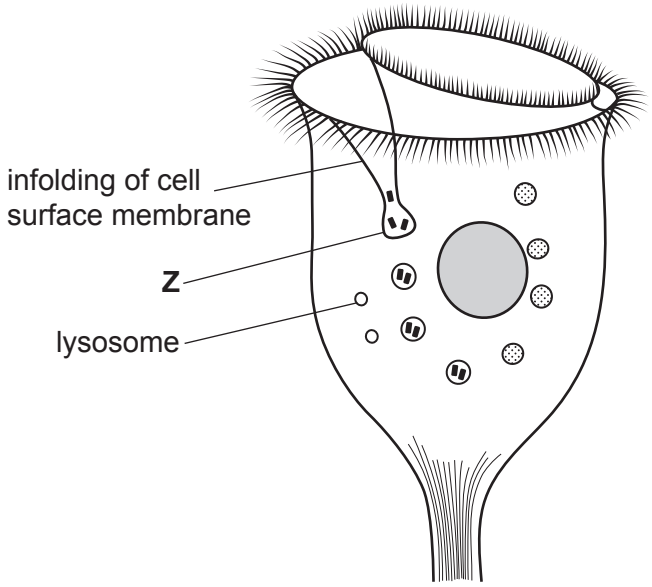

Fig. 6.2

(i) State the name of the process which takes the bacteria into the cell at **Z and** describe the way in which it occurs.

name .....

description .....

.....

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.....

..... [3]

(ii) Describe the role of lysosomes in intracellular digestion in *Vorticella*.

.....

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.....

.....

..... [3]

STUDENTS RESOURCE

9700/22/M/J/2020/Q1

7 Picornaviruses are small viruses that are 30 nm in diameter. Picornaviruses are able to enter the cells of mammals and birds and can replicate within these cells.

Fig. 1.1 shows the entry of a picornavirus into its host cell.

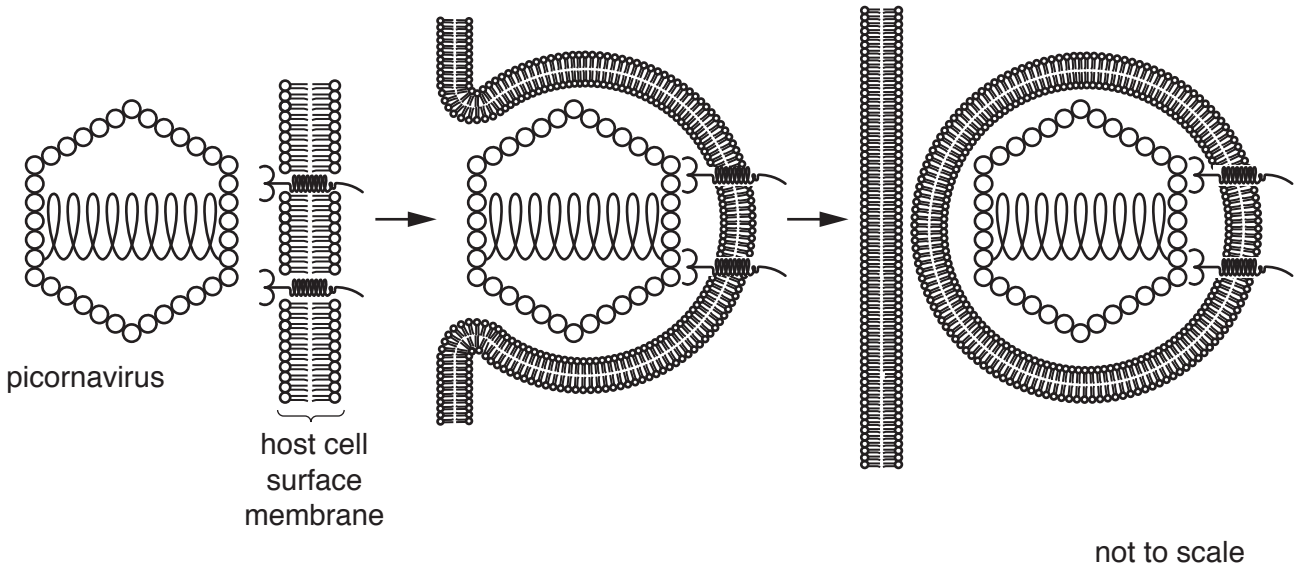

Fig. 1.1

(a) State the key features of a virus, such as picornavirus.

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.....

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..... [2]

STUDENTS RESOURCE

(b) State, with reasons, whether a picornavirus can be seen using the light microscope.

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..... [3]

(c) With reference to Fig. 1.1, describe how the picornavirus enters the host cell.

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.....

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.....

..... [3]

STUDENTS RESOURCE

2018

9700/23/O/N/2018/Q1

8 **(a)** Aphids are small insects which feed directly on phloem sap.

The salivary glands of aphids have secretory cells that make and release a variety of proteins that assist in feeding.

Fig. 1.1 is a transmission electron micrograph of a small area of a salivary gland cell of an aphid.

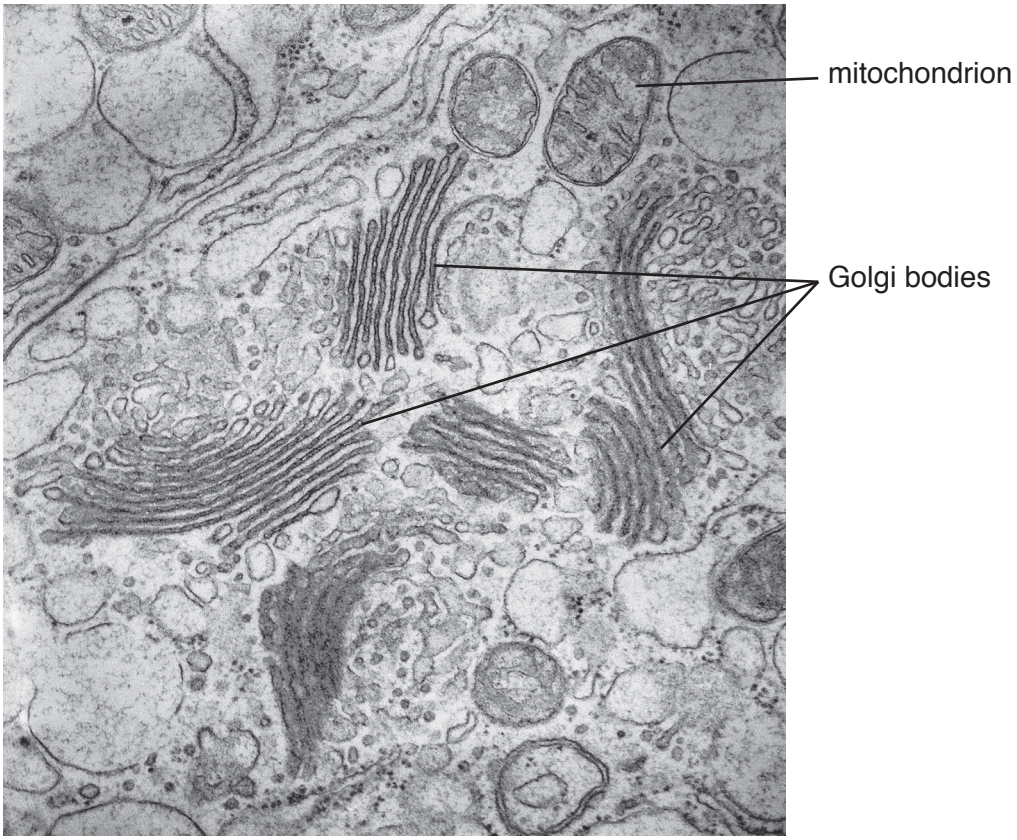

Fig. 1.1

Describe the role of Golgi bodies in secretory cells, such as the salivary gland cells of aphids.

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..... [3]

STUDENTS RESOURCE

(b) (i) Explain why secretory cells have large numbers of mitochondria.

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..... [2]

(ii) Mitochondria are partly controlled by the nucleus, but can also function independently.

Suggest the features of mitochondria that allow them to function independently of the nucleus.

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.....

.....

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.....

..... [2]

(c) Aphids are important vectors of plant viral diseases.

(i) Describe the structure of a typical virus.

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest how viruses are able to pass from one plant cell to the next without crossing membranes.

.....

.....

..... [1]

STUDENTS RESOURCE

9700/21/O/N/2018/Q3(a)

9 **(a)** Fig. 3.1 is a transmission electron micrograph showing two adjacent cells in a leaf.

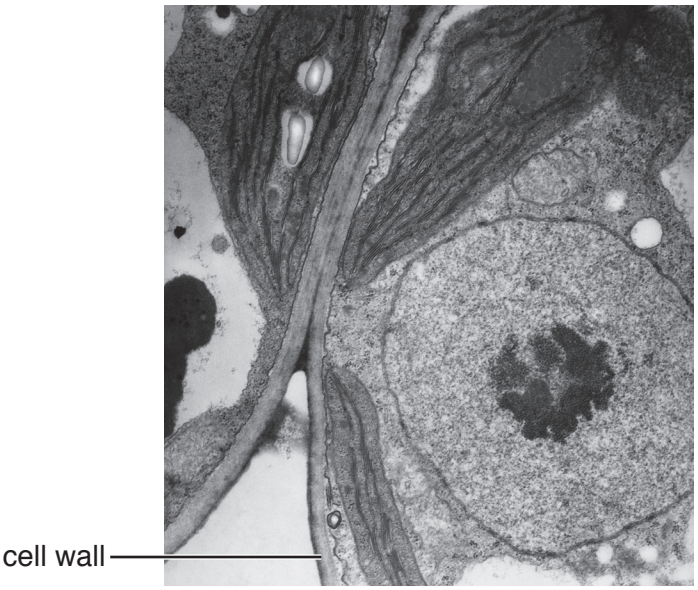

Fig. 3.1

(i) Cellulose is the main polysaccharide in cell walls of plants.
Describe the structure of cellulose.

.....

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.....

.....

..... [3]

(ii) State **one** feature **visible** in Fig. 3.1, other than the cell wall, that identifies the cells as plant cells.

..... [1]

(iii) Outline the role of ATP in a leaf cell.

.....

.....

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.....

.....

..... [3]

STUDENTS RESOURCE

9700/23/M/J/2018/Q6(b)

10 Although many infectious diseases are caused by prokaryotic organisms, there are some that are caused by eukaryotic organisms.

Complete Table 6.1 to show some differences between a prokaryotic cell and a eukaryotic cell.

Table 6.1

prokaryotic cell	eukaryotic cell
no true nucleus, genetic material not enclosed	true nucleus, genetic material enclosed by a double membrane known as a .....
..... DNA	linear DNA
70S ribosomes only	70S and ..... ribosomes
no double membrane-bound organelles	double membrane-bound organelles such as .....
cell wall contains	where cell wall is present, generally contains mainly cellulose or chitin

[2]

STUDENTS RESOURCE

9700/22/M/J/2018/Q1

11 Fig. 1.1 is a drawing of a photomicrograph of a spongy mesophyll cell from a leaf.

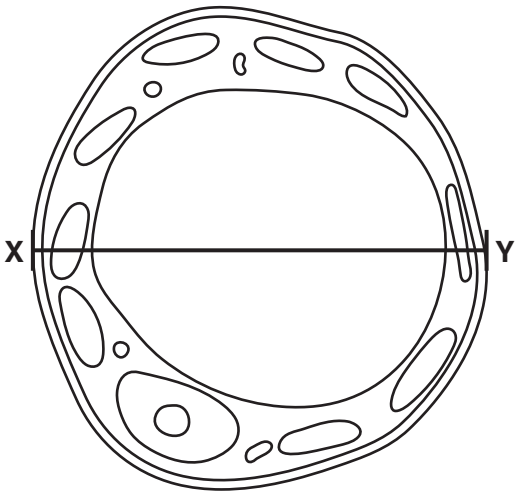

Fig. 1.1

(a) On Fig. 1.1, add a label line and the correct letter for each of the three cell structures listed.

- nucleolus = **N**
- tonoplast = **T**
- chloroplast = **C**

[3]

(b) The drawing in Fig. 1.1 is 2000 times larger than the actual size of the cell.

Describe the steps you would follow to determine the actual diameter of the cell in micrometres (μm), at **X**—**Y**.

.....

.....

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.....

.....[2]

(c) The drawing in Fig. 1.1 was made using the high power objective lens of a light microscope. Some of the structures in Fig. 1.1 confirm that the cell is eukaryotic.

An electron micrograph of the same cell would reveal **additional** cell structures that are found in eukaryotes and not in prokaryotes.

List two examples of these additional cell structures.

1 .....

2 .....

[2]

STUDENTS RESOURCE

9700/21/M/J/2018/Q1

12 Fig. 1.1 is a transmission electron micrograph of a cell from the root of thale cress, *Arabidopsis thaliana*.

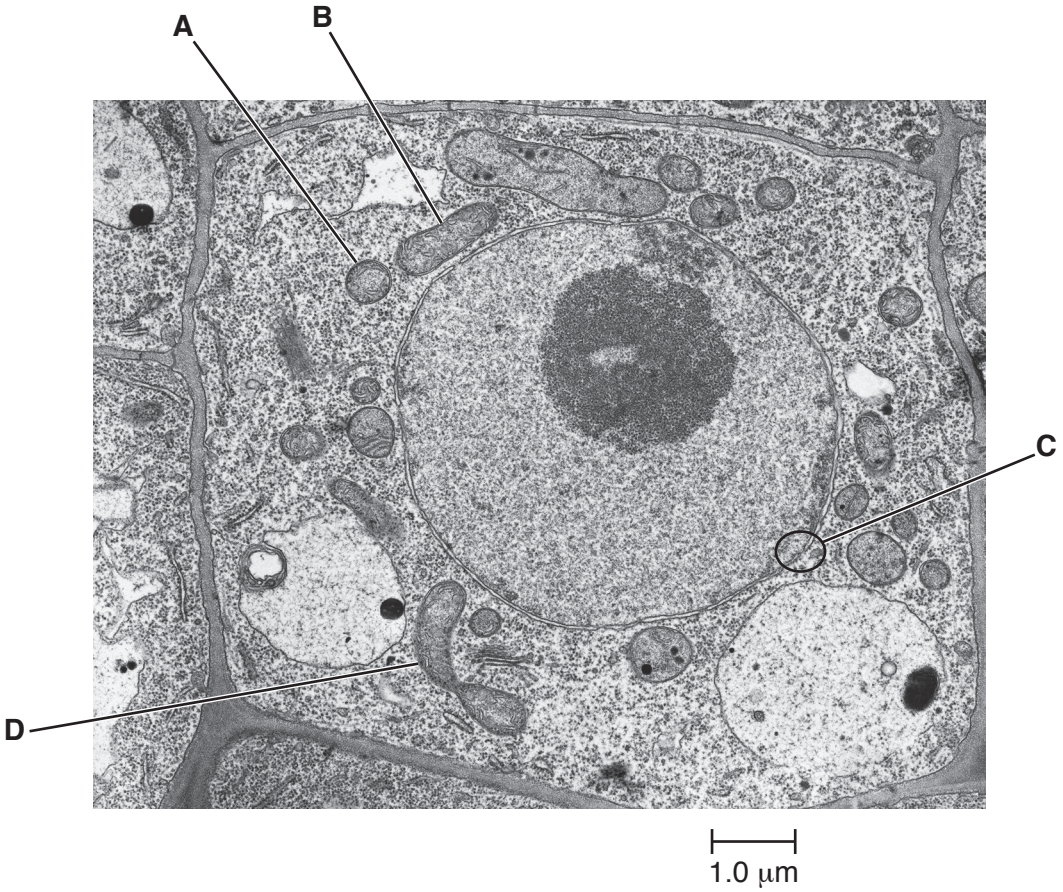

Fig. 1.1

(a) (i) The structures labelled **A** and **B** on Fig. 1.1 are sections of two mitochondria.

Suggest why **A** and **B** are different shapes.

.....

.....

.....[1]

(ii) The structure labelled **D** on Fig. 1.1 is a mitochondrion about to divide.

Explain the importance of the division of mitochondria for the cell shown in Fig. 1.1 **and** for cells in the root tips of thale cress.

.....

.....

.....

.....

.....[2]

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(b) Within a cell, substances move between the nucleus and the cytoplasm. The area labelled **C** in Fig. 1.1 shows an area where this communication occurs.

Make a large, labelled drawing of area **C** to show where this communication occurs.

[2]

(c) Outline the functions of the nucleus in non-dividing cells, such as the cell in Fig. 1.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

STUDENTS RESOURCE

9700/22/F/M/2018/Q1

13 Fig. 1.1 is an electron micrograph of part of a eukaryotic cell.

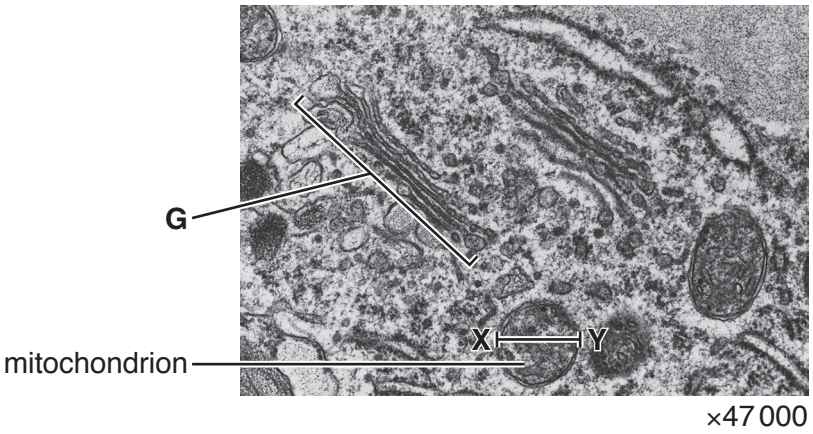

Fig. 1.1

(a) State how it is possible to deduce that Fig. 1.1 is a transmission electron micrograph and **not** a scanning electron micrograph.

.....

..... [1]

(b) Both the Golgi body and the rough endoplasmic reticulum are part of the internal network of membranes in cells.

Outline structural features shown in Fig. 1.1 that identify **G** as the Golgi body and **not** the rough endoplasmic reticulum.

.....

.....

.....

.....

..... [2]

(c) Calculate the actual diameter, **X–Y**, of the mitochondrion labelled in Fig. 1.1.

Write down the formula that you will use to make your calculation. Give your answer to the nearest whole **nanometre** (nm).

formula

actual diameter ..... nm
[2]

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(d) The inner and outer membranes of the mitochondrion have a fluid mosaic structure similar to other cell membranes. They are both approximately 6 to 7 nanometres (nm) thick.

(i) Outline the fluid mosaic model of membrane structure.
There is space below for a diagram.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The inner and outer membranes of the mitochondrion differ in the detail of their membrane components. The inner membrane is also much less permeable than the outer membrane.

Suggest **one** way in which the structure of the inner membrane may differ from that of the outer membrane to produce a **less permeable** inner membrane.

.....

.....

..... [1]

STUDENTS RESOURCE

2017

9700/23/O/N/2017/Q1

14 Fig. 1.1 is a transmission electron micrograph of a part of an animal cell.

Fig. 1.1

magnification ×16 000

(a) Calculate the actual width of the organelle labelled **A**, as shown by line **X**–**Y**.
State the formula that you will use and show your working.
Give your answer in μm and to one decimal place.

formula

..... μm [3]

(b) **(i)** Name the organelle **A** and state its role in cells.

name .....

role .....

.....

.....[2]

(ii) Name the cell structure labelled **B** and state **one** reason for your answer.

name .....

reason .....

.....

.....[2]

STUDENTS RESOURCE

9700/21/O/N/2017/Q5

15 Fig. 5.1 is a transmission electron micrograph of part of a cell.

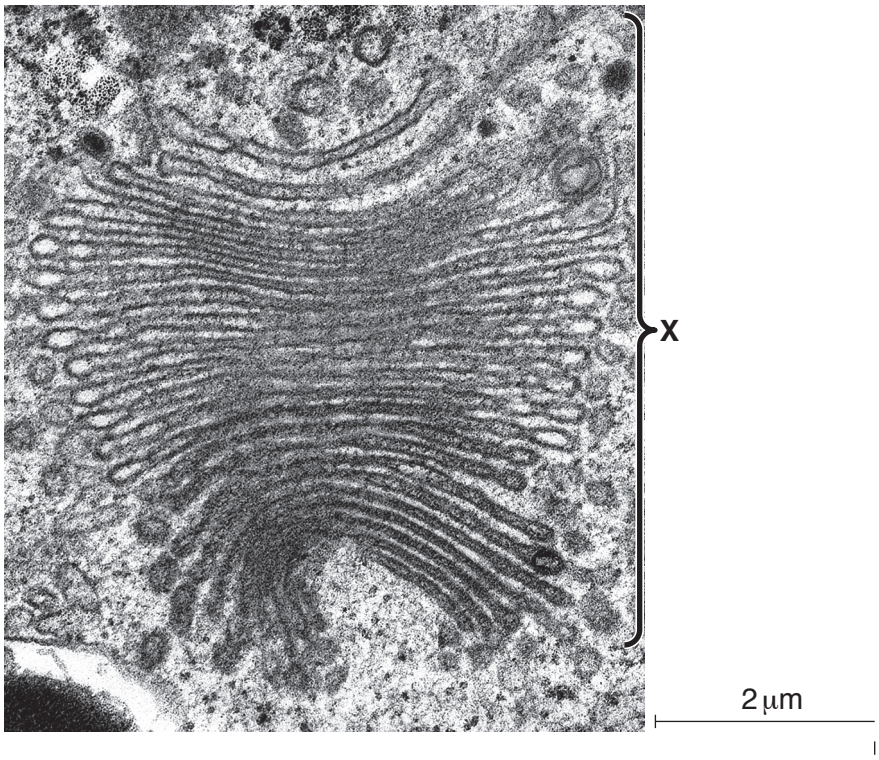

Fig. 5.1

(a) (i) Name the organelle labelled **X**.

.....[1]

(ii) Put a tick (✓) in the box beside the type, or types, of cell that contain this organelle.

animal cell	
plant cell	
bacterial cell	

[1]

(b) Use the scale bar to calculate the magnification of Fig. 5.1.

Write down the formula and use it to make your calculation. Show your working.

formula

magnification = ...[3]

(c) The organelle in Fig. 5.1 is made from structures surrounded by a single membrane.

Name **two** organelles that are surrounded by double membranes.

.....[2]

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