Answer **all** the questions.

1(a). Plant and animal cells have different structural features.

(i) Name **two** features of plant cells that are not features of animal cells.

1

2

---

[2]

(ii) Name **one** structure present in animal cells that is not present in plant cells.

---

[1]

(iii) The cytoskeleton in cells consists of microtubules and microfilaments.

Describe the roles of the cytoskeleton.

---

[3]

(b). The pancreas is an organ that secretes protease enzymes.

Outline how the organelles in pancreatic cells work together to produce and release these protein molecules from the cells.

In your answer you should use appropriate technical terms, spelled correctly.

[5]

2. A scientist drew a diagram to explain the mechanism used to load sucrose into the sieve tube elements.

His diagram is shown in Fig. 4.2.

A
charged particles are removed from the companion cells

B
co-transport of charged particles and sucrose into the companion cells

C
sucrose moves into the sieve tube elements

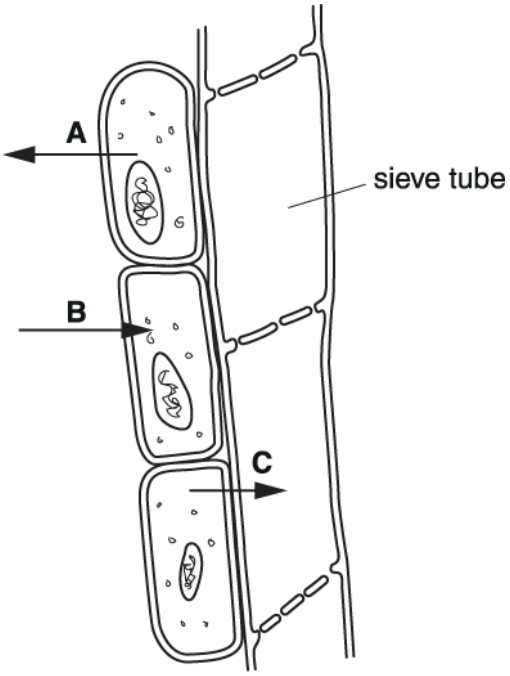


Fig. 4.2

(i) The following paragraph is an extract from the scientist's work.

Complete the paragraph.

At step **A**, charged particles are moved out of the companion cells by the process of _____ .

This creates a _____ gradient between the companion cell and its surroundings. At step **B**, the charged particles and assimilates are co-transported by _____ diffusion into the companion cells.

The assimilates build up in the companion cells and move by _____ into the sieve tube elements at step **C**. Assimilates, such as sucrose and _____, can be loaded in this way.

[5]

(ii) The structure of cells is usually adapted to carry out their functions.

The scientist used an electron microscope to look for further evidence to support the mechanism involved in loading sucrose into the sieve tubes.

Suggest what evidence the scientist might expect to see in companion cells, using an electron microscope.

---

[2]

3. State the correct term for the following definition.

The detailed structure of cells visible only with an electron microscope.

---

[1]

4. After being mixed with iodine, which of the following would show a blue / black colour?

A potato tuber cells
B erythrocytes
C sieve tube elements
D neutrophils

Your answer ☐

[1]

5(a). Biological processes can be investigated using models.

The effect of cell size on diffusion can be investigated using cubes of agar jelly to represent cells of different sizes.

A student used cubes of agar jelly containing universal indicator, which changes colour at different pH.

- Five different sizes of cubes were cut from a larger block using a scalpel.
- Cubes were placed in a beaker containing hydrochloric acid (enough to cover the cubes) and a stopwatch was started.
- After 2 minutes the cubes were removed, rinsed with distilled water and blotted dry.
- Acid absorbed at the outside continued diffusing towards the centre of the blocks.
- The time taken for the blocks to turn entirely red was recorded.

The results are shown in **Table 22.1 on the insert**.

Cube	Length of one side of agar cube (mm)	Surface area to volume ratio	Time taken to turn red (min)			
			Test 1	Test 2	Test 3	Mean
A	5	1.20	6.4	2.9	5.4	4.9
B	10	0.60	14.8	15.5	14.6	15.0
C	20	0.30	30.6	28.3	27.4	28.8
D	30	0.20	44.1	42.2	43.0	43.1
E	40	0.15	58.7	60.1	57.4	58.7

Table 22.1

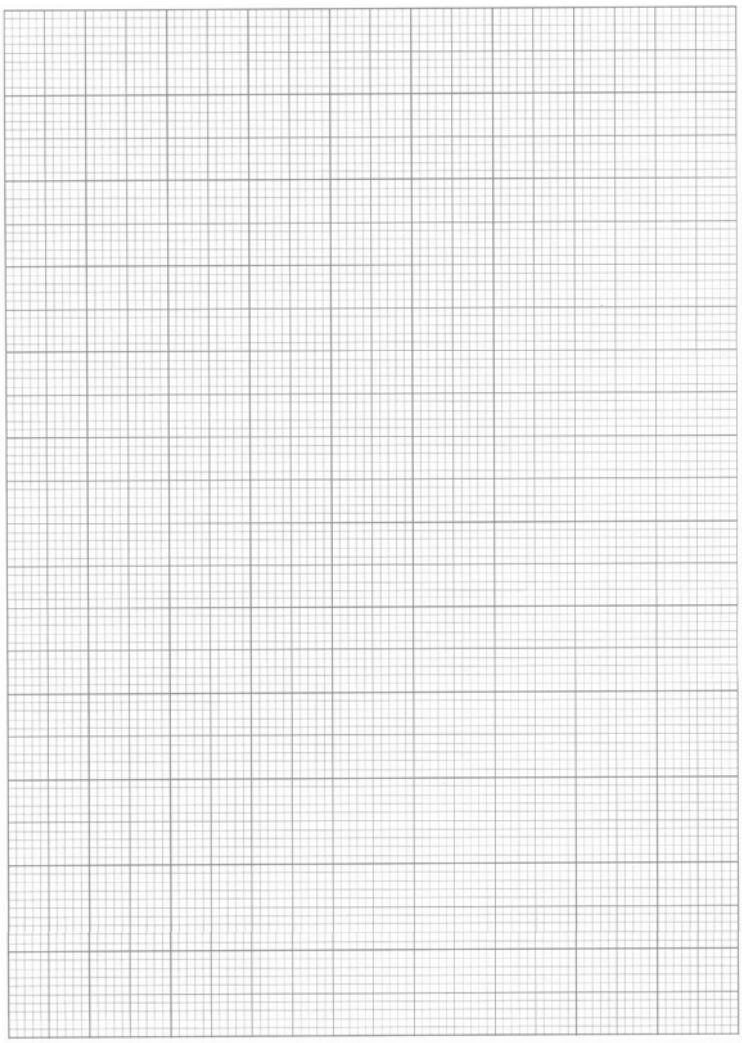
What was the role of the universal indicator in this experiment?

---

[1]

(b).

(i) In the space provided, plot a graph of mean time taken to turn red against surface area to volume ratio. **[4]**



(ii) Describe the pattern shown by your graph.

---

[1]

(iii) An identical procedure was carried out on a cube of unknown size. This cube turned red after 21.5 min.

Use your graph to estimate the surface area to volume ratio of this unknown cube.

Answer _____ **[1]**

(iv) Suggest how the original procedure could be modified in order to improve the accuracy of your answer to part **(iii)**.

---

[1]

(c). Use the data in **Table 22.1, on the insert**, to calculate the **rate** of diffusion of acid in **Cube C** from the outer surface to the centre of the cube.

Answer_____ **[3]**

(d).

(i) Explain which of the mean values, **A**–**E**, is likely to be the least accurate. You should process data from the table to support your answer.

---

[2]

(ii) Identify one limitation in the practical procedure that may have caused the results to be inaccurate **and** explain which cube's results are most likely to have been affected by this limitation.

Limitation _____

Is more likely to affect cube ….. because _____

---

[3]

(e). The procedure described above involved the use of model cells. Hydrogen ions from the acid were able to travel freely to the centre of the agar jelly cubes.

The rate of movement of molecules from the plasma membrane towards the centre of **living** cells is often **greater** than that seen in the procedure the student carried out even if the cells are kept at the same temperature.

Suggest a reason for this observation.

---

[1]

6. Xylem vessel elements are produced from non-xylem cells in meristematic tissue.

Fig. 23.1 shows an electronmicrograph of xylem tissue.

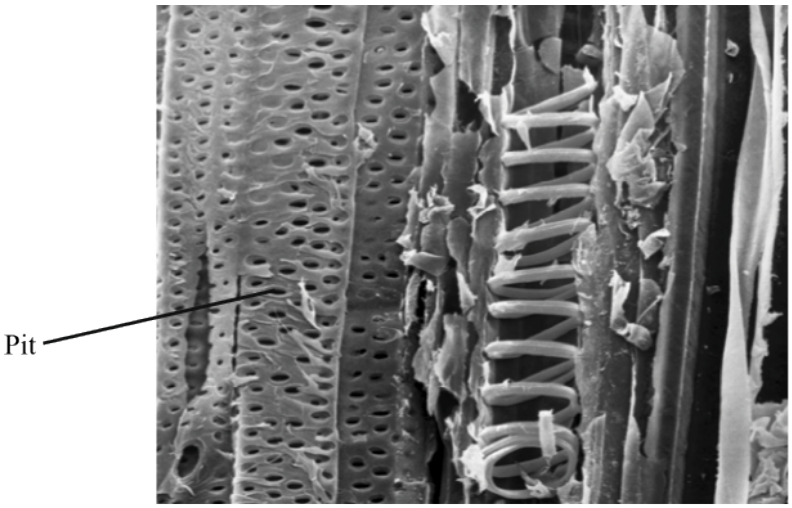


Fig. 23.1

State the function of the pits in xylem tissue.

---

[1]

7(a). A thin-layer chromatography procedure was carried out on an extract of leaf cells that contained chlorophyll and other pigments.

Liquid extract from the leaf cells was dried thoroughly.

The extract was then mixed with an organic solvent and placed onto a thin-layer chromatography plate suspended in organic solvent.

Fig. 24.1 shows the results of the procedure.

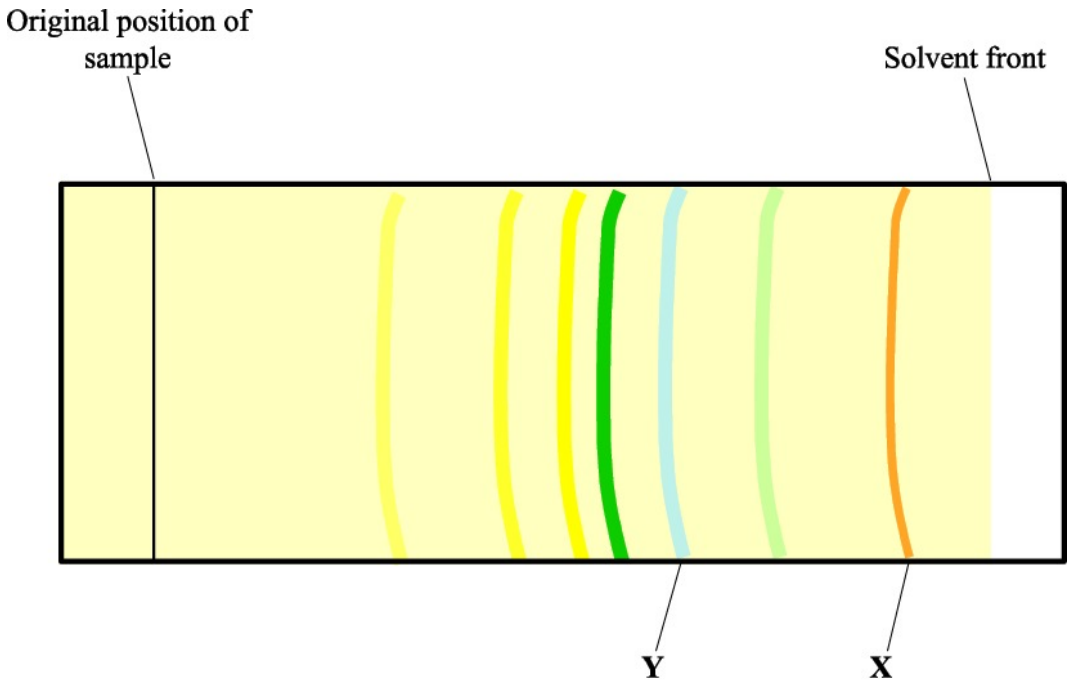


Fig. 24.1

Table 24.1 shows the typical *Rf* values for various pigments present in plants.

Pigment	**Colour**	***Rf* value**
Carotene	yellow-orange	0.91
Pheophytin a	grey	0.75
Chlorophyll a	blue green	0.63
Chlorophyll b	green	0.58

Table 24.1

(i) Name the organelle that is likely to have yielded most of the pigments present in the leaf extract.

[1]

(ii) Suggest why it was important that the leaf extract was dried thoroughly before mixing with the organic solvent.

[1]

(b).

(i) Calculate the *Rf* value for pigment **Y** on Fig. 24.1.

Answer _____ **[1]**

(ii) The student concluded that in Fig. 24.1 pigment **Y** was probably chlorophyll a.

How well do the results support the student's conclusion? Support your answer with reference to Fig 24.1 and Table 24.1.

[3]

8. Three types of microscope are listed below.

Select the row that shows the correct use for each type of microscope.

	Type of microscope and what it is used to observe		
	Light microscope	**Transmission electron microscope**	**Laser scanning confocal microscope**
A	an object at a certain depth within a cell	cell surfaces	organelles
B	an object at a certain depth within a cell	cell surfaces	whole cells and tissues
C	whole cells and tissues	organelles	cell surfaces
D	whole cells and tissues	organelles	an object at a certain depth within a cell

Your answer ☐

[1]

9. Cyanobacteria are photoautotrophs and fossil records confirm their existence 3.5 billion years ago.

Which row describes the structure of cyanobacteria?

	Feature					
	Nucleus	**Circular DNA**	**Mitochondria**	**Ribosomes**	**Chloroplast**	**Cell wall**
A	✓		✓		✓	
B			✓		✓	✓
C	✓	✓		✓		
D		✓		✓		✓

Your answer ☐

[1]

10. **Fig. 8.1** shows an animal cell.

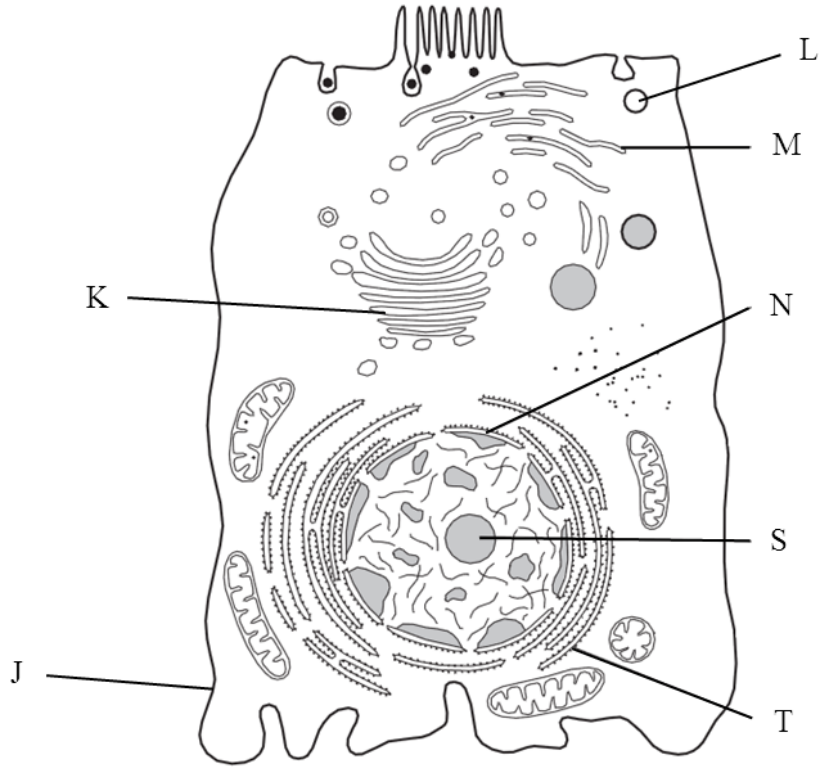


Fig. 8.1

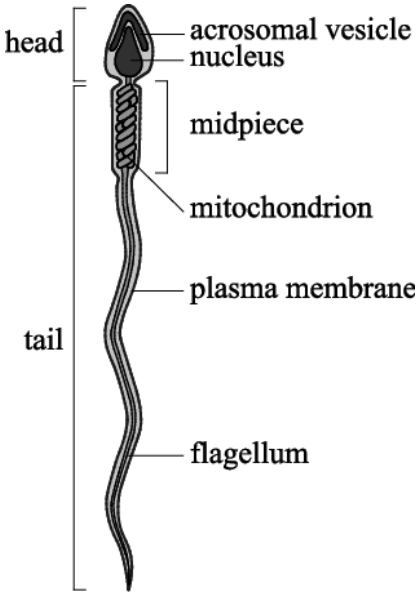
Which option describes the correct sequence of organelles involved during the production and secretion of a protein from this cell?

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

Your answer ☐

[1]

11. Sperm cells are an example of a specialised cell.



Which statement correctly describes one specialisation of a sperm cell?

A tail contains flagellum which generates ATP
B head contains chromosomes in homologous pairs
C acrosome contains enzymes to digest outer portion of egg
D midpiece contains mitochondria which enter egg

Your answer ☐

[1]

12(a). **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.

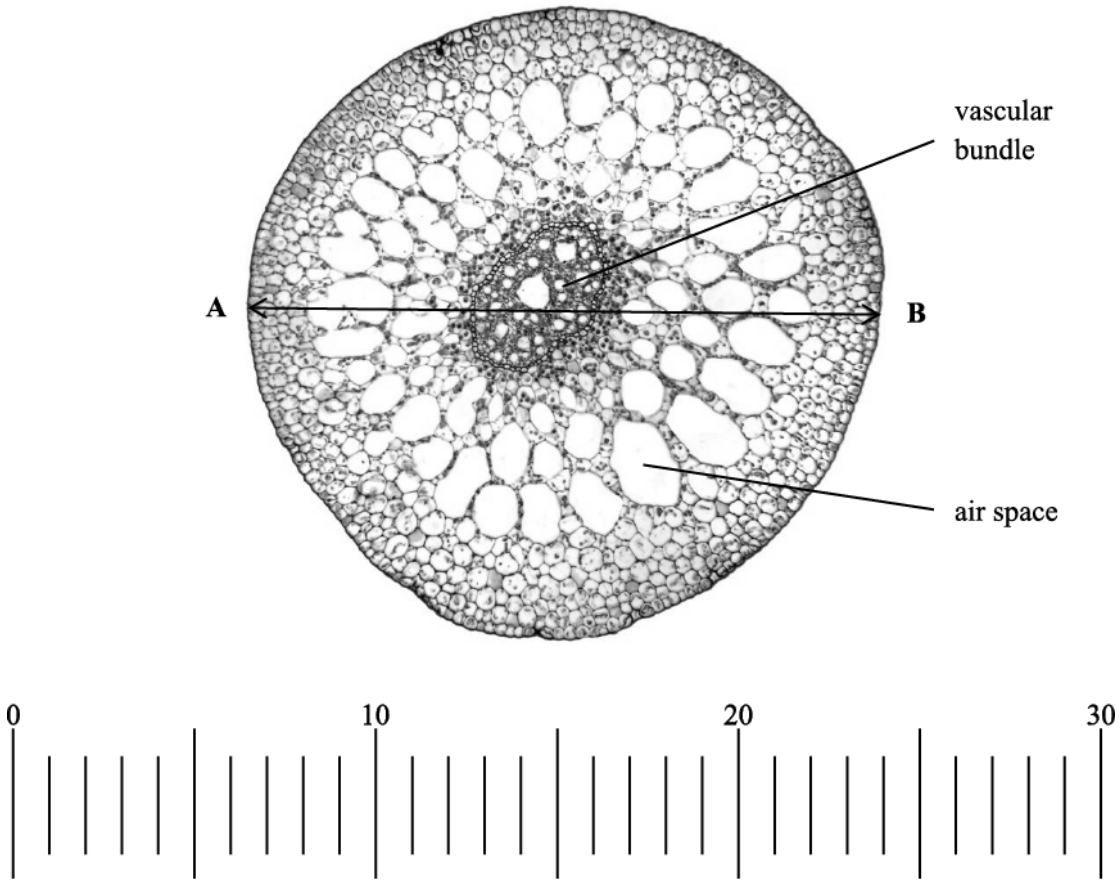


Fig. 22.1

(i) Measure the width of the stem between points **A** and **B**.
Give your answer to the nearest 0.1 mm.

Answer _____ **[1]**

(ii) Calculate the magnification of the image in **Fig. 22.1**.

Answer _____ **[2]**

(iii) The thin stem and thin cell walls do not provide much support for the leaf. Suggest how the leaf is supported.

---

[2]

(b). 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.

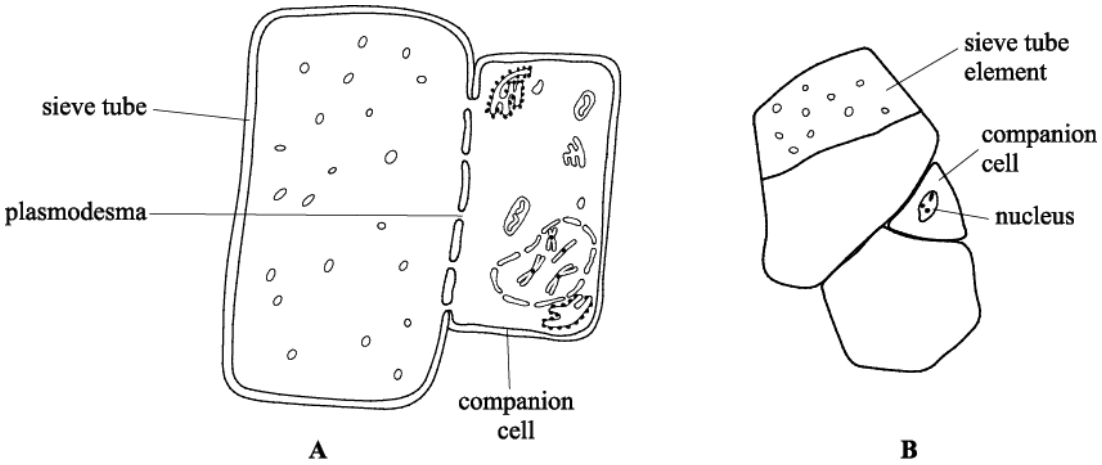


Fig. 22.2

(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.

---

[2]

13. The concept of molecules with complementary shapes can be used to explain many processes in living things.

Lupus is an autoimmune disease. Lupus occurs when nuclear proteins are exposed and the immune system makes antibodies against these proteins. As a result the proteins clump together. These clumps stick to surfaces such as the blood vessel walls and cause fatigue, joint pain and skin rashes.

(i) What is meant by the term *autoimmune disease*?

---

[2]

(ii) Suggest why antibodies specific to nuclear proteins are not normally made.

---

[1]

14. 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]

15. One of the main functions of the liver cells is the formation of urea by the ornithine cycle, an outline of which is shown in **Fig. 17.2**.

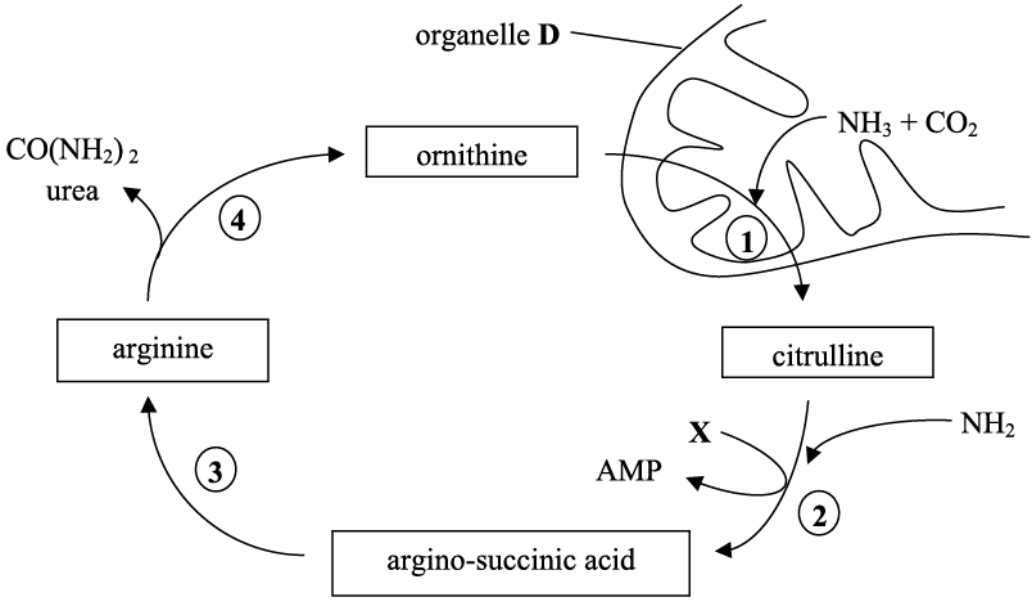


Fig. 17.2

(i) Step **1** of the cycle takes place in the organelle represented by **D**.

Identify organelle **D**.

[1]

(ii) During the cycle ornithine moves into organelle **D** and citrulline moves out of the organelle.

Suggest the method by which these molecules move into and out of the organelle during the cycle. Give reasons for your choice.

[2]

(iii) How has the ammonia that is used in step **1** been formed?

[1]

(iv) Identify the compound labelled **X** in **Fig. 17.2**.

[1]

16. Which of the following, **A** to **D**, is a feature of **both** light microscopy **and** confocal microscopy?

A can be used to observe ribosomes
B can be used with live tissues
C obtain images using laser light
D require a great deal of training to use

Your answer

[1]

17. *Heliamphora*, shown in Fig. 18.1, is a genus of carnivorous plant. Its leaves are adapted to form water-filled traps for insects. The insects are attracted by nectar, then fall into the traps and drown. The plants digest the insects and absorb the mineral ions produced. This allows *Heliamphora* to survive in soils with low mineral content.

Fig. 18.1

A student prepared slides of *Heliamphora* vascular tissue for viewing under a light microscope.

The method the student used is outlined below:

1. Select a blade.
2. Cut *Heliamphora* tissue.
3. Select best pieces.
4. Place on slide.
5. Add cover slip.

(i) Suggest **three** improvements to this method. For each improvement, explain how it would increase the **validity** of the slides produced.

Improvement 1:

Explanation:

Improvement 2:

Explanation:

Improvement 3:

Explanation:

[6]

(ii) Discuss the benefits of using stains when making slides for light microscopy.

[3]

18. The kidney is one of the organs of excretion in vertebrate animals.

Fig. 2.1 shows a light micrograph of a section through a kidney cortex.

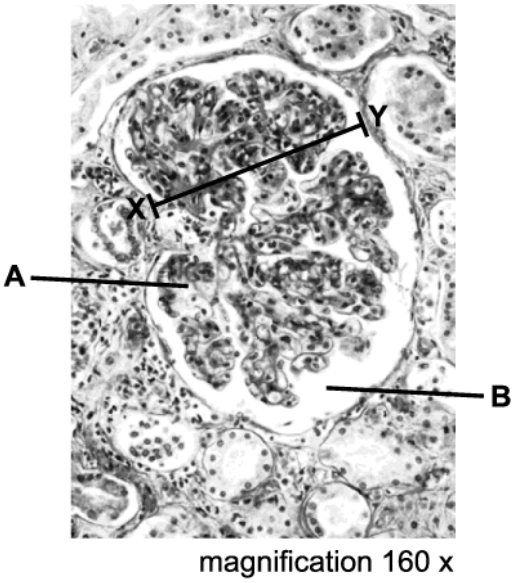


Fig. 2.1

(i) Name the parts of the kidney labelled **A** and **B**.

A

B

---

[2]

(ii) Calculate the length of the line labelled **X** to **Y**.

Give your answer in micrometres (μm) to **two** significant figures.

Answer = _____ µm **[2]**

19. A range of microscopes are available for scientific research. Each type of microscope has a different use.

Select the row that shows the correct uses for all the types of microscope.

	Type of microscope and what it is used to observe			
	Light microscope	**Transmission electron microscope**	**Scanning electron microscope**	**Laser scanning confocal microscope**
A	an object at a certain depth within a cell	organelles	cell surfaces	whole cells and tissues
B	cell surfaces	an object at a certain depth within a cell	whole cells and tissues	organelles
C	whole cells and tissues	organelles	cell surfaces	an object at a certain depth within a cell
D	organelles	an object at a certain depth within a cell	whole cells and tissues	cell surfaces

Your answer ☐

[1]

20. 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]

21(a). A small, permanent pond is the habitat for a climax community of producers (aquatic plants and algae) and consumers (bacteria, protoctista, worms, snails, arthropods and small vertebrates like newts and fish).

Why might ecologists call this a 'climax community'?

[1]

(b). The protoctist *Paramecium caudatum* is usually between 200 and 300 μm in length. An accurate measurement would help in the correct identification of a specimen from this pond.

What laboratory equipment would you select to make an accurate measurement of the length of *Paramecium caudatum*?

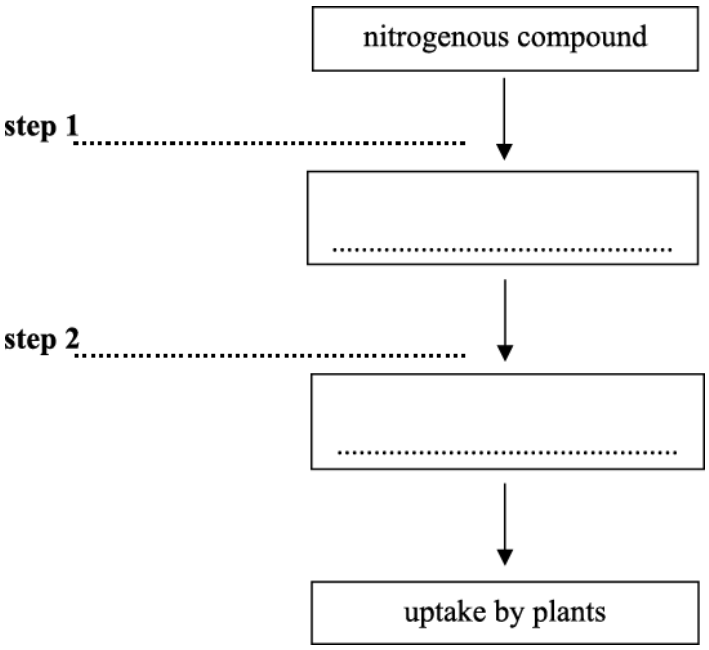
[2]

(c). An animal fell into the pond. It drowned and decayed. Within a year the biological compounds in its body had been completely recycled.

(i) What nitrogenous excretory molecule from the decomposers would pass to the next stage of the nitrogen cycle?

[1]

(ii) Complete the flow chart to show what happens to this nitrogenous compound, and name the groups of bacteria involved at steps 1 and 2, as it is converted to a form that plants can take up and use.



[4]

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

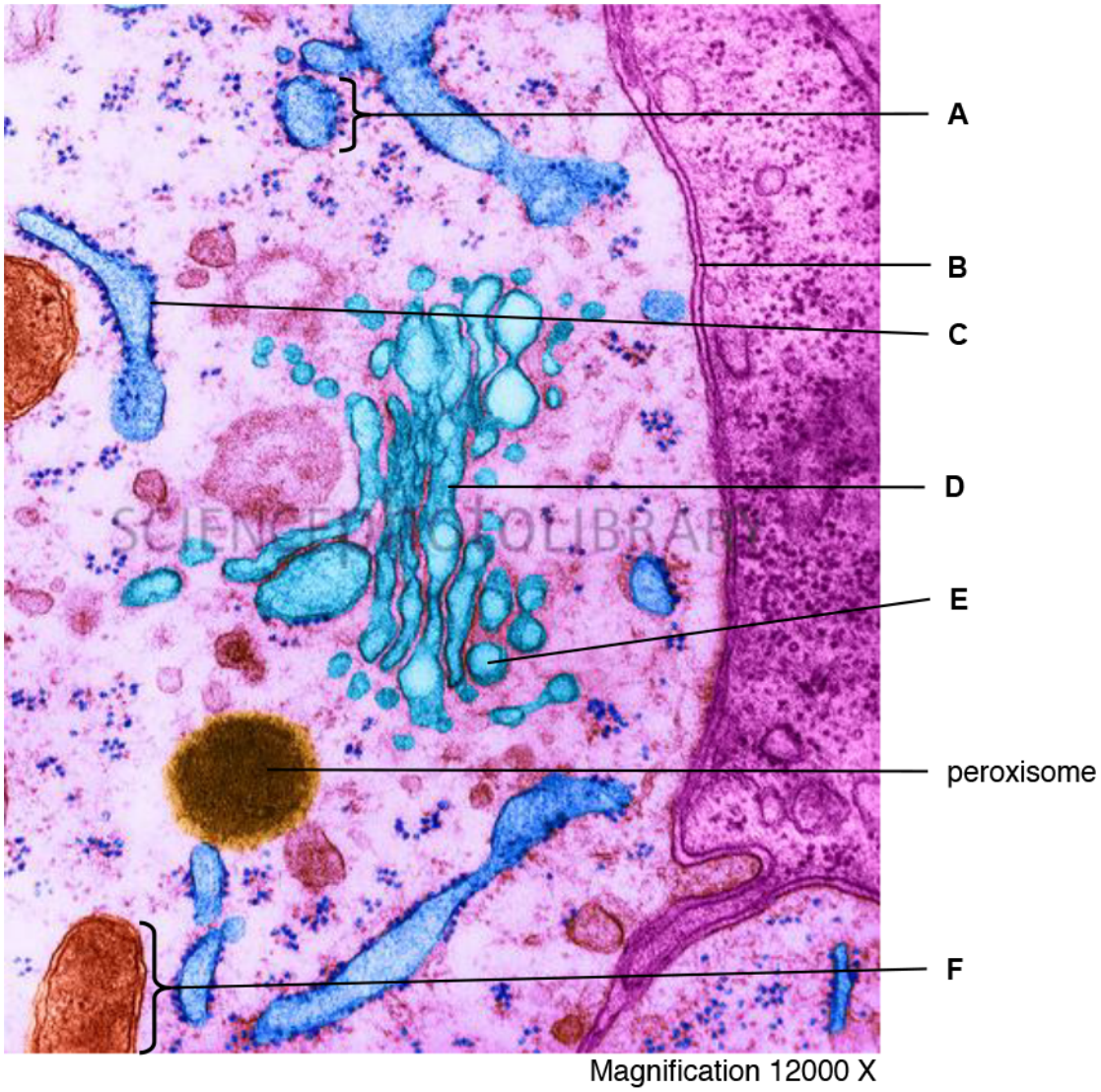


Fig. 20.1

(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]**

(c). Peroxisomes are vesicles that usually contain enzymes such as catalase.

Explain how peroxisomes can be moved around inside the cell.

_____

_____

_____

_____

_____ **[2]**

(d). Catalase is an intracellular enzyme with an iron-containing haem group.

(i) State the term used to describe an ion that is essential for the enzyme to function.

_____ **[1]**

(ii) Name another conjugated protein that contains a haem group.

_____ **[1]**

24. Plague is caused by the bacterium, *Yersinia pestis.*

(i) The bacterium is a rod-shaped cell that is approximately 3 μm long.

Yersinia pestis is viewed using a light microscope with a magnification of 1250.
What would be the length of the cell in the image produced by this microscope?

Answer _____ mm **[2]**

(ii) Photographs taken of the image obtained by the light microscope could be further enlarged using a projector.

Why might the enlarged image be unable to tell us more about the structure of *Yersinia pestis?*

_____

_____ **[1]**

(iii) Outbreaks of plague still occur occasionally. Plague is transmitted by several methods including droplet infection, close contact between people and fleas moving between infected rats and people.

Suggest **two** ways to minimise the spread of an outbreak of plague.

_____

_____

_____

_____ **[2]**

25. Microscopes vary in their magnification and resolution.

Which of the rows, **A** to **D**, in the table below is correct?

	Light microscope		**Transmission electron microscope**		**Scanning electron microscope**	
	Magnification	**Resolution (nm)**	**Magnification**	**Resolution (nm)**	**Magnification**	**Resolution (nm)**
A	× 1500	200	× 10 000	0.2	× 50 000	0.2
B	× 400	100	× 500 000	10.0	× 100 000	0.2
C	× 1500	200	× 500 000	.02	× 100 000	0.2
D	× 1500	100	× 500 000	10.0	× 100 000	10.0

Your answer

[1]

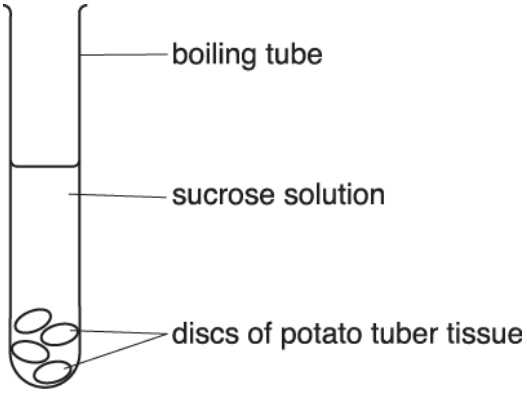
26. Which of the following structures, **A** to **D**, are found in prokaryotes **and** in eukaryotes?

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

Your answer

[1]

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

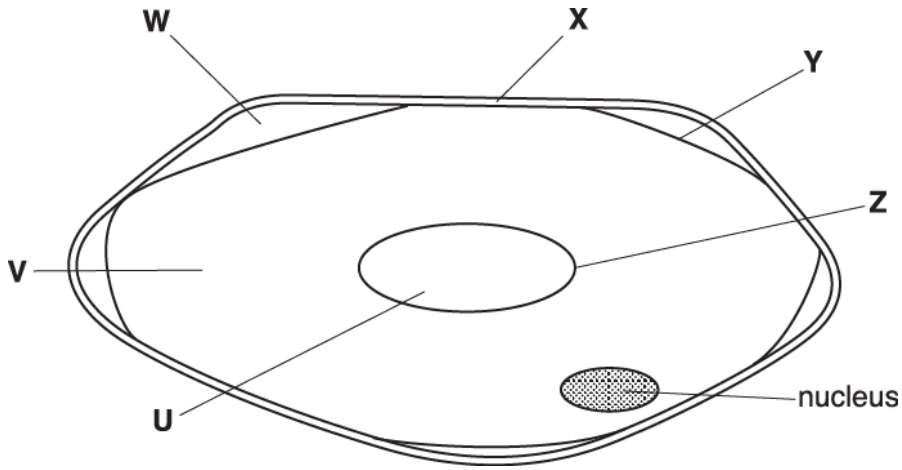


The discs were placed in boiling tubes containing sucrose solutions of different concentrations for four hours. The percentage change of mass was then calculated.

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]**

28. Haemoglobin is found in erythrocytes. Unlike other vertebrates, the mature erythrocytes of mammals lack nuclei and other membrane-bound organelles.

(i) Explain **one** advantage and **one** disadvantage of the lack of nuclei and other membranebound organelles to mammalian erythrocytes.

Advantage _____

_____

Disadvantage _____

_____ **[2]**

(ii) Viruses do not use erythrocytes as host cells, whereas the malarial pathogen *Plasmodium* spends part of its life cycle inside erythrocytes.

Suggest why.

_____

_____

_____

_____

_____ **[2]**

(iii) Explain why erythrocytes do **not** make use of any of the oxygen that they are transporting.

_____

_____

_____

_____

_____ **[2]**

29. *Amoeba proteus* is a single-celled organism that lives in freshwater habitats. Fig. 1.1 is a drawing of *A. proteus*.

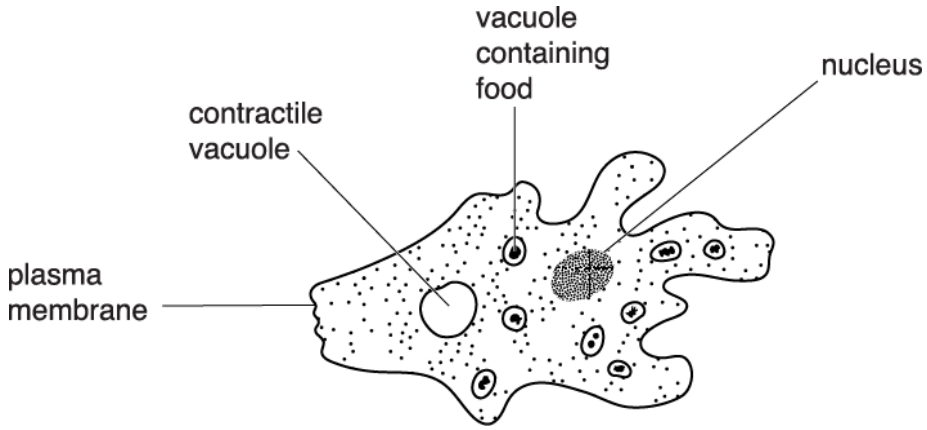


Fig. 1.1

State **one** feature shown in Fig. 1.1 that would **not** be present in a prokaryotic cell.

[1]

30(a). Table 3.1 lists the **maximum** magnification and resolution of three different types of microscope.

Microscope	Magnification	Resolution (nm)
X	× 1500	200
Y	× 100 000	20
Z	× 500 000	1

Table 3.1

Which microscope, **X, Y** or **Z**, is a **transmission** electron microscope?

[1]

(b). Fig. 3.1(a) and Fig. 3.1(b) below show root hairs on the surface of roots. The two images were taken using different types of microscope.

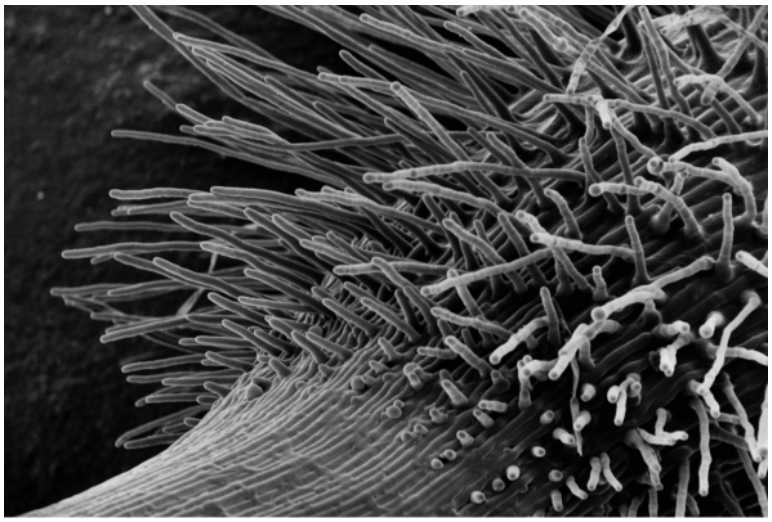


Fig. 3.1(a)

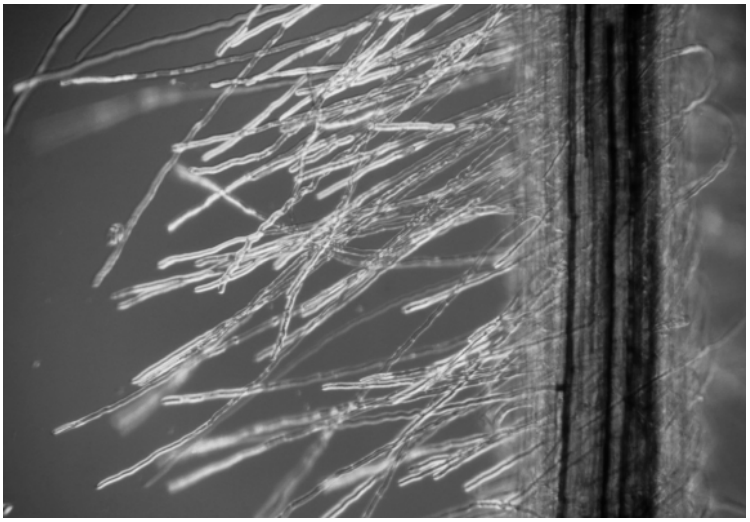


Fig. 3.1(b)

One of the images was taken using a scanning electron microscope.

Identify which image, **Fig. 3.1(a)** or **Fig. 3.1(b)**, was taken using a scanning electron microscope.

Justify your choice.

---

[2]

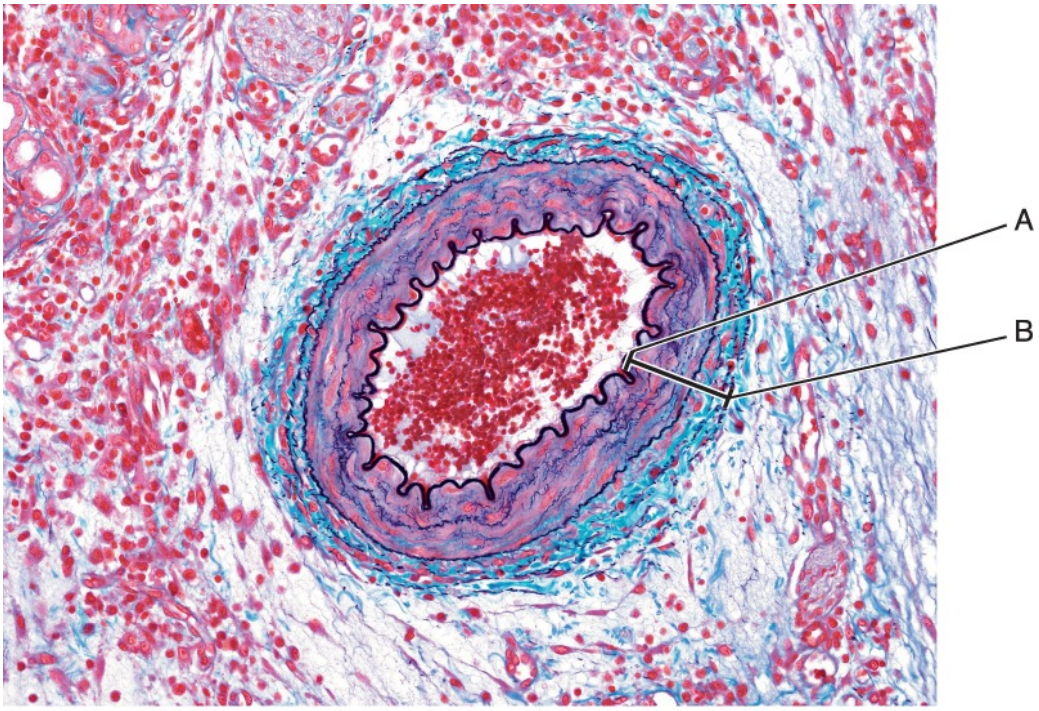
31. Cells are usually stained before viewing under a light microscope.

Explain why cells need to be stained.

---

[2]

32. The figure shows a small artery. These small arteries are found linking the larger arteries with the arterioles that carry blood into the capillary beds of an organ or tissue.



Calculate the thickness of the wall of the artery between the points marked **A** and **B** on the figure.

Show your working and express your answer to the nearest **micrometre**.

Answer =_ μm **[2]**

33. 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]

34(a). Table 6.1 gives the functions of certain organelles in a eukaryotic cell.

Complete the table by stating the function associated with each organelle.

The first row has been completed for you.

Organelle	**Function**
nucleus	contains the genetic material
smooth endoplasmic reticulum	
lysosome	
ribosome	

[3]

Table 6.1

(b). 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]

35. Many people in the UK consume large amounts of milk and beef.

Over-consumption of milk and beef can lead to an unbalanced diet and malnutrition.

(i) Define the term *balanced diet*.

---

[2]

(ii) Milk and beef both contain triglyceride molecules.

Fig. 7.3 represents a triglyceride molecule.

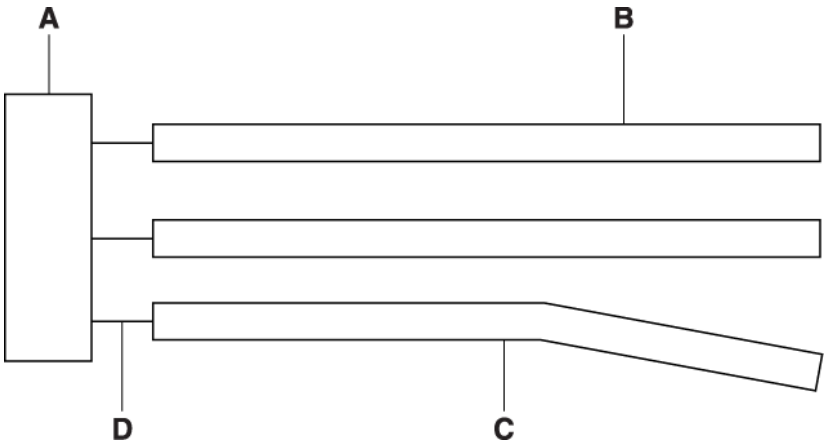


Fig. 7.3

Identify **A**, **C** and **D** on Fig. 7.3.

A

C

D

[3]

(iii) Suggest and explain why over-consumption of milk and beef can lead to malnutrition.

---

[3]

36. A mixture of three sugars is added to batch fermenter at the beginning of the process:

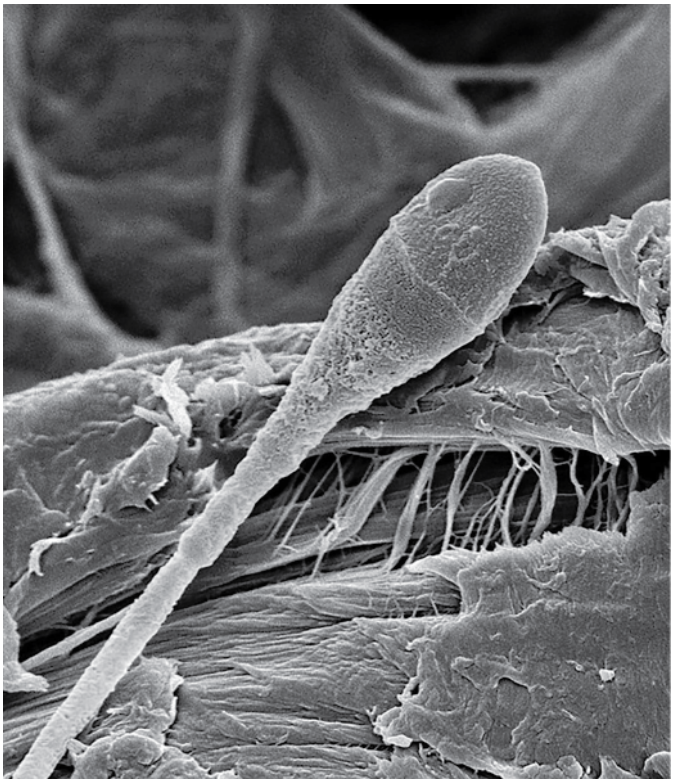
- the monosaccharide glucose, which the yeast uses up first, during days 0 to 2
- the disaccharide maltose, which is used during days 1 to 5
- the trisaccharide maltotriose, which is used during days 4 to 6.

Suggest why the yeast uses the sugars in this order.

---

[3]

37. The image below is a scanning electron micrograph of part of a sperm cell.



The actual diameter of the sperm head is 5.1 μm. The diameter of the sperm head in the image is 1.9 cm.

Which row, **A** to **D**, correctly describes the resolution and magnification of the image above?

	Resolution	**Magnification**
A	5 nm	3725
B	37250	1 μm
C	0.1 mm	26840
D	2684	50 nm

Your answer

[1]

38. Fig. 19.3 is a light microscope image of kidney tubule cells.

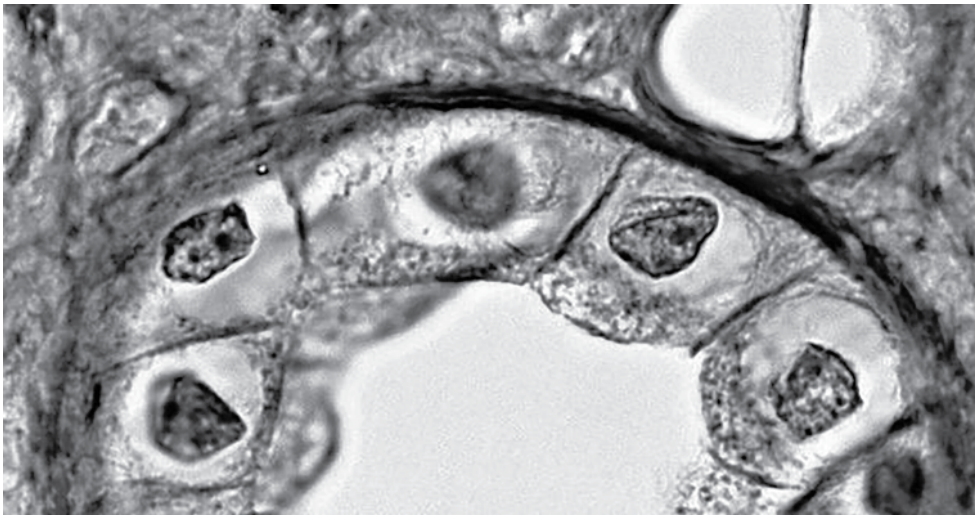


Fig. 19.3

(i) State **three** structures within the tubule cells that are **not** visible in this image.

1

2

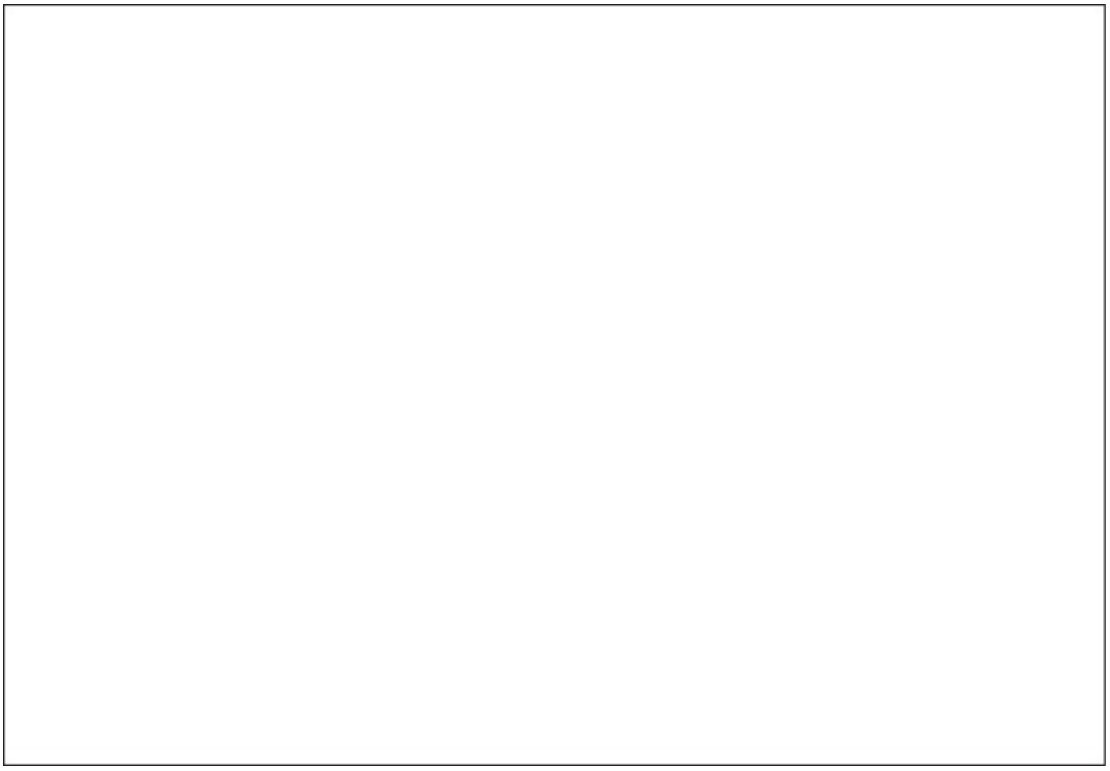
3

---

[3]

(ii) Draw **one** of the cells from Fig. 19.3 in the space below.

Label your diagram to show any visible features.



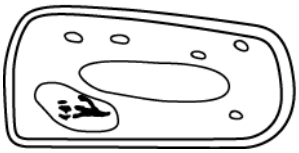
[4]

39. Which of the diagrams, **A** to **D**, is a stem cell?

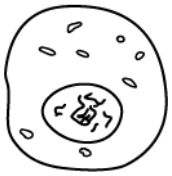
A

B

C



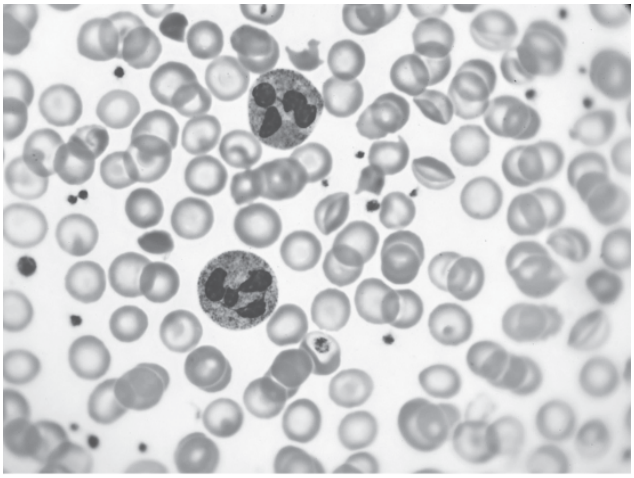
D



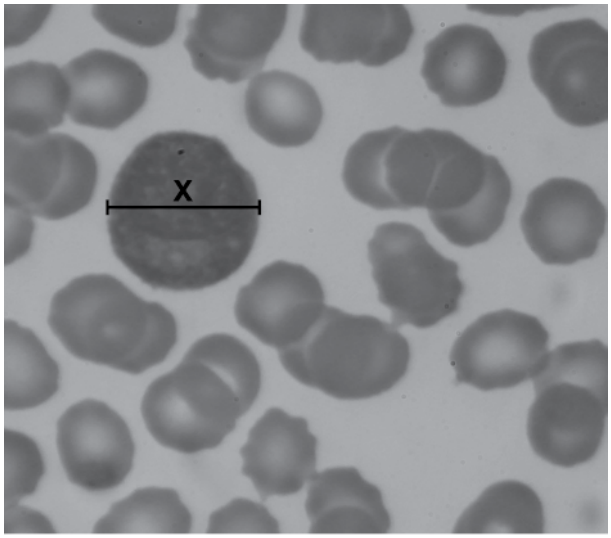
Your answer

[1]

40. Fig. 1 shows two blood smears, **A** and **B**.



A



B

Fig. 1

(i) Which of the two images, **A** or **B**, shows a non-specific immune response?

Explain your answer.

---

[1]

(ii) The actual width of **X** in Fig. 1 image **B** is 15 μm.

Calculate the magnification used to produce image **B** in Fig. 1.

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

Answer = _____ **[2]**

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a	i	cellulose / cell, wall ; chloroplast(s) ; starch grain(s) / amyloplast(s) ; large / permanent, vacuole ; tonoplast ; plasmodesma(ta) ;	2 max	**Mark the first answer on each prompt line.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **DO NOT CREDIT** wall unqualified, **DO NOT CREDIT** if incorrect compound e.g peptidoglycan / chitin **IGNORE** plastid **IGNORE** vacuole alone – must be qualified as large or permanent **Examiner's Comments** Candidates were asked to name two characteristics of plant cells that were not found in animal cells. The most common responses were 'chloroplasts' and 'cell wall'. A number of candidates need to be more specific in their responses to such questions, as 'vacuole' was not sufficient to gain a mark at this level. Examiners were looking for the more specific response of a large or permanent vacuole.
		ii	centriole / glycogen granule ;	1	**Mark the first answer.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **ACCEPT** lysosomes, cilia, flagella **Examiner's Comments** Candidates needed to name one structure present in animal cells that was not found in plant cells. Many candidates gave a correct response. 'Centrioles' was the most common such response, closely followed by cilia / flagella. The mark scheme allowed 'lysosomes' even though this is a feature that is still being debated - plant cells certainly have small vacuoles that contain lytic enzymes, but they are not always called lysosomes in plants.

Question			Answer/Indicative content	Marks	Guidance
		iii	1 (whole) cell, support / stability / scaffolding / maintain shape ; 2 movement of, cilia / flagella / undulipodia OR use of cilia / flagellum / undulipodium to move cell ; 3 changing shape of cell / cytokinesis / pseudopodia / phagocytosis / endocytosis / exocytosis / muscle contraction ; 4 (named) organelles, moved / held in place ; 5 movement of, chromosomes / chromatids / (m)RNA ;	3 max	**IGNORE** 'movement of, cell / membrane' unqualified **IGNORE** strength / structure / rigid **IGNORE** make up cilia / flagella **ACCEPT** descriptions **ACCEPT** movement of vesicle **IGNORE** movement of substances / materials **ACCEPT** formation of spindle / centrioles **Examiner's Comments** Candidates were asked to describe the roles of the cytoskeleton. Most candidates were able to give some correct responses. Many stated that the cytoskeleton was involved with transporting vesicles or organelles around the cell. Some candidates need however to be more specific, as transporting 'substances' around the cell was not accepted. Movement of cilia or flagella and provision of support for the cell were also commonly stated.

Question			Answer/Indicative content	Marks	Guidance
	b			4 max	Max 4 marks for content Look for name of organelle and its function / role **ACCEPT** enzyme / protease for protein **MAX 3** if answer refers to insulin or incorrect protein
			1 nucleus, contains gene (for protein) / site of **transcription** / produces mRNA ;		**ACCEPT** DNA / genetic material / genetic information for 'gene' **IGNORE** 'mRNA leaves nucleus'
			2 **ribosomes / rough endoplasmic reticulum** / RER, site of, protein synthesis / **translation** ;		**ACCEPT** description of assembling a *chain* of amino acids
			3 **vesicles** for transport (of protein) ;		mp3 can be awarded either for transport between ER and Golgi or between Golgi and Plasma membrane
			4 **Golgi** (apparatus / body), processes / modifies / (re)packages, proteins ;		E.G. tertiary folding / quaternary structure / carbohydrate added / converted to glycoprotein / placed in vesicles **IGNORE** ref to RER
			5 (vesicles) fuse to, **cell surface / plasma, membrane** ;		**IGNORE** binds / attach / joins **IGNORE** exocytosis **IGNORE** ref to vesicles leaving cell **ACCEPT** merges with / becomes part of

Question			Answer/Indicative content	Marks	Guidance
			QWC ;	1	Any **two** technical terms from the list below used appropriately and spelled correctly : **ribosomes** **rough endoplasmic reticulum (NOT** RER for QWC) **transcription (and derivatives)** **translation (and derivatives)** **golgi** **vesicles** **plasma membrane / cell surface membrane** **Examiner's Comments** Candidates were asked to outline how organelles work together to secrete a specific protein. Most candidates gave excellent responses that were well organised and clearly worded. The QWC mark was usually awarded. In certain areas candidates need to be more specific with their wording of responses. For example, they should describe the secretory vesicle as 'fusing to the cell surface membrane' rather than 'binding to the membrane'. Binding does not necessarily suggest that the vesicle membrane becomes a part of the cell surface membrane and that the contents of the vesicle are released through the membrane.
			Total	**11**	

Question			Answer/Indicative content	Marks	Guidance
2		i	active transport ; concentration / pH / H^+ / proton / electrochemical ; facilitated ; diffusion ; amino acids ;	5	**Mark the first answer.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **IGNORE** active loading **IGNORE** high **DO NOT ACCEPT** diffusion **ACCEPT** facilitated diffusion **ACCEPT** plasmodesmata **DO NOT CREDIT** facilitated diffusion **DO NOT CREDIT** glucose / fructose / ions **Examiner's Comments** Was a gap fill question in which the candidate's knowledge of the active loading process was tested. Most candidates scored two or three marks appreciating that active transport must be required to create a concentration gradient and that the hydrogen ions must move through the membrane by facilitated diffusion, while the sucrose could diffuse through plasmodesmata into the sieve tube. Few candidates appreciated that assimilates are molecules that have become part of the organism and that amino acids are often transported. This part of the question was more difficult as the molecule mentioned had to be an assimilate and one that is transported in the phloem.

Question			Answer/Indicative content	Marks	Guidance
		ii	many / large, mitochondria ; plasmodesmata (between companion cell and sieve tube) / described ; many ribosomes / extensive RER ; many proteins in the, plasma / cell surface, membrane ;	2	**IGNORE** qualification of type of protein **Examiner's Comments** Candidates were asked what evidence for the active loading mechanism might be gained from observation using an electron microscope. Most candidates appreciated that mitochondria were required to produce the ATP used in active transport. Some did not link the need for many mitochondria in particularly active tissues. Fewer candidates were able to provide a second line of evidence such as the presence of plasmodesmata. Weaker candidates need to be trained to recall what features of cells are visible under an electron microscope as some were suggesting that the movement of sucrose and even hydrogen ions could actually be observed.
			Total	**7**	
3			ultrastructure ;	1	**Mark the first answer for each question part.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Examiner's Comments** The term ultrastructure was not so well known and common errors were to write ‘organelles’ or cytoskeleton’.
			Total	**1**	
4			A	1	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
5	a		detect the presence of acid / H^+ (1) measure end-point / dependent variable (1)	1	
	b	i	surface area to volume ratio on x-axis **and** time on y-axis (1) plotted points occupy at least half of available area **and** linear scale on both axes **and** line of best fit drawn (1) axes labelled time (min) **and** surface area to volume ratio / AW (1) all points plotted correctly (to +/– half a 2 mm grid square) (1)	4	**DO NOT ALLOW** if units given for x-axis **ALLOW** ecf for correctly plotted points on incorrectly-scaled graph
		ii	time taken for diffusion (to centre of cube), increases as surface area to volume ratio decreases, ORA	1	Answer must mention surface area to volume ratio **DO NOT ALLOW** if colour change is discussed in place of diffusion **IGNORE** rate **ALLOW** a description consistent with the graph the candidate has drawn
		iii	0.44	1	**ALLOW** answer in the range of 0.40 – 0.48 depending on candidate's plotted graph Answer must be reported to 2 decimal places
		iv	test cubes of (known) length between 10 and 20 mm	1	
	c		0.35 / 0.347 (1) (1) mm min^{-1}	3	**ALLOW** 0.69 / 0.694 for 1 mark **ALLOW** 0.3 or 0.3472 for 1 mark **ALLOW** mm/min
	d	i	*cube **A**, because…* time for test 2 different from others (1) use of processed figures to support (1)	2	**ALLOW** calculated rates for cube **A** - **E** **ALLOW** calculated range compared with that of cubes **B** - **E**

Question			Answer/Indicative content	Marks	Guidance
		ii	*Limitation* inconsistency in surface area (1) cube **A** (1) *Because* It is the smallest cube so small error in cutting will have proportionately larger effect in a small cube / *idea that* error is a bigger proportion of total time (1) *Limitation* using human eye and judgement to determine end point (1) cube **E** (1) *Because* largest cube so harder to see through 2cm of jelly / AW (1)	3	**ALLOW** mark only if one of the other two marks is awarded **ALLOW** mark only if one of the other two marks is awarded
	e		*idea of* involvement of cytoskeleton / vesicles (1)	1	**IGNORE** reference to different diffusion resistance
			Total	**17**	
6			lateral movement of water	1	
			Total	**1**	
7	a	i	chloroplast	1	
		ii	*idea that* presence of water may have altered the RF	1	**ALLOW** too diluted
	b	i	*Rf* is 0.61	1	**ALLOW** 0.60 or 0.62 **DO NOT ALLOW** 0.6
		ii	*does not support because* calculated *Rf* is not 0.63 (1) *supports because* within range of experimental variability (1) other *Rf* values appear to be slightly low (1) correct ranking position on chromatogram (1) colour is blue / green (1)	3	
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
8			D	1	
			Total	**1**	
9			D	1	
			Total	**1**	
10			B	1	
			Total	**1**	
11			C	1	
			Total	**1**	
12	a	i	1.7 mm (1)	1	
		ii	× 50 (1)(1)		**ALLOW** 1 mark for correct working e.g. 80 / 1.6 **ALLOW** answer in the range of 48–51
		iii	air spaces give buoyancy (1) supported by (surrounding) water (1)	2	
	b	i	*B* comment about detail of organelles (1) comment about shapes of cells (1)	2	**No Mark for identification of B** e.g. light microscope would not allow nuclear pores / ribosomes / endoplasmic reticulum / plasmodesmata to be seen. e.g. sieve tube elements are angular / hexagonal.
		ii	the ability to see more detail / separate two objects (1)	1	
		iii	Nile blue (1) to increase contrast / to make nuclei visible / to show no nuclei in sieve tubes (1)	2	
			Total	**10**	
13		i	abnormal immune response (1) against tissues normally in the body (1)	2	
		ii	nuclear proteins normally, hidden in nucleus / not exposed to tissue fluids (1)	1	
			Total	**3**	
14			C	1	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
15		i	mitochondrion	1	**ALLOW** mitochondria.
		ii	*either* facilitated diffusion (1) conversion of ornithine into citrulline creates concentration gradients **or** (molecules are not lipid soluble so) require protein channels to cross membrane (1) ***or*** active transport (1) ornithine and citrulline need to be moved into and out of **D** more quickly than would be met by diffusion (1)	2	
		iii	deamination / removal of NH_2 group from amino acid (1)	1	
		iv	ATP (1)	1	
			Total	**5**	
16			B	1	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
17		i	sharp blade (should be selected) (1) so slide is thin enough, individual cells are visible / resolution is high (1) method for slicing pieces of tissue (thinly) (1) so slide is thin enough, individual cells are visible / resolution is high (1) select thin(nest) slides (1) to ensure maximum light can penetrate sample (1) wet mount (1) prevents dehydration / distortion of tissue (1) squash slide (1) easier to see individual cells / allows light to penetrate tissue more easily (1)	6	**ALLOW** any reasonable method (e.g. microtome) **ALLOW** quantified thickness (e.g. measured with a micrometer) **ALLOW** description **ALLOW** description
		ii	contrast is high(er) (1) more (internal) structures visible (1) some (named) organelles / cell components more visible, because they bind to stain (1) clearer image can be obtained (1)	3	
			Total	**9**	
18		i	A = Glomerulus (1) B = Bowman's capsule (1)	2	**ALLOW** capillary (network)
		ii	190 (1)(1)	2	**AWARD ONE MARK** for: 0.03 or 3 / 160
			Total	**4**	
19			C	1	
			Total	**1**	
20			D	1	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
21	a		(pond community is) final / stable / not subject to further succession	1	**IGNORE** 'permanent', it is in the rubric.
	b		light microscope (1) graticule (1)	2	
	c	i	urea / uric acid	1	**ALLOW** ammonia, ammonium (ions).
		ii	Nitrosomonas (1) nitrite (1) Nitrobacter (1) nitrate (1)	4	
			Total	**8**	
22			(m)RNA transported out of nucleus (1) (m)RNA transported to / associates with ribosome (1) translation / protein synthesis, occurs at ribosome (1) (t)RNA brings specific amino acids **or** (t)RNA described (1) peptide bonds form between adjacent amino acids **or** peptide bonds described (1) polypeptide / protein processed through Golgi apparatus (1)	4	
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
23	a	i	**C** / ribosomes	1	
		ii	*Any two from:* A rough endoplasmic reticulum D Golgi apparatus E secretory vesicle F mitochondrion (1)(1)	2	
	b		C/A then D then E (1)(1)(1)	3	letters must be in correct order, if not all correct: allow one mark if C/A as first letter given allow one mark for E as last letter given allow one mark for D in the middle **IGNORE B** as this is plasma membrane rather than an organelle
	c		attach to cytoskeleton (1) moved by, protein motors / dynein (1)	2	**ACCEPT** by change in length of microtubules
	d	i	cofactor / prosthetic group (1)	1	
		ii	haemoglobin / myoglobin / cytochrome (1)	1	**ACCEPT** other correct named protein
			Total	**10**	
24		i	3.75 (1)(1)	2	**ALLOW** 3,750 μm or 0.375 cm for **one** mark. **ALLOW** 1 mark for correct working e.g. 3 x 1250
		ii	(with light microscope) no further resolution (at × 1250) (1)	1	**IGNORE** ref to further detail, as implied in question. **ALLOW** ref to resolution not the same as magnification.
		iii	*two from* stay keep indoors / increase ventilation / wear masks (1) measures to, exclude / not attract / kill, rats / fleas (1) strict / immediate quarantine for persons with symptoms (1)	2	**ALLOW** (longer term) measures to reduce overcrowding.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
25			C	1	**Examiner's Comments** This was answered reasonably well. It should be emphasised that questions such as this, where data are presented that do not have definitive values (in this case, varying according to the particular make and model of microscope), that candidates are expected to have an appreciation of the magnitude of the values rather than learning precise figures and expecting to quote those.
			Total	**1**	
26			D	1	**Examiner's Comments** This question was also well answered, with most candidates correctly giving D as the answer.
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
27		i	X (cellulose) cell wall ☐ Y cell surface membrane / plasma membrane ☐ Z vacuole membrane / tonoplast ☐	max 3	*If additional incorrect answer given, then 0 marks* Y **ACCEPT** plasmalemma Z **IGNORE** vacuole **Examiner's Comments** Almost all candidates correctly identified X as the cell wall. Few however went on to gain both of the other marks. The vast majority of candidates knew Y was the 'cell membrane' but failed to use the correct A Level terminology of cell surface membrane or plasma membrane. Z was typically identified as the vacuole rather than the vacuole membrane, although label line U was to the vacuole. Some candidates thought the label line pointed to the nuclear membrane, despite the nucleus being clearly labelled.
		ii	sucrose solution ☐	1	*If additional incorrect answer given, then 0 marks* **ACCEPT** sugar solution / external solution / solution placed in **DO NOT CREDIT** 'solution' unqualified **Examiner's Comments** It seems that the majority of candidates did not appreciate that the cell wall is fully permeable and so sucrose solution would therefore enter the space at W. Typical wrong responses were water/air/nothing.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
28		i	*advantages* A1 more space for / can contain more / can carry more, haemoglobin / oxygen ☐ A2 can squeeze through capillaries easily ☐ *disadvantages* D1 limited life span / cannot divide / cannot reproduce / cannot undergo mitosis ☐ D2 no, protein synthesis / repair ☐ D3 no respiration, in / by, mitochondria **or** no mitochondria for respiration **or** limited respiration / no aerobic respiration / only anaerobic respiration ☐	max 2	Mark **first answer** only for advantage and disadvantage. A1 **DO NOT CREDIT** in context of larger surface area **ACCEPT** 'Hb' for haemoglobin D1 max time of 120 days / 4 months D3 **DO NOT CREDIT** 'no mitochondria so no respiration' (as some respiration will still take place) **ACCEPT** 'ATP release' or 'energy provided' instead of 'respiration' e.g. no energy being provided from mitochondria ATP is not released by mitochondria **DO NOT CREDIT** ref to producing / creating, energy **Examiner's Comments** Most candidates stated that lack of a nucleus left more space for oxygen/haemoglobin but a significant number referred wrongly to an increase in surface area. The short life span of erythrocyte was commonly stated as a disadvantage but very few candidates realised their inability to carry out protein synthesis. Many candidates simply re-stated that erythrocytes had no membrane-bound organelles or a nucleus without any further qualification. A common misunderstanding was that the erythrocyte would be unable to respire, failing to realise that anaerobic respiration does still take place. A significant number said that erythrocytes would be unable to defend themselves from infection without a nucleus, or could not control cell activities

Question			Answer/Indicative content	Marks	Guidance
					or what entered or left the cell.
		ii	*virus* virus is unable to / cannot, replicate / reproduce, on its own / outside a host cell **or** virus requires host cell, machinery / DNA / RER / ribosomes, for protein synthesis **or** virus does not contain, RER / ribosomes, for protein synthesis ☐ – *Plasmodium* *idea that Plasmodium is* using the host cell to hide from the immune system **or** for *Plasmodium* to complete its life cycle **or** for *Plasmodium* to use as a source of food (for, growth / reproduction) ☐	2	**IGNORE** ref to the erythrocyte not having membrane-bound organelles without ref to the need of the virus to use them inside the cell Must be a clear statement **ACCEPT** needs / has to use, host cell to, replicate / reproduce **ACCEPT** 'malarial pathogen' for *Plasmodium* **IGNORE** eukaryotic / protoctist **IGNORE** it has its own, DNA / nucleus / protein synthesis apparatus **IGNORE** ref to just, part / stage, of life cycle **IGNORE** ref to organelles **Examiner's Comments** This was a challenging question for many, and several failed to specify which organism they were talking about. Candidates often understood that viruses couldn't use erythrocytes for reproduction but failed to make the link that viruses must use the host cell to replicate. Candidates restated the question describing that part of the Plasmodium life cycle took place in the red blood cell but failed to realise it did not complete its life cycle. Commonly, candidates said that the Plasmodium used the erythrocyte for transport and as a source of oxygen. Many candidates spoke of Plasmodium using the erythrocyte

Question			Answer/Indicative content	Marks	Guidance
					because it is injected directly into the blood by the mosquito. Only the most able candidates described how Plasmodium could evade the immune response within the red blood cell.
		iii	1 oxygen is bound to haemoglobin (while being transported) □ 2 lack mitochondria □ 3 (therefore) no aerobic respiration □ 4 (moved by mass flow so) doesn't need, energy / ATP, to move **or** needs less, energy / ATP (for metabolic processes) □	2	1 **ACCEPT** 'it' for 'oxygen' **ACCEPT** 'Hb' for haemoglobin 3 **ACCEPT** only respires anaerobically **IGNORE** ref to energy 4 **DO NOT CREDIT'** does not need, energy / ATP' unqualified **DO NOT CREDIT** 'makes / produces, energy' **Examiner's Comments** Most candidates scored 1 mark for lack of mitochondria although some candidates just referred to no organelles or no organelles for respiration. Very few candidates made the connection with aerobic respiration and the majority of candidates believed that erythrocytes could not respire at all and just had a completely passive role. Many candidates referred to the pointless nature of using the oxygen that they are supposed to be carrying to other tissues, more of a philosophical attitude than biological one.
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
29			nucleus; (contractile / food) vacuole;	max 1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Examiner's Comments** Well answered and nearly all candidates gave a correct response as 'nucleus' or 'food vacuole'. Some candidates obviously relied on memorised differences between Eukaryotes and Prokaryotes and provided answers such as 'different sized ribosomes'. When a question states 'shown in Fig. 1.1', candidates should understand that they must refer to the figure rather than rely on memory.
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
30	a		Z;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Examiner's Comments** Most students recognised that microscope Z was the transmission electron microscope.
	b		Fig. 3.1(a) (no mark) shows surface view; 3D / three dimensional; better <u>resolution</u> (than b);	max 2	Please place a green blob on paper Do not allow mp 2 if fig 3.1 b selected Do not allow mp 3 if fig 3.1 b selected Must be comparative comment **Examiner's Comments** Most students recognised that Fig. 3.1(a) was the image from a scanning electron microscope and were able to justify their choice successfully. The most common response was that the image was three dimensional, but many candidates also stated that it was a surface view. Fewer candidates stated that the resolution was higher than in Fig. 3.1(b).
			Total	**3**	
31			create / provide / increase contrast; make, cells / (named) component(s), visible OR cells / (named) components, can be, identified / distinguished / differentiated;	2	**IGNORE** clearer **ACCEPT** (named) organelle(s) stand out from surroundings **ACCEPT** regions / parts / AW, of cell **Examiner's Comments** Most candidates knew that staining made cell components visible and many also understood that the stain increases the contrast.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
32			14 000 / 120 = 117 µm;	2	length of line A-B = 14mm / 14000 µm Correct answer = 2 marks. Allow one mark if correct working shown including units for cm & mm e.g. 1.4 cm / 120 14 mm / 120 14000 / 120 If answer = 125 µm allow one mark for correct working but incorrect measurement (15mm instead of 14) Allow one mark if not rounded to nearest micrometre **Examiner's Comments** As ever, many candidates proved incapable of performing a relatively simple calculation. Better candidates did well and gave the correct response or at least showed they knew how to carry out the calculation. However, too many candidates appeared to have little idea of what to do. Commonly the magnification was left out of the calculation and candidates simply converted mm to μm. Another common error was to convert mm to μm by dividing by 1000 rather than multiplying. This is an area in which centres need to improve in light of the increased maths requirements of the new specifications.
			Total	**2**	

Question			Answer/Indicative content	Marks	Guidance
33				4	**Mark the first answer in each box.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Award 1 mark for each correct row** **ACCEPT** tick / present & cross / not present / absent / none **IGNORE** ref to nucleoid **CREDIT** murein as alternative to peptidoglycan **ACCEPT** peptidoglycin **DO NOT ACCEPT** peptoglycan **ACCEPT** 'on RER' or 'in cytoplasm' for yes **ACCEPT** ref to size of ribosomes (large / 80S / 22nm in Eukaryotes, small / 70S / 18nm in bacteria) **Examiner's Comments** Overall, this question was one of the most straightforward in the paper, expecting candidates to simply recall their knowledge. Errors were made either because students had not revised the content sufficiently well, or through phrasing their responses incorrectly. This was generally well answered by candidates, especially rows 1 and 2 where the majority of candidates identified budding as the means of cell division and that all except the bacterium possess a nucleus. However, a significant number of candidates suggested cytokinesis, binary fission or mitosis as the means of cell division. Rows 3 and 4 were less well answered. The material in the cell wall of plant cells (cellulose) was well known, but only the best candidates knew peptidoglycan and how to spell this term correctly. Some guessed at cellulose, polysaccharide and chitin or left the space blank. The most common mistake in row 4 was to suggest that either yeast or bacterium had no ribosomes.

Animal	Plant	Yeast	Bacterium	
		budding		;
yes	yes	yes	no	;
	cellulose		peptidoglycan	;
yes	yes	yes	yes	;

Question			Answer/Indicative content	Marks	Guidance
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
34	a				**Mark the first answer in each box.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then = **0 marks**
			transport / synthesis / metabolism, of, fats / lipids / steroid (hormones) / carbohydrates;		**CREDIT** 'processes' 'packages' **ACCEPT** 'processes toxins'
			contain (hydrolysing) enzymes **OR** break down / digest, (named) organelles / cells / (named) pathogens;		**DO NOT CREDIT** 'are, hydrolysing / digestive enzymes' 'produce enzymes' **IGNORE** ref to 'harmful substances' 'waste materials' 'phagocytosis' 'secretes enzymes'
			protein synthesis;	3	**CREDIT** ref to translation **Examiner's Comments** *smooth endoplasmic reticulum* The majority of candidates were able to state a function of smooth endoplasmic reticulum, usually referring to synthesis of lipids. A number of responses incorrectly made reference to proteins being associated with this organelle. *lysosome* The lysosome function was well known. The commonest errors stated that it produced enzymes or that the lysosome engulfed material during phagocytosis. *Ribosomes* Protein synthesis was usually correctly stated as the function of ribosomes. A few candidates gave accounts that confused the role of ribosomes with the role of mRNA.

Question			Answer/Indicative content	Marks	Guidance
	b		✓ ; ✓ ; ✓ ;	3	If four ticks given reduce mark by 1 If five ticks given reduce mark by 2 If six ticks given reduce mark by 3 For each mark reduction annotate with 'CON' **Examiner's Comments** Candidates were asked to select the statements that could be used as evidence for the endosymbiotic theory. Many able candidates correctly selected the features which highlighted the similarities between the organelles and free-living bacteria. These included the similarities in overall size, type of ribosomes and the circular organisation of DNA. However, it was quite common for candidates to select the exact opposite of the 3 correct answers. This was either a misinterpretation of the question or, more likely, that weaker candidates simply ticked the boxes opposite the statements they knew to be correct statements.
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
35		i	(contains) all / each, of, nutrients / food groups; in correct proportions / AW;	2	**ACCEPT** a list of food groups that contains at least – protein, fat, carbohydrate, vitamins, minerals **IGNORE** components **ACCEPT** right amount of **Examiner's Comments** Many candidates gained both marks. 'Correct', or 'right', proportions gained a mark but the oft-seen 'balanced', or 'sufficient' proportions did not. Likewise, food 'types' was not considered precise enough.
		ii	**A** glycerol; **C** <u>unsaturated</u> fatty acid; **D** <u>ester</u>, bond / link;	3	**Mark the first answer on each prompt line**. If the answer is correct and another answer is given that is incorrect or contradicts the original answer, then = **0 marks** **A IGNORE** molecule **C ACCEPT** unsaturated hydrocarbon, tail / chain **D IGNORE** covalent **Examiner's Comments** The glycerol and ester bond were correctly identified by most candidates. Slightly fewer, although more than half, correctly identified the fatty acid. However, only a minority described the fatty acid as unsaturated. Many referred to the fatty acid as a hydrocarbon tail.

Question			Answer/Indicative content	Marks	Guidance
		iii	1 contains, large amounts of energy / more energy than individual needs; 2 increased, fat / lipid, deposition / storage; 3 (associated with) <u>obesity</u>; 4 (lots of meat and dairy in diet could mean) lack of <u>other (named) food groups / AW</u>;	3 max	**1 ACCEPT** contains, too many calories / excess energy **1 ACCEPT** contains a lot of <u>saturated</u> fat **2 ACCEPT** in context of arteries and adipose tissue **2 ACCEPT** cholesterol / LDL as AW for fat **2 IGNORE** build up **3 IGNORE** CHD (as not malnutrition) **4 ACCEPT** nutrients as AW for food groups **4 IGNORE** unbalanced diet **4 IGNORE** fat / protein **Examiner's Comments** Most candidates gained some marks but few got all four. All marking points were seen. Many answered in terms of the development of atherosclerosis, rather than obesity as a form of malnutrition, but were still able to gain 2 marks. Some candidates missed out on the first marking point by stating that beef contained a lot of unsaturated fat. The minority of responses that merely defined malnutrition without placing it in context gained no credit.
			Total	**8**	

Question			Answer/Indicative content	Marks	Guidance
36			**1** glucose can, be used / enters glycolysis, directly / without being broken down (first); **2** maltose, must, be hydrolysed / have glycosidic bonds broken; **3** enzyme / maltase, only made when, needed / maltose present / glucose running out; **4** enzyme induced / gene(s) switched on; **5** transcription and translation / protein synthesis, takes time; **6** maltotriose requires, more (2) hydrolysis (reactions) / breaking of more (2) glycosidic bonds **or** enzyme to break down maltotriose made last;	3 max	**ACCEPT** 'monosaccharide' for glucose and 'disaccharide' for maltose and 'trisaccharide' for maltotriose throughout **1 IGNORE** ref to glucose being used first / at start / immediately (as stated in Q) **Examiner's Comments** This was a challenging question, which few candidates grasped, often simply reciting the information given in the stem of the question. Many thought that glucose needed to be broken down before it could be used. There was a lot of reference to breaking the disaccharide or trisaccharide down before use, but many answers were vague and did not mention hydrolysis or glycosidic bonds, gaining no credit. Only a few candidates realised that enzymes would need to be produced to carry out the hydrolysis and that this would involve enzyme induction and protein synthesis.
			Total	**3**	
37			A ☐	1	
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
38		i	ribosomes □ mitochondria □ (rough / smooth) endoplasmic reticulum □ Golgi apparatus □ vesicle □ centriole □	3 max	**IGNORE** organelles not present in this cell, e.g. flagellum / chloroplast
		ii	one cell drawn **AND** clear continuous lines □ correct proportions □ uses ≥50% of area provided □ *labels:* label lines drawn with a ruler to correct feature □ cell membrane **AND** nucleus **AND** cytoplasm □	4 max	**DO NOT ALLOW** more than one cell **DO NOT ALLOW** ragged lines / any shading **ALLOW** if it is clear which cell the candidate has attempted to draw **IGNORE** any annotations not mentioned here **DO NOT ALLOW** arrow heads
			Total	**7**	
39			D □	1	
			Total	**1**	
40		i	*A because* nuclei (of white blood cells) are lobed □	1	Mark is for the explanation
		ii	(x) 1300 □□	2	If answer is incorrect **ALLOW** 1 mark for evidence of 0.02 (m) / 0.000015 (m) or equivalent numbers in alternate units
			Total	**3**	