1. Three types of microscope are listed below.

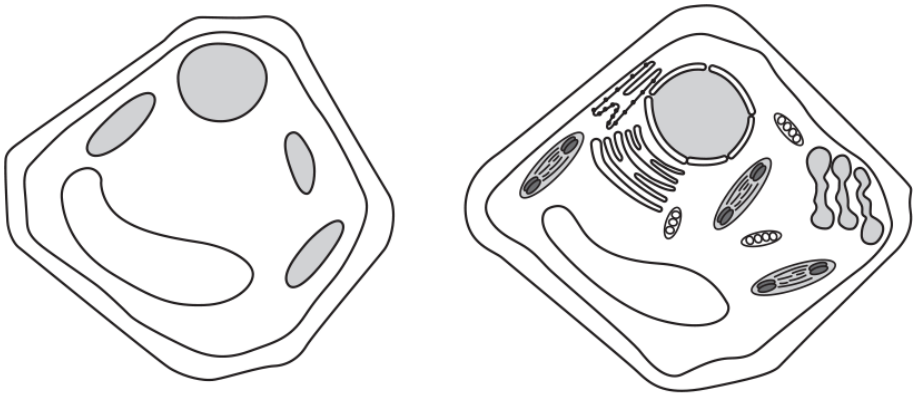
Select the row that shows the correct use for each type of microscope.

	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]

2. Fig. 1.1 shows a student's diagrams of two plant cells. Each cell was observed using a different type of microscope. The cells are not drawn to scale.



Cell A Cell B

Fig. 1.1

i. **Cell B** in Fig. 1.1 was observed using an electron microscope.
Give one piece of evidence from Fig. 1.1 that supports this.

---

[1]

ii. Give one way that an image produced by a laser scanning confocal microscope differs from that produced by an electron microscope.

---

[1]

3(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.

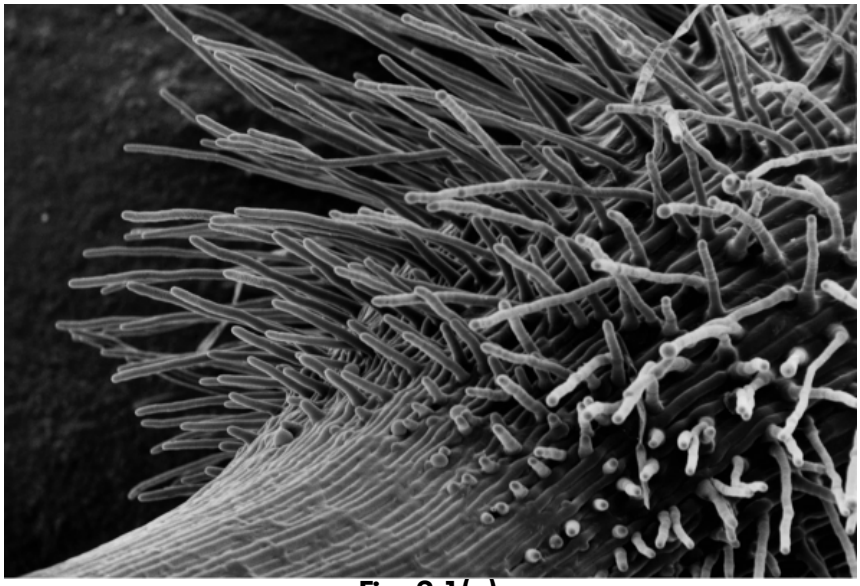


Fig. 3.1(a)

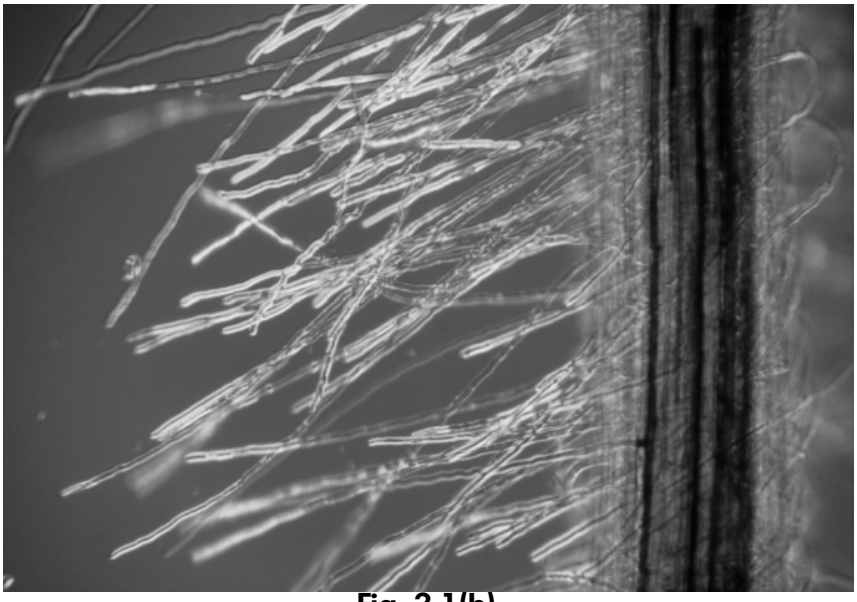


Fig. 3.1(b)

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]**

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

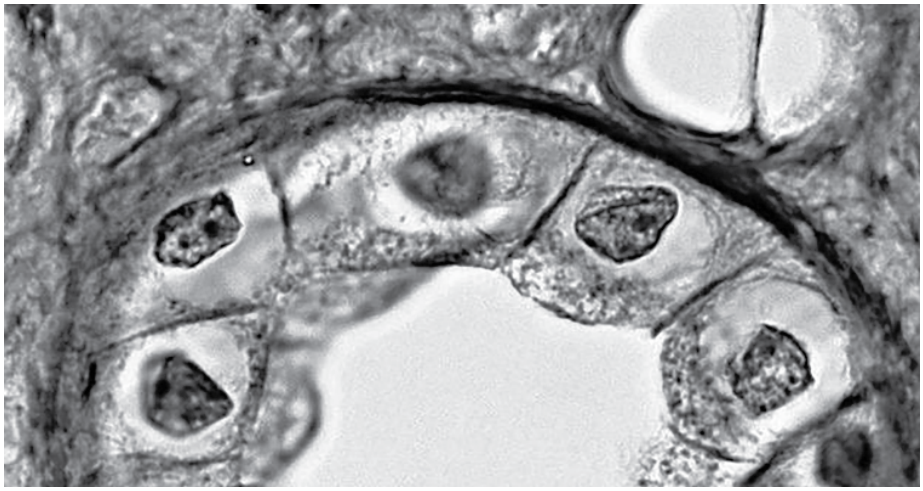


Fig. 19.3

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

1

2

3

---

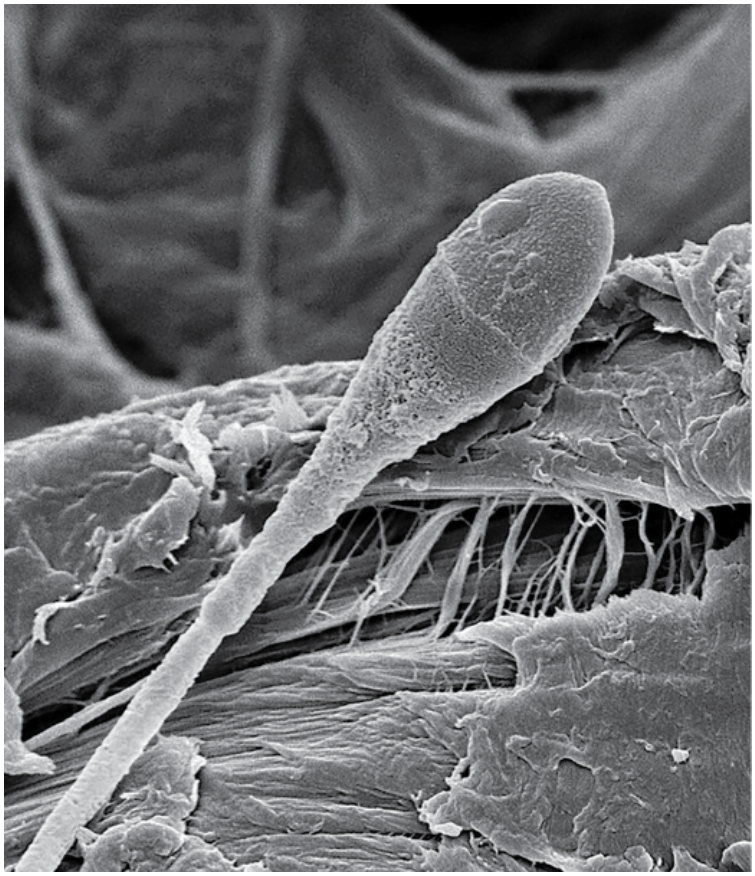
[3]

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

Label your diagram to show any visible features.

[4]

5. 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]

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

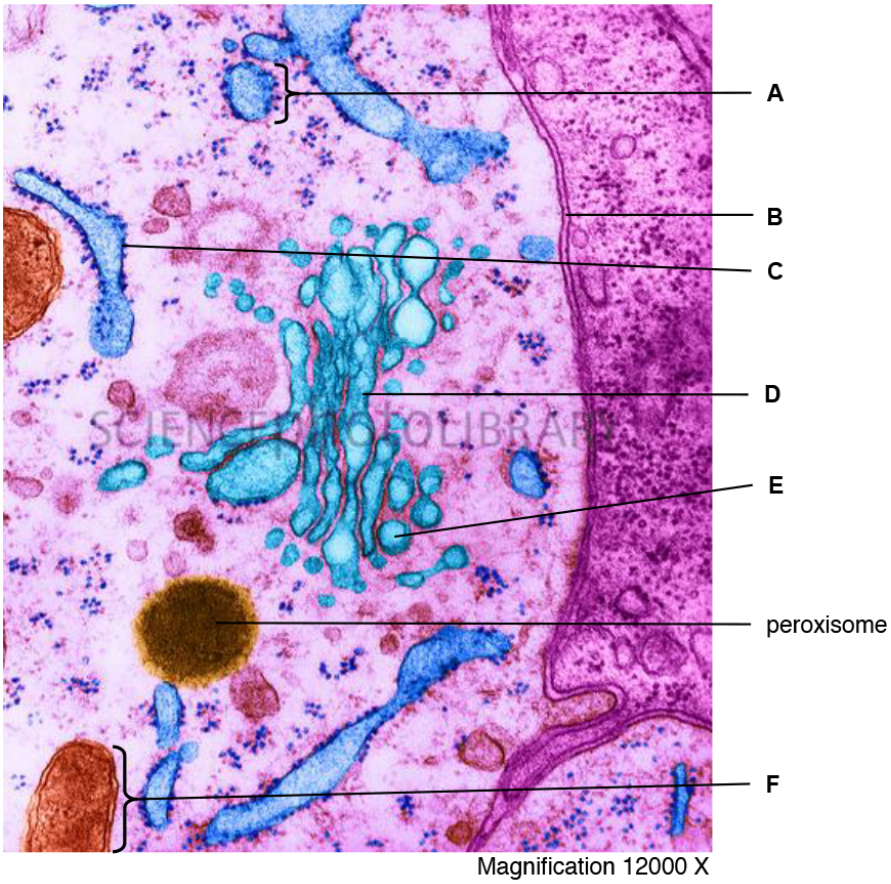


Fig. 20.1

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]

7. 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]

8(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]

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. 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]

END OF QUESTION paper

Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			D	1	
			Total	**1**	
2		i	*you can now see* Golgi body / mitochondria / (smooth / rough) endoplasmic reticulum / ER / RER / SER / ribosomes **OR** organelles seen in more detail / grana (in chloroplast) / thylakoids (in chloroplast) / nuclear pore / cristae (in mitochondria) / membranes within organelles / double nuclear membrane / (double) nuclear envelope **OR** resolution is, higher / better ✓	**1**	**IGNORE** clarity **IGNORE** ref to size of organelles **DO NOT ACCEPT** chloroplast **IGNORE** ref to ultrastructure unqualified **Examiner's Comments** This was answered well with most candidates correctly identifying an organelle which could not be seen with a light microscope, but could then be seen in the second image. Many correctly referred to rough endoplasmic reticulum or mitochondria although the presence of organelles simply being visible was insufficient. Many were able to comment on the higher resolution of cell B but a good proportion failed to gain credit due to the use of 'high' rather than 'higher'. Weaker answers often were too vague, simply stating that the 'ultrastructure' or 'detail' of the cell could be seen.
		ii	*LSCM image* has lowerresolution (than EM) **OR** can havefluorescent tag **OR** can see movement (as can be used on living cells) **OR** can see, different layers / at different depths (of the sample) ✓	**1 max**	**ORA** for electron microscope needs to be comparative **IGNORE** colour

					IGNORE ref to 2D / 3D / depth of field **Examiner's Comments** The majority of candidates were not confident in answering this question and as a result gave an incomplete or irrelevant answer. Some candidates were awarded the resolution mark but some were clearly confused as to which microscope has the higher resolution or were unsure about the difference between resolution and magnification. Many students responded in terms of the image being either 2D or 3D, some answers stated 'in colour', and several did not state which type of microscope they were referring to. Of the few correct answers seen, the majority referred to different depths of sample or the usefulness of being able to use a fluorescent tag. None referred to the advantage of being able to see movement (in living cells).
			Total	**2**	
3	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**	
4		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	<u>one</u> 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**	
5			A ✓	1	
			Total	**1**	
6	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
			Total	**6**	
7			<table><tr><td>**1**</td><td>transportvesicle from RER ✓</td></tr><tr><td>**2**</td><td>modification / processing / folding ✓</td></tr><tr><td>**3**</td><td>in / at, Golgi (body / apparatus) ✓</td></tr><tr><td>**4**</td><td>(packaged into)secretory vesicle ✓</td></tr><tr><td>**5**</td><td>vesicles move along the cytoskeleton ✓</td></tr><tr><td>**6**</td><td>(vesicle) fuses with, cellsurface / plasma, membrane ✓</td></tr><tr><td>**7**</td><td>(secretion occurs by)exocytosis ✓</td></tr></table>	**3 max**	***NOTE*** *answers must be the in context of* ***protein*** *transport. Penalise once if a different material (e.g. gene) is transported* to max 2 <table><tr><td>**2**</td><td>**ACCEPT**example of modification e.g. converted into a glycoprotein **ACCEPT** in context of RER or Golgi</td></tr><tr><td>**3**</td><td>**IGNORE** SER / smooth endoplasmic reticulum</td></tr><tr><td>**5**</td><td>**ACCEPT** use of motor proteins / chaperones / microtubules</td></tr><tr><td>**6**</td><td>**ACCEPT** merges with **DO NOT ACCEPT** binds / attaches / dissolves</td></tr><tr><td>**7**</td><td>**DO NOT ACCEPT** exocytosis in context of excretion (rather than secretion) **DO NOT ACCEPT** vesicle being released by exocytosis</td></tr></table> **Examiner's Comments** Some candidates wrongly answered in

					terms of the transport of the gene, RNA or even the ribosome itself, rather than the protein. Others limited their answers to accounts of transcription and translation without moving on to secretion. However, many candidates had learned the topic well and gained full marks in a single sentence. Generally candidates knew that processing and packaging happens at the Golgi apparatus, but could be less clear on other details. Few candidates included the distinction between transport vesicles and secretory vesicles, or used the precise terms. Several candidates failed to specify that the vesicle fused with the cell surface membrane, rather than just the cell membrane, and described the vesicle being released rather than the protein. Some candidates were familiar with the function of the cytoskeleton and used terms like chaperones and motor proteins.
			Total	**3**	
8	a		(using) microtubules / tubulin / motor proteins ✓	1	**ALLOW** kinesins / dyneins / 'moto' proteins **IGNORE**spindle fibres, centrioles **Examiner's Comments** Just under half of candidates associated movement of organelles in a cell with microtubules or motor proteins.
	b		**1**goblet cells, secrete / release / make / produce / form, mucus✓ **2**mucus traps, pathogens / microorganisms / bacteria ✓ **3** ref. phagocytes / neutrophils / macrophages / lysozyme ✓ **4**cilia / ciliated cells / ciliated epithelium, sweep / brush / waft / move / AW, mucus✓ 5 cytoskeleton / microtubules / tubulin, move(s) / make(s) up, the cilia✓	4 max	**IGNORE** excrete **ALLOW** named example of a lung pathogen **IGNORE** cilia trap, pathogens / microorganisms **ALLOW** 'cillia' / other spelling that looks and sounds same **DO NOT ALLOW** cilia cells **Examiner's Comments**

					Most candidates scored one or more marks. High ability responses showed correct and precise use of biological terms such as goblet cells, mucus, cilia and pathogens. Lower ability responses did not distinguish between the roles of two sorts of epithelial cells, goblet cells and ciliated cells. The commonest error was to say that cilia trap pathogens.
			Total	**5**	
9			D	1	
			Total	**1**	
10			<table><tr><th>Animal</th><th>Plant</th><th>Yeast</th><th>Bacterium</th></tr><tr><td></td><td></td><td>budding</td><td></td></tr><tr><td>yes</td><td>yes</td><td>yes</td><td>no</td></tr><tr><td></td><td>cellulose</td><td></td><td>peptidoglycan</td></tr><tr><td>yes</td><td>yes</td><td>yes</td><td>yes</td></tr></table>	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.
			Total	**4**	