

**Questions**

Q1.

The photograph shows a germinating pollen grain as seen through a light microscope.



(Source: © CAROLINA BIOLOGICAL SUPPLY COMPANY/SCIENCE PHOTO LIBRARY)

The actual length of this pollen tube is 136  $\mu\text{m}$ .

Calculate the magnification of this photograph.

(2)

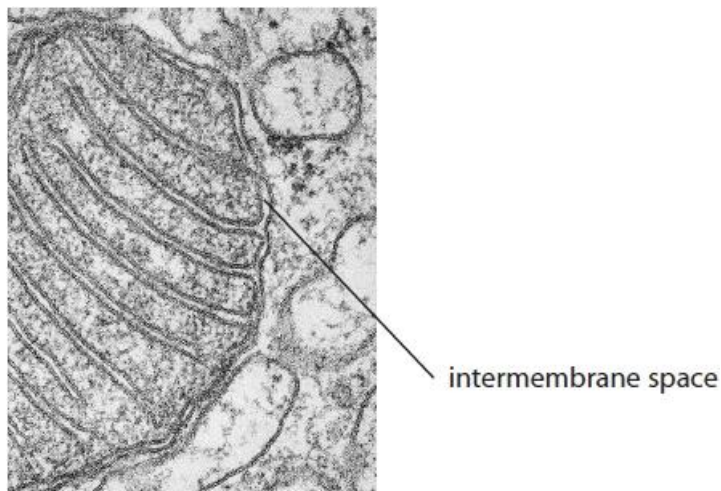
Answer .....

**(Total for question = 2 marks)**

**Q2.**

Cells and some cell organelles are surrounded by a membrane.

The photograph shows part of a mitochondrion, as seen using an electron microscope.



(Source: © DON W. FAWCETT/SCIENCE PHOTO LIBRARY)

(i) State why the intermembrane space can be seen in this photograph, when it is not always visible in photographs of mitochondria using other electron microscopes.

(1)

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(ii) The width of each membrane in this photograph is 6 nm.

Calculate the actual width of the intermembrane space in the region labelled on this photograph.

(2)

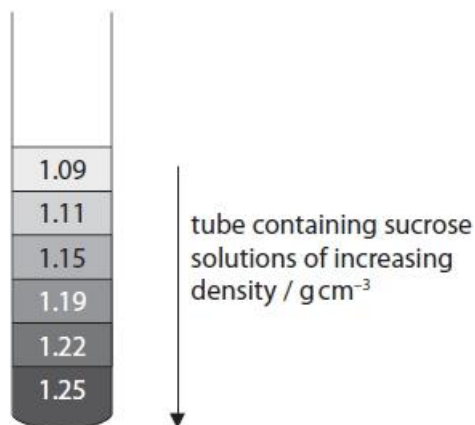
Answer ..... nm

**(Total for question = 3 marks)**

## Q3.

A scientist separated the components of animal cells using density gradient centrifugation.

The density gradient is made by layering sucrose solutions of different density on top of each other in a tube, as shown in the diagram.

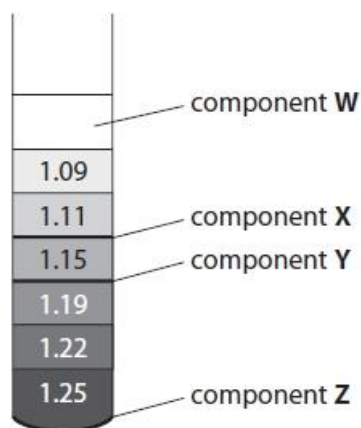


The animal cells were broken up in a salt solution which was then placed on top of the sucrose column.

The tube was then spun in a centrifuge.

This caused the cell components to move different distances down through the sucrose column according to their density.

The diagram shows the position of some cell components in the sucrose column after centrifugation.



The table shows the density of some cell organelles.

Organelle	Density / g cm <sup>-3</sup>
endoplasmic reticulum	1.16
Golgi apparatus	1.15 to 1.16
lysosome	1.12
mitochondrion	1.19

(a) Component **W** was present after centrifugation.

Explain what might be present in component **W** other than water and salt.

(2)

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(b) Which row correctly identifies the organelles present in component **X** and component **Y**?

(1)

	Component X	Component Y
<input type="checkbox"/> <b>A</b>	endoplasmic reticulum	mitochondrion
<input type="checkbox"/> <b>B</b>	Golgi apparatus	lysosome
<input type="checkbox"/> <b>C</b>	lysosome	Golgi apparatus
<input type="checkbox"/> <b>D</b>	mitochondrion	Golgi apparatus

(c) Explain which other organelle would be present in component **Z**.

(2)

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(d) Explain how rough endoplasmic reticulum can be separated from smooth endoplasmic reticulum using density gradient centrifugation.

(2)

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**(Total for question = 7 marks)**

**Q4.**

Microscopy is a technique used to study structures that are not within the resolution range of the human eye.

\* A school wanted to buy some new microscope objective lenses that would give better resolution.

Several factors affect the resolution of a microscope.

The tables show some data that the school was given from a company selling microscope objective lenses.

**Table 1**

Magnification of objective lenses	Objective lenses P		Objective lenses Q		Objective lenses R	
	Numerical aperture	Resolution / $\mu\text{m}$	Numerical aperture	Resolution / $\mu\text{m}$	Numerical aperture	Resolution / $\mu\text{m}$
$\times 4$	0.10	2.75	0.13	2.12	0.20	1.38
$\times 10$	0.25	1.10	0.30	0.92	0.45	0.61
$\times 40$	0.65	0.42	0.75	0.37	0.95	0.29
$\times 100$	1.25	0.22	1.30	0.21	1.40	0.20

**Table 2**

Wavelength of light / nm	Resolution / $\mu\text{m}$
360	0.19
400	0.21
500	0.26
600	0.32
700	0.37



**Q5.**

Enzymes are catalysts that are sensitive to changes in temperature.

Some antibiotics affect the enzymes involved in the growth of bacteria.

(i) Explain why Gram positive bacteria and Gram negative bacteria react differently to some antibiotics.

(3)

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(ii) Explain why viruses are not affected by antibiotics.

(2)

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**(Total for question = 5 marks)**

**Q6.**

Antibiotics can affect bacteria.

The table describes the mode of action of four antibiotics.

Antibiotic	Mode of action
benzylpenicillin	disrupts peptidoglycan structure
streptomycin	binds to 70S ribosomes
ciprofloxacin	inhibits enzymes involved in prokaryotic DNA replication
rifamycin	inhibits prokaryotic RNA polymerase

(i) Name the antibiotic that affects Gram positive bacteria only.

(1)

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(ii) Give one reason why these antibiotics will not affect human cells.

(1)

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.....**(Total for question = 2 marks)**



Q7.

The photograph shows part of a bacterial cell surrounded by viruses, as seen using an electron microscope.



(i) Which of these structures would be present in a bacterial cell but absent in a palisade mesophyll cell? (1)

- A cellulose cell wall and nucleoid
- B cellulose cell wall and nucleolus
- C peptidoglycan cell wall and nucleoid
- D peptidoglycan cell wall and nucleolus

(ii) Which virus contains DNA? (1)

- A Ebola
- B HIV
- C  $\lambda$  (lambda) phage
- D tobacco mosaic

(iii) Explain why an electron microscope, rather than a light microscope, was used to produce this photograph. (2)

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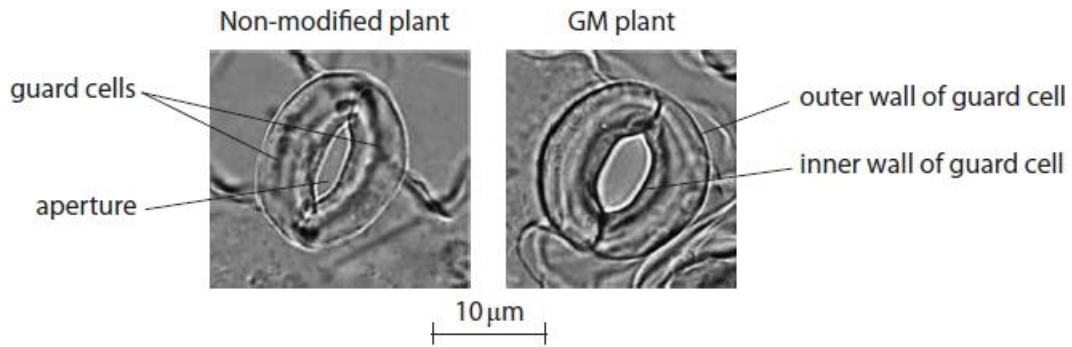
**(Total for question = 4 marks)**

**Q8.**

Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.



Sourced from: [http://www.aip.nagoya-u.ac.jp/en/public/nu\\_research/images/Wang\\_f1.jpg](http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg)

- (i) Calculate the magnification of the GM plant photograph using the scale bar.  
Give the answer in standard form.

(2)

Answer .....

- (ii) Calculate how many times wider the aperture of the stoma of the GM plant is compared with the stoma of the non-modified plant.

(1)

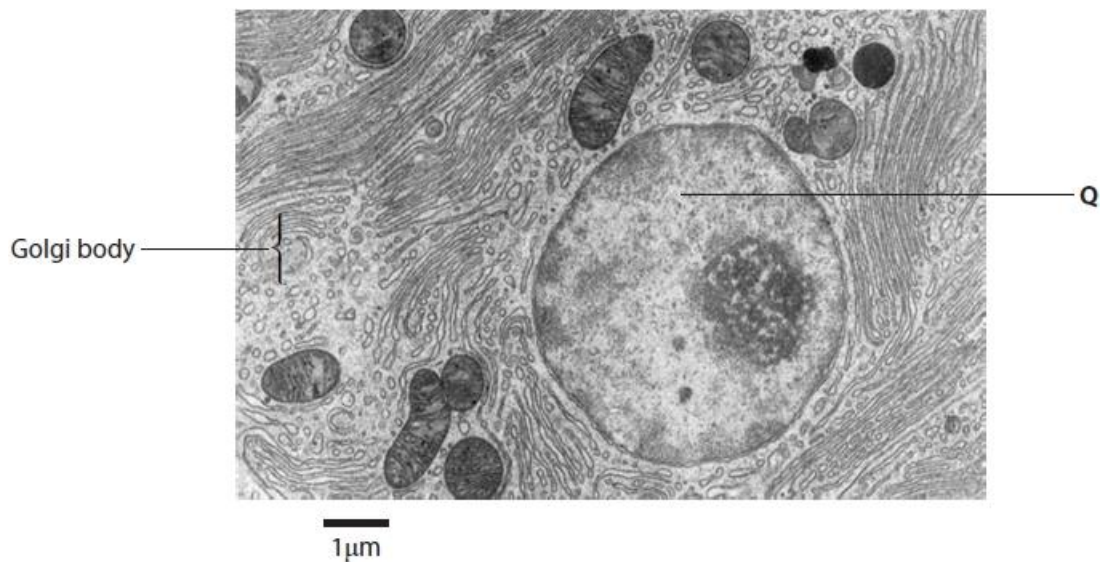
Answer .....

**(Total for question = 3 marks)**

**Q9.**

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Calculate the maximum diameter of organelle **Q**.

(2)

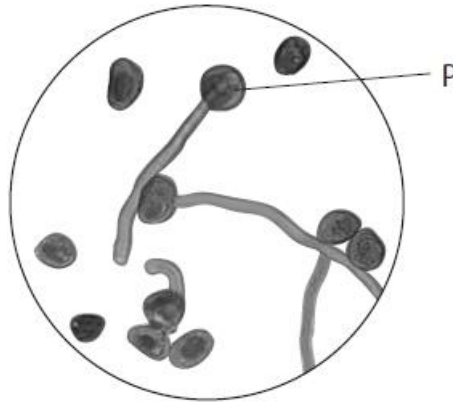
Answer .....

**(Total for question = 2 marks)**

**Q10.**

A student used a light microscope to determine the mean percentage germination of pollen grains.

The photograph shows one high power field of view observed by the student.



The student used a paintbrush to obtain pollen grains from a flower.

Describe the steps taken by the student to see these pollen grains using a microscope.

(3)

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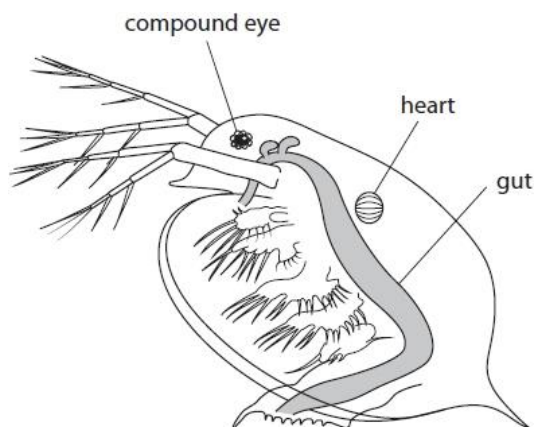
**(Total for question = 3 marks)**

**Q11.**

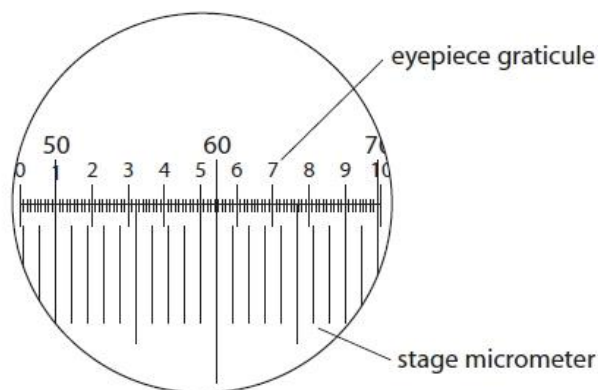
Water fleas are small animals that live in pond water.

A student observed a water flea using a light microscope.

The diagram shows the student's drawing of the water flea.



The diagram shows an eyepiece graticule and a stage micrometer used by the student to measure the diameter of the heart in this water flea.



(Source: <http://biology4alevel.blogspot.com/2014/07/2-cell-structure-microscopy.html>)

Each small division on the stage micrometer is 0.01 mm.

The diameter of the heart was found to be 0.2 mm.

Determine the number of eyepiece units that equal the diameter of the water flea heart.

(1)

Answer .....

**(Total for question = 1 mark)**

## Q12.

Ultraviolet (UV) radiation damages DNA and is used in microbiology to produce aseptic conditions.

The effectiveness of UV radiation was investigated, using three species of pathogenic bacteria.

The table provides information about the bacteria used in this investigation.

Bacteria	Gram staining	Infected part of body
<i>P. aeruginosa</i>	negative	blood
<i>S. aureus</i>	positive	lung
<i>E. coli</i>	negative	intestine

(i) Compare and contrast the structure of the wall of Gram positive bacteria and Gram negative bacteria.

(3)

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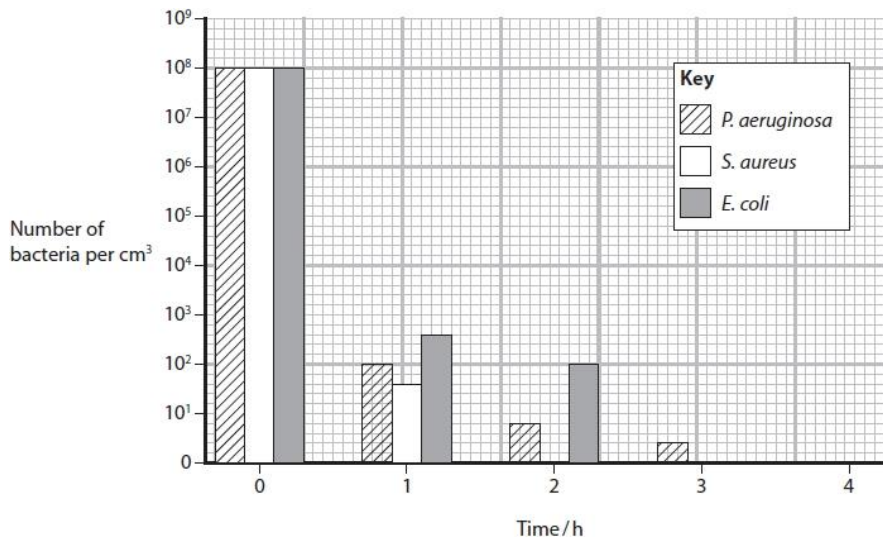
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(ii) In this investigation, living bacteria of each species were exposed to UV radiation for four hours.

The numbers of living bacteria were counted each hour during the four-hour period. The graph shows the results of this investigation.



Calculate the percentage change in numbers of living *E. coli* after two hours of exposure to UV radiation.

(2)

Answer ..... %

(iii) A student concluded from this investigation that if food is exposed to UV radiation, it would remove all risk of food poisoning.

Criticise the validity of this conclusion.

(4)

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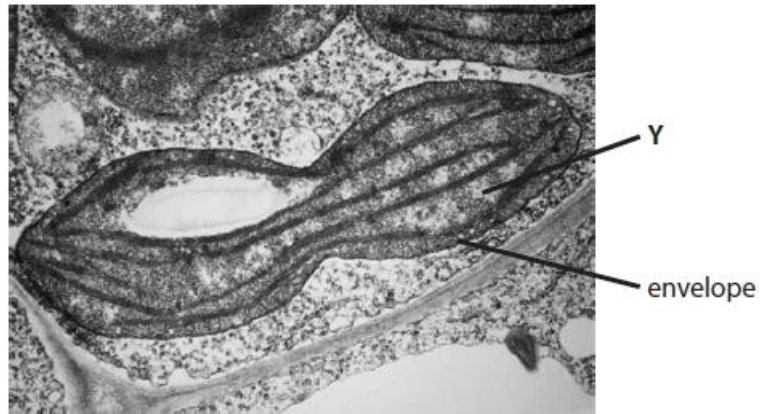
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(Total for question = 9 marks)

**Q13.**

When a photosynthetic plant cell grows, the number of chloroplasts in the cell increases. This increase in the number of chloroplasts can result from the division of chloroplasts already present in the cell.

The electron micrograph shows a chloroplast dividing.



The envelope consists of two membranes. These membranes are separated by a gap of  $10 \times 10^{-3}$  to  $20 \times 10^{-3} \mu\text{m}$ .

The magnification of this electron micrograph is  $\times 12\,000$ .

(i) Calculate the maximum width of this gap in this electron micrograph.

(2)

Answer .....

(ii) Explain why the envelope in this electron micrograph cannot be seen as two separate membranes.

(2)

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**(Total for question = 4 marks)**



**Q14.**

The pathogenic effects of bacteria can be due to the toxins they release.

Endotoxins are released by Gram negative bacteria.

(i) Name **one** type of Gram negative bacteria that releases endotoxins.

(1)

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(ii) Give **one** difference between the structure of Gram negative bacteria and Gram positive bacteria.

(1)

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**(Total for question = 2 marks)**

Q15.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Prokaryotic cells and eukaryotic cells contain a number of organelles.

The table gives information about some organelles.

Organelle	Information about each organelle
P	$10^{-9}$ m in diameter involved in translation
Q	5000 nm in diameter contains thylakoids
R	stack of curved cisternae involved in protein modification
S	$1.2 \times 10^{-3}$ mm in diameter has a single membrane

Which of the following is a lysosome?

(1)

- A P
- B Q
- C R
- D S

(Total for question = 1 marks)

Q16.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Prokaryotic cells and eukaryotic cells contain a number of organelles.

The table gives information about some organelles.

Organelle	Information about each organelle
P	$10^{-9}$ m in diameter involved in translation
Q	5000 nm in diameter contains thylakoids
R	stack of curved cisternae involved in protein modification
S	$1.2 \times 10^{-3}$ mm in diameter has a single membrane

How many of the organelles in the table contain DNA?

(1)

- A 1
- B 2
- C 3
- D 4

(Total for question = 1 mark)

Q17.

Answer the question with a cross in the box you think is correct  . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross  .

Prokaryotic cells and eukaryotic cells contain a number of organelles.

The table gives information about some organelles.

Organelle	Information about each organelle
P	$10^{-9}$ m in diameter involved in translation
Q	5000 nm in diameter contains thylakoids
R	stack of curved cisternae involved in protein modification
S	$1.2 \times 10^{-3}$ mm in diameter has a single membrane

The table gives information about organelles found in prokaryotic cells and animal cells.

For each organelle, put **one** cross  in the appropriate box in each row to show which cells contain these organelles.

(2)

Organelle	Organelle found in			
	both prokaryotic cells and animal cells	prokaryotic cells only	animal cells only	neither prokaryotic cells nor animal cells
P	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Q	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Total for question = 2 marks)

Q18.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Prokaryotic cells and eukaryotic cells contain a number of organelles.

The table gives information about some organelles.

Organelle	Information about each organelle
P	$10^{-9}$ m in diameter involved in translation
Q	5000 nm in diameter contains thylakoids
R	stack of curved cisternae involved in protein modification
S	$1.2 \times 10^{-3}$ mm in diameter has a single membrane

Which of the following shows the organelles in order of size from largest to smallest?

(1)

- A P S Q
- B Q P S
- C Q S P
- D S P Q

(Total for question = 1 mark)

**Q19.**

Plant stems contain xylem and phloem, tissues specialised for transport.

The photomicrograph shows a longitudinal section of phloem tissue.



State why stains, such as methylene blue, are sometimes used when preparing a microscope slide.

(1)

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**(Total for question = 1 mark)**

**Q20.**

Cysteine proteases are enzymes found in fruits such as pineapples.

When a protease enzyme is added to fat-free skimmed milk, the milk turns from cloudy to clear.

Cysteine proteases are also found in the predatory bacterium *Bdellovibrio bacteriovorus* (BvB).

These bacteria are harmless to humans but prey on Gram negative bacteria.

(i) Give two differences between Gram negative and Gram positive bacteria.

(2)

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(ii) The cell of the predatory BvB is 1µm in length and can swim 100 times its length per second.

Calculate the swimming speed of this bacterial cell in mm s<sup>-1</sup>.

(2)

Answer .....

(iii) The BvB bacteria have been described as 'living antibiotics'.

Explain why the BvB bacteria might be useful in the future for treating bacterial infections.

(2)

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**(Total for question = 6 marks)**

**Q21.**

Some antibiotics work by inhibiting the production of ribosomes in bacteria.

The structure of ribosomes in bacteria is similar to the structure of ribosomes in mitochondria.

These antibiotics can destroy cancer cells in humans.

The diagram shows the membranes of a mitochondrion from a cancer cell treated with these antibiotics.



(i) Give one difference in the membranes of this mitochondrion compared with the membranes of a mitochondrion from an untreated cancer cell.

(1)

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(ii) Some cancer cells depend on oxidative phosphorylation for ATP production.

Explain why the antibiotics that inhibit the production of ribosomes prevent oxidative phosphorylation when used to treat cancer cells.

(2)

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(iii) Some scientists suggested that inhibiting both glycolysis and mitochondrial respiration may be an effective way of treating cancer cells.

Explain why this suggestion may be an effective way of treating cancer cells.

(2)

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**(Total for question = 5 marks)**



**Q22.**

Eukaryotic cells and prokaryotic cells have similarities and differences in their ultrastructure.

Compare and contrast the ultrastructures of eukaryotic cells and prokaryotic cells.

**(4)**

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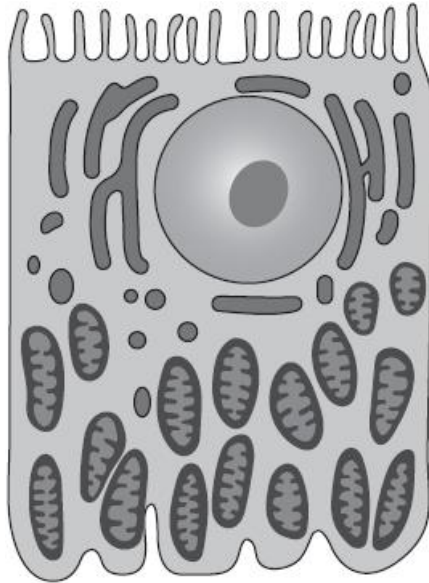
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**(Total for question = 4 marks)**

Q23.

The diagram shows a cell from the proximal convoluted tubule of the nephron.



Explain how the features shown in the diagram enable this cell to carry out its function.

(4)

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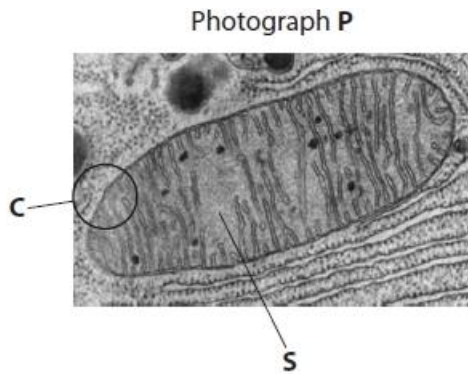
(Total for question = 4 marks)

Q24.

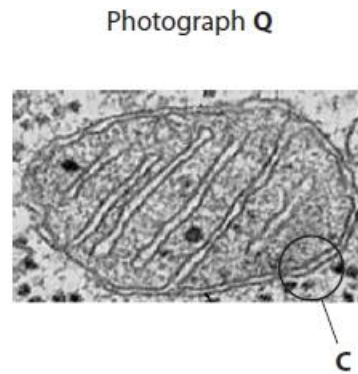
Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Photographs P and Q are electron micrographs of mitochondria.

Each photograph was taken using a different electron microscope.



Sourced from: <http://book.bionumbers.org/how-big-are-mitochondria/>



Source: Cellupedia

(i) What is the structure labelled **S**?

(1)

- A** crista
- B** matrix
- C** stroma
- D** thylakoid

(ii) Explain the difference in appearance of the parts labelled **C** using the two different electron microscopes.

(2)

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**(Total for question = 3 marks)**

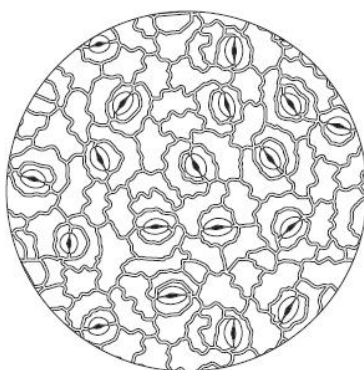
**Q25.**

A student investigated the effect of light intensity on the development of stomata in coffee plant leaves.

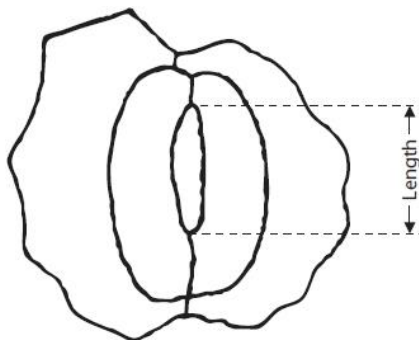
The following method was used:

- young coffee seedlings were separated into two groups
- one group was grown in bright light and the other group was grown in dim light
- leaves were selected from each group and their surfaces were painted with nail varnish
- the nail varnish was allowed to dry and then peeled off the leaf surface
- each nail varnish peel was observed using a light microscope.

The diagram shows an example of the field of view seen by the student when using the high power lens.



The diagram shows one of the stomata drawn by the student.



The actual length of this stoma is  $20\ \mu\text{m}$ .

Calculate the magnification of this drawing.

(2)

Answer .....

**(Total for question = 2 marks)**

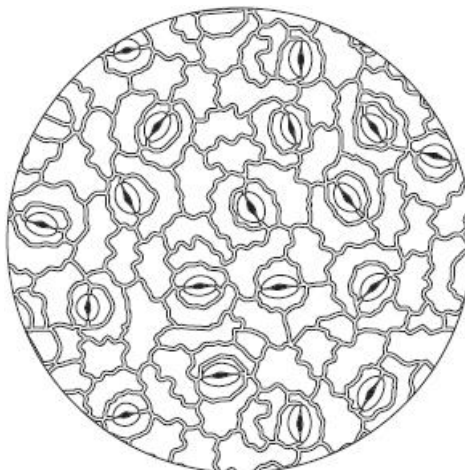
**Q26.**

A student investigated the effect of light intensity on the development of stomata in coffee plant leaves.

The following method was used:

- young coffee seedlings were separated into two groups
- one group was grown in bright light and the other group was grown in dim light
- leaves were selected from each group and their surfaces were painted with nail varnish
- the nail varnish was allowed to dry and then peeled off the leaf surface
- each nail varnish peel was observed using a light microscope.

The diagram shows an example of the field of view seen by the student when using the high power lens.



Describe how a microscope should be used to observe the stomata using the high power lens.

(3)

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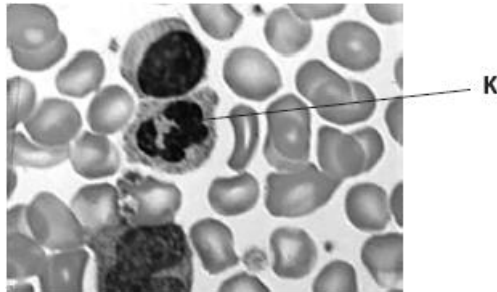
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**(Total for question = 3 marks)**

**Q27.**

Microscopy is a technique used to study structures that are not within the resolution range of the human eye.

The photograph shows cells in a blood smear, as seen using a light microscope.



(i) Draw the cell labelled **K**, as shown in the photograph. Your drawing should have a magnification  $\times 2$ .

(4)

(ii) Describe how to use a micrometer to determine how many times bigger your drawing is than the actual cell in the blood smear.

(4)

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**(Total for question = 8 marks)**

**Q28.**

Leigh syndrome is a genetic disorder inherited from the mother. The mother carries genes for the disorder in her mitochondrial DNA.

Draw and label a mitochondrion.

(4)

**(Total for question = 4 marks)**

**Q29.**

Mitosis is involved in growth and repair of tissues and organs.

Describe the differences between a tissue and an organ.

(2)

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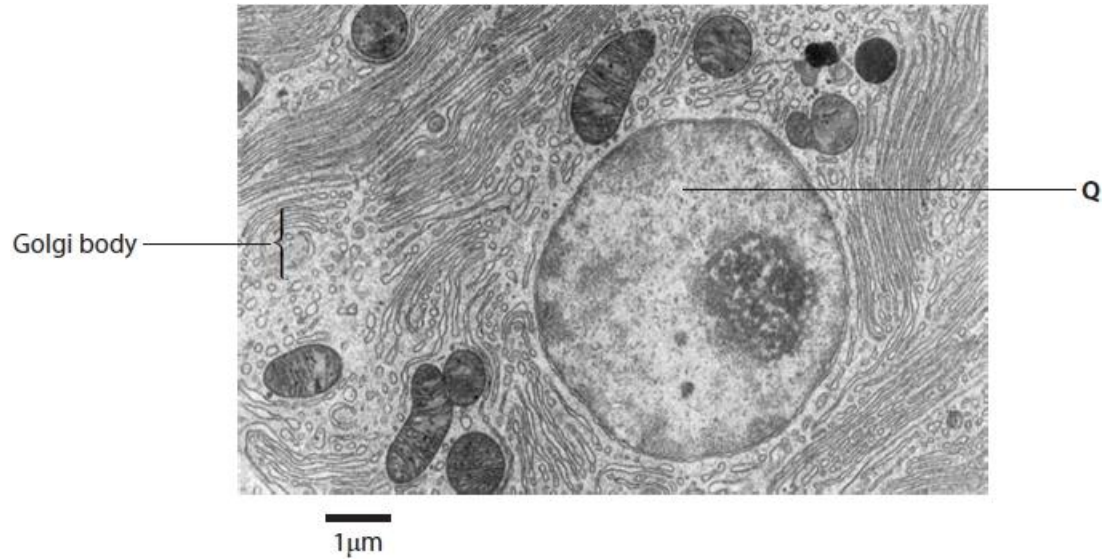
**(Total for question = 2 marks)**



**Q30.**

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Name organelle **Q**.

(1)

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**(Total for question = 1 mark)**

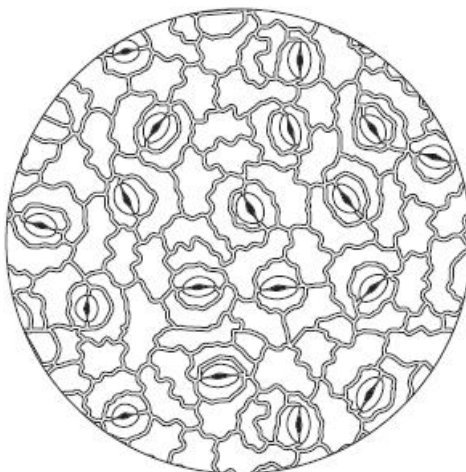
## Q31.

A student investigated the effect of light intensity on the development of stomata in coffee plant leaves.

The following method was used:

- young coffee seedlings were separated into two groups
- one group was grown in bright light and the other group was grown in dim light
- leaves were selected from each group and their surfaces were painted with nail varnish
- the nail varnish was allowed to dry and then peeled off the leaf surface
- each nail varnish peel was observed using a light microscope.

The diagram shows an example of the field of view seen by the student when using the high power lens.



The diameter of the field of view is 0.4 mm.

Calculate the number of stomata per  $\text{mm}^2$  on the leaf surface.

The area of a circle is  $\pi r^2$ , where  $\pi$  is 3.142.

(2)

Answer .....  $\text{mm}^{-2}$

**(Total for question = 2 marks)**

**Q32.**

Plant and animal cells contain a number of organelles.

The table gives information about some of these organelles.

Organelle	Information about the organelle
P	$10^{-9}$ m in size involved in translation
Q	contains thylakoids
R	involved in aerobic respiration
S	2500 nm in size involved in protein modification
T	$6\ \mu\text{m}$ in size has a double membrane
U	has a single membrane

The number of organelles in the table which contain DNA is

(1)

- A one
- B two
- C three
- D four

**(Total for question = 1 mark)**

Q33.

Plant and animal cells contain a number of organelles.

The table gives information about some of these organelles.

Organelle	Information about the organelle
P	$10^{-9}$ m in size involved in translation
Q	contains thylakoids
R	involved in aerobic respiration
S	2500 nm in size involved in protein modification
T	$6\ \mu\text{m}$ in size has a double membrane
U	has a single membrane

Which row of the table is correct for organelles **Q** and **R**?

(1)

	Found in animals cells	Found in plant cells
<input type="checkbox"/> A	Q and R	Q and R
<input type="checkbox"/> B	Q	R
<input type="checkbox"/> C	R	Q and R
<input type="checkbox"/> D	Q and R	Q

(Total for question = 1 mark)

Q34.

Plant and animal cells contain a number of organelles.

The table gives information about some of these organelles.

Organelle	Information about the organelle
P	$10^{-9}$ m in size involved in translation
Q	contains thylakoids
R	involved in aerobic respiration
S	2500 nm in size involved in protein modification
T	$6\ \mu\text{m}$ in size has a double membrane
U	has a single membrane

Which of the following shows the organelles in order of size from smallest to largest?

(1)

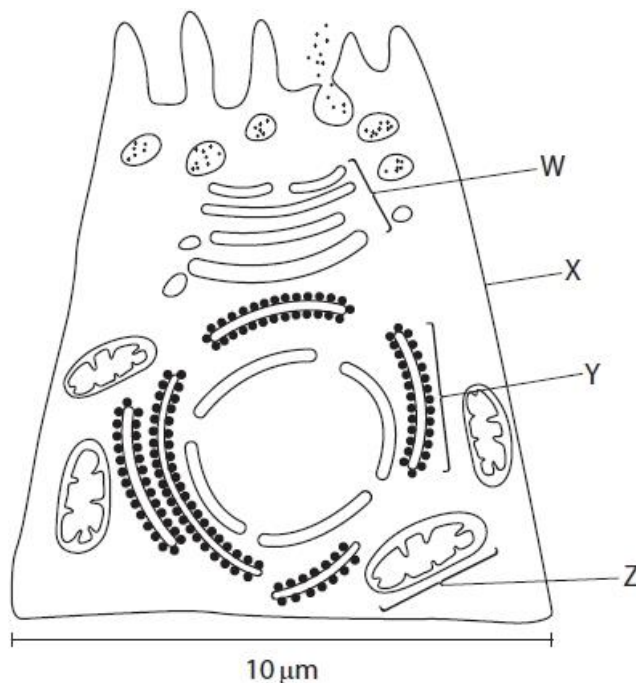
- A P S T
- B P T S
- C S T P
- D T S P

(Total for question = 1 mark)

Q35.

Some of the cells in the pancreas secrete proteins.

The diagram represents a pancreatic cell.



(i) The structure labelled Y represents the

(1)

- A centrioles
- B Golgi apparatus
- C rough endoplasmic reticulum
- D smooth endoplasmic reticulum

(ii) The structure also found in a prokaryotic cell is labelled

(1)

- A W
- B X
- C Y
- D Z

(iii) Calculate the magnification of this cell.

(2)

Answer .....

(iv) Explain why these pancreatic cells contain large numbers of organelle Z.

(3)

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**(Total for question = 7 marks)**

**Q36.**

Explain why it is possible to see the detailed structure of a prokaryotic cell with an electron microscope but not with a light microscope.

(2)

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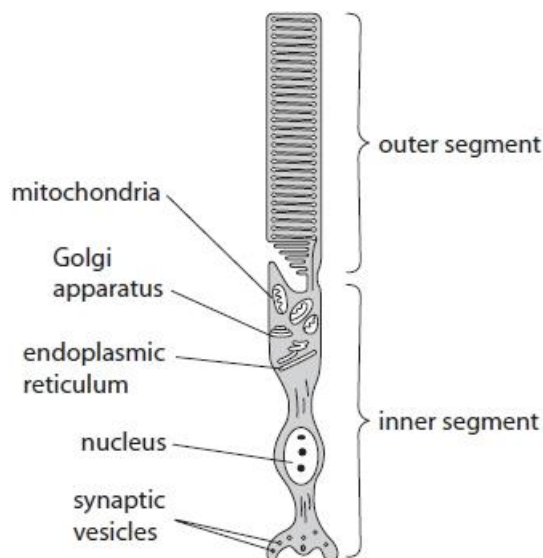
**(Total for question = 2 marks)**



Q37.

Answer the question with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

The diagram shows the structure of a rod cell.



(i) How many of the labelled organelles have a double membrane?

(1)

- A** 0  
 **B** 1  
 **C** 2  
 **D** 3

(ii) Which of the following statements about the effect of light on rod cells are correct?

(1)

1. rhodopsin breaks down into opsin and trans-retinal
2. voltage-gated sodium channels open in the membrane
3. more neurotransmitter is released from the presynaptic terminal

- A** 1 only  
 **B** 1 and 2  
 **C** 1 and 3  
 **D** 2 and 3

**(Total for question = 2 marks)**

**Q38.**

The retina contains rod cells and bipolar neurones.

Rod cells contain large numbers of mitochondria.

Explain the role of mitochondria in the functioning of rod cells.

(2)

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**(Total for question = 2 marks)**

**Q39.**

*Salmonella* are Gram negative bacteria found in the large intestine of humans.

Which is the correct statement about *Salmonella*?

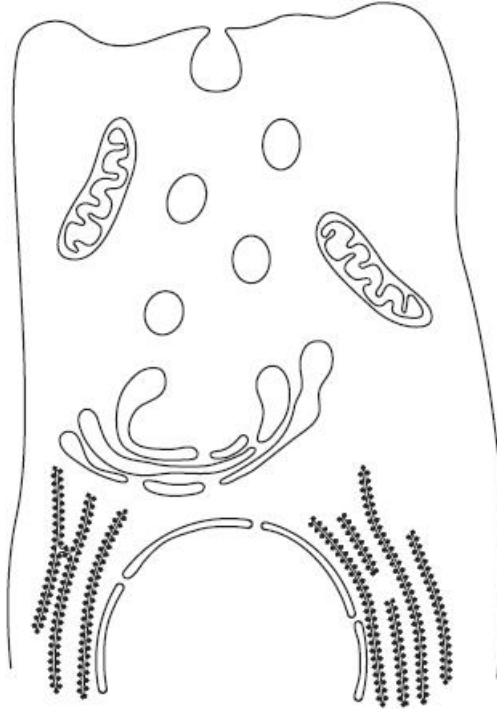
(1)

- A** *Salmonella* has a thick peptidoglycan cell wall and produces endotoxins
- B** *Salmonella* has a thick peptidoglycan cell wall and produces exotoxins
- C** *Salmonella* has a thin peptidoglycan cell wall and produces endotoxins
- D** *Salmonella* has a thin peptidoglycan cell wall and produces exotoxins

**(Total for question = 1 mark)**

**Q40.**

The diagram shows part of a cell from the pancreas that produces enzymes for use in the digestion of food.



State one way in which the structure of a prokaryotic cell would differ from the cell shown in this diagram.

(1)

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**(Total for question = 1 mark)**

**Q41.**

Plant and animal cells contain a number of organelles.

The table gives information about some of these organelles.

Organelle	Information about the organelle
<b>P</b>	$10^{-9}$ m in size involved in translation
<b>Q</b>	contains thylakoids
<b>R</b>	involved in aerobic respiration
<b>S</b>	2500 nm in size involved in protein modification
<b>T</b>	$6\ \mu\text{m}$ in size has a double membrane
<b>U</b>	has a single membrane

Which of the following describes the structure of organelle **S**?

(1)

- A** network of interconnecting tubules
- B** pair of cylinders at right angles to one another
- C** stacks of curved cisternae
- D** two subunits with a groove

(Total for question = 1 mark)

Q42.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Which row in the table is correct for structures found in animal cells and prokaryotic cells?

(1)

	Nucleolus		Plasmid		Ribosome	
	Animal cell	Prokaryotic cell	Animal cell	Prokaryotic cell	Animal cell	Prokaryotic cell
<input type="checkbox"/> A	✓	✗	✓	✓	✓	✓
<input checked="" type="checkbox"/> B	✗	✓	✓	✓	✗	✓
<input type="checkbox"/> C	✓	✗	✗	✓	✓	✓
<input type="checkbox"/> D	✓	✓	✓	✗	✓	✗

(Total for question = 1 mark)

Q43.

Cells and some cell organelles are surrounded by a membrane.

The table shows the percentage of some types of membrane in one cell from a liver and one cell from a pancreas.

Type of membrane	Percentage of total membranes (%)	
	Cell from a liver	Cell from a pancreas
Plasma cell membrane	2	5
Rough endoplasmic reticulum	35	60
Smooth endoplasmic reticulum	16	<1
Golgi apparatus	7	10
Mitochondria	39	21
Secretory vesicle	not determined	3
Other	1	between 0 and 1

Analyse the data to explain three differences in the percentages of these types of membrane in these two cells.

(3)

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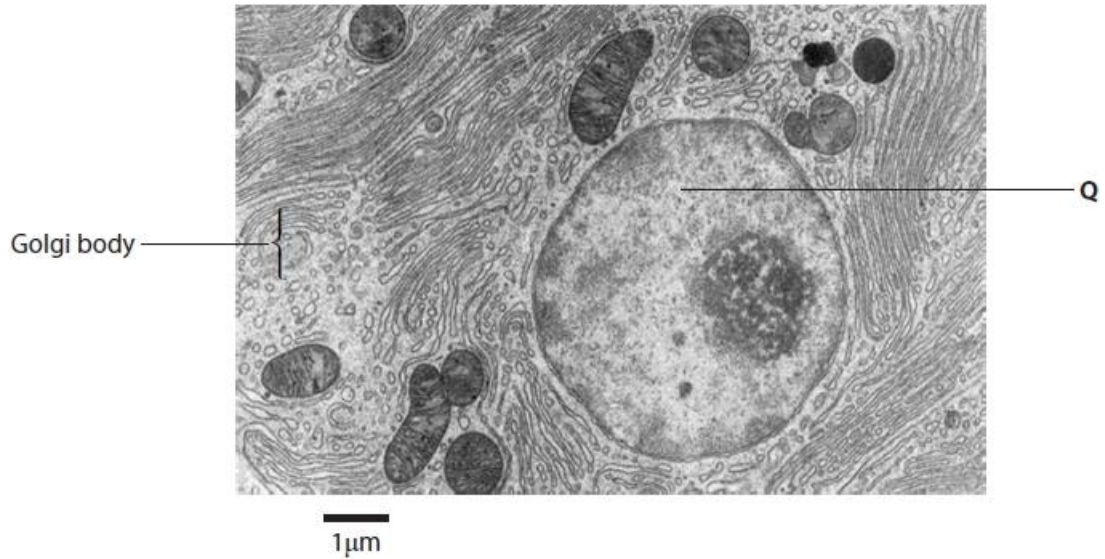
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(Total for question = 3 marks)

Q44.

The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Describe the role of the Golgi body in producing secreted enzymes.

(3)

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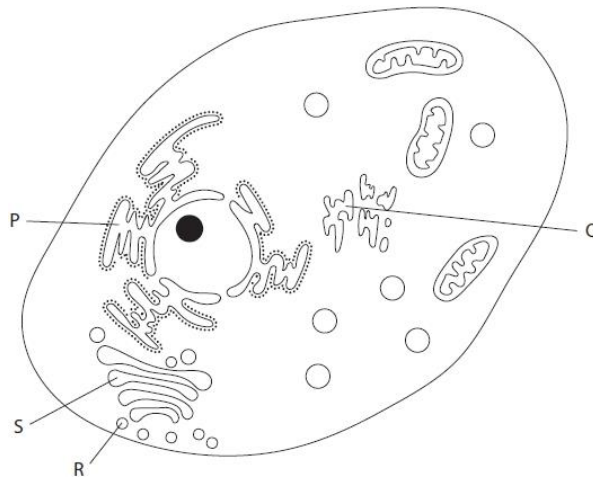
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(Total for question = 3 marks)

Q45.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

The diagram shows the structure of an animal cell.



(i) Which of the following is the name of the structure labelled Q?

(1)

- A centriole
- B nucleus
- C rough endoplasmic reticulum
- D smooth endoplasmic reticulum

(ii) These cells were cultured in radioactively-labelled amino acids.

In which sequence would the cell structures in the diagram become radioactive during protein synthesis?

(1)

- A Q S R
- B S P R
- C P R Q
- D P S R

(iii) Explain one function of lysosomes.

(2)

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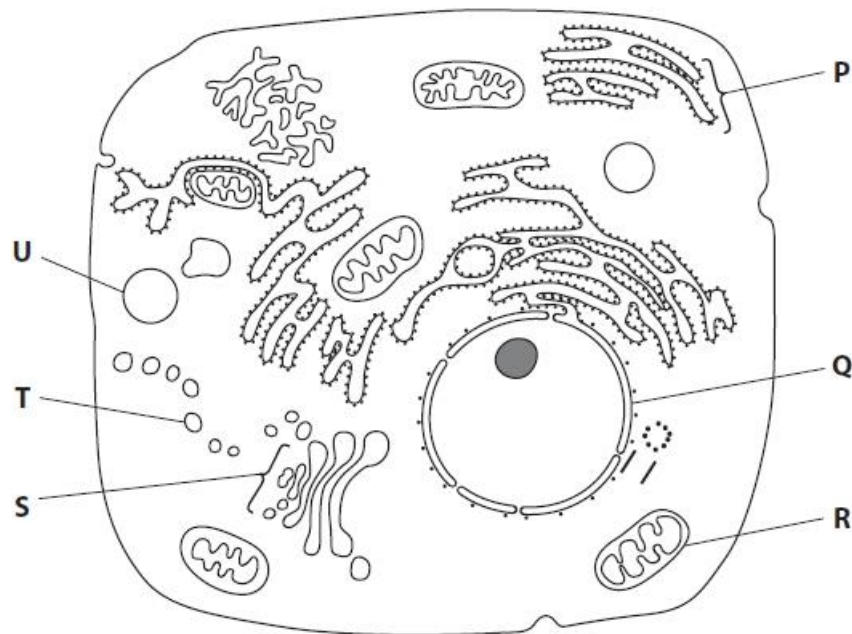
(Total for question = 4 marks)



Q46.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

The diagram shows the ultrastructure of an animal cell.



Magnification  $\times 9000$

(i) The structure labelled **R** on the diagram represents a

- A** chloroplast  
 **B** lysosome  
 **C** mitochondrion  
 **D** ribosome

(1)

(ii) The structure labelled **Q** on the diagram represents the

- A** cell surface membrane  
 **B** nuclear envelope  
 **C** rough endoplasmic reticulum  
 **D** smooth endoplasmic reticulum

(1)

(iii) Calculate the actual diameter of the structure labelled **U**.

(2)

Answer .....

(iv) Describe how the structures labelled **P**, **S** and **T** are involved in the production and secretion of molecules from this cell.

(3)

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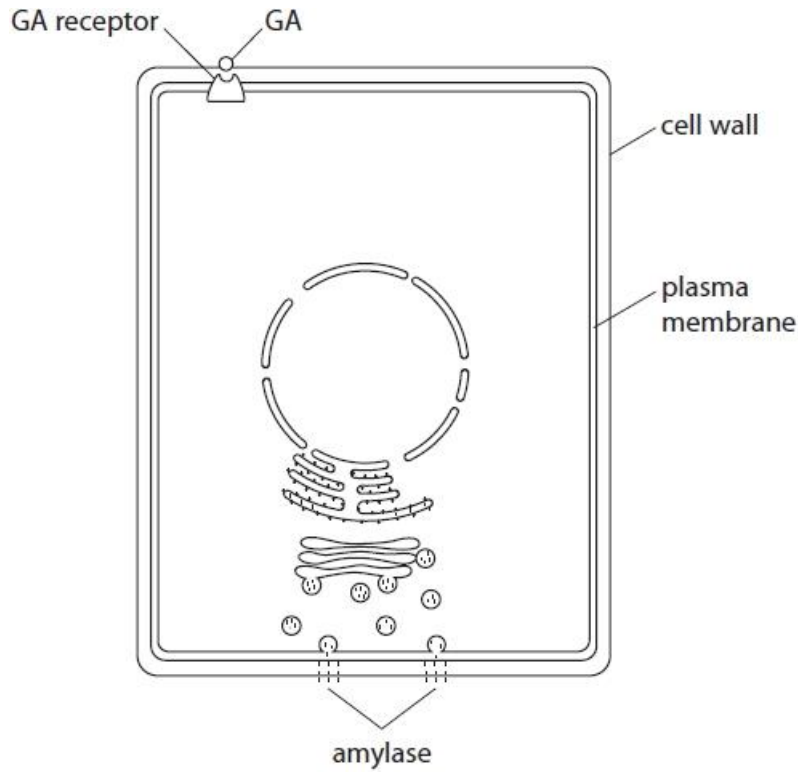
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**(Total for question = 7 marks)**

**Q47.**

Gibberellin stimulates cells in the aleurone layer of cereal grains, such as barley, to produce the enzyme amylase.

The diagram shows a cell from the aleurone layer with some of the structures involved in the production of amylase.



Gibberellin binds to a protein receptor in the cell surface membrane and this stimulates transcription in the nucleus.

(i) Describe the process of transcription in the nucleus of this cell.

(2)

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(ii) Describe the processes occurring after transcription that result in the release of amylase from the cell shown in the diagram.

(5)

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**(Total for question = 7 marks)**

**Q48.**

Cattle with bovine spongiform encephalopathy (BSE) have microscopic holes in their brain tissue.

This disease involves the misfolding of proteins which then form clumps.

Clumps of misfolded proteins can be seen with an electron microscope.

BSE is diagnosed by examination of brain tissue.

(i) Explain why the clumps of misfolded proteins can be seen with an electron microscope, but not with a light microscope.

(2)

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(ii) Explain why stains are used when preparing tissue for examination using a light microscope.

(2)

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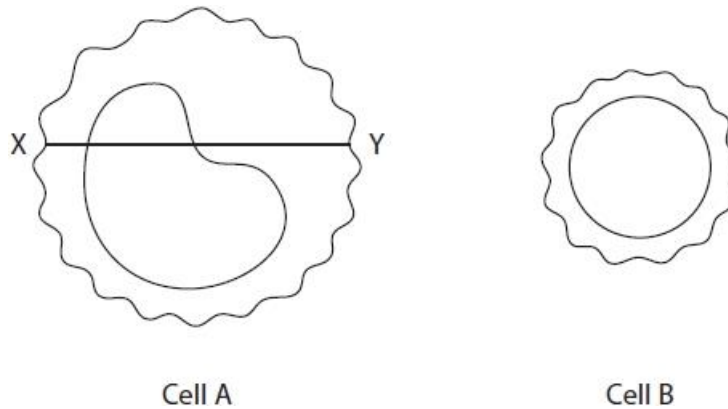
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**(Total for question = 4 marks)**

**Q49.**

A student drew two types of white blood cell, from a slide viewed using a light microscope.



The student used the internet to research the actual diameter of these two types of cell.

The student found several values for the diameters of cell A and cell B. They used the mean value for the diameter of cell B to calculate the magnification of the drawing of cell B.

The student calculated the magnification of the drawing of cell B to be  $\times 1571$ .

The student found the following values for the diameter of cell A: 0.016 mm, 0.022 mm, 0.019 mm, 0.021 mm, 0.017 mm.

Calculate the magnification of the drawing of cell A, using the mean diameter of this cell.

Measure the diameter of cell A between the points X and Y on the diagram.

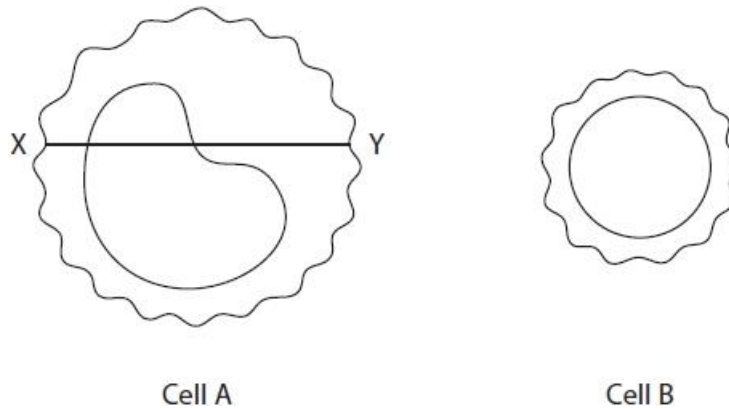
(2)

Answer .....

**(Total for question = 2 marks)**

**Q50.**

A student drew two types of white blood cell, from a slide viewed using a light microscope.



The student used the internet to research the actual diameter of these two types of cell.

The student found several values for the diameters of cell A and cell B. They used the mean value for the diameter of cell B to calculate the magnification of the drawing of cell B.

The student calculated the magnification of the drawing of cell B to be  $\times 1571$ .

The student found the following values for the diameter of cell A: 0.016 mm, 0.022 mm, 0.019 mm, 0.021 mm, 0.017 mm.

This method of calculating the magnification of these drawings is not accurate.

Describe a method that the student could use to calculate the magnification accurately.

**(3)**

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**(Total for question = 3 marks)**

**Mark Scheme**

Q1.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>length of pollen tube measured from photo (1)</li> <li>magnification calculated (1)</li> </ul>	<p>Length = 33 (mm) Accept 31 – 34 (mm) / 3.1 – 3.4 (cm)</p> <p>Magnification = <math>\frac{\text{photo size}}{\text{actual size}} = \frac{33\,000}{136}</math> = 243 / 242.7 / 242.65x</p> <p>Accept values in the range 227.9 to 250.0 x Units lose mp2</p> <p>Correct answer with no working gains 2 marks</p>	<b>Grad (2)</b>

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>the resolution of the (electron) microscope was good (to see the two membranes as separate structures)</li> </ul>	<b>DO NOT ACCEPT</b> magnification <b>IGNORE</b> in focus / refs to wavelengths / clearer	(1) EXP

Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>magnification of photograph calculated / ratio of membrane to space given (1)</li> <li>value 12 (nm) (1)</li> </ul>	<p>100 000 OR in the range of space : membrane = 1 : 1.5 to 1 : 2.5 or 0.4 : 1 to 0.67 : 1</p> <p><b>ACCEPT</b> any value between 9 and 15 to one decimal place max <b>ECF</b> for 1 mark if numerical value falls in our range and answer is given to one decimal place max but order of magnitude is wrong</p> <p>Correct answer only = 2 marks</p>	(2) EXP



Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>• solutes / named solute (1)</li> <li>• because they are less dense than 1.09 (gcm<sup>-3</sup>) (1)</li> </ul>	e.g. glucose, enzymes, ATP, amino acids, protein, lipids, vitamins, mineral ions and fragments of cell membrane  Allow oxygen / carbon dioxide if qualified  Ignore sodium chloride, sucrose, sugar and salt	(2)

Question Number	Answer	Additional Guidance	Mark
(b)	C (lysosome, Golgi apparatus)		(1)

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>• nucleus / ribosomes (1)</li> <li>• because they are {largest / most dense} (1)</li> </ul>	Reject nucleolus  Allow more dense than 1.22 or more dense than mitochondria or similar Allow contains very dense material Must be in context of an organelle not listed on the table	(2)

Question Number	Acceptable Answer	Additional Guidance	Mark
(d)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>• use smaller intervals in of (sucrose) density (1)</li> <li>• rough endoplasmic reticulum is {more dense / has ribosomes} (1)</li> </ul>	Allow use gradient between e.g. 1.15 and 1.19  Allow converse	(2)

Q4.

Question Number	Answer
*	<p>Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> <li>• data used to support trends e.g. figures quoted / calculation done</li> <li>• table 1 shows that resolution increases with an increase in numerical aperture</li> <li>• table 2 shows an increase in wavelength decreases the resolution</li> <li>• table 1 suggests an increase in magnification increases the resolution</li> <li>• comparison of objectives with the same magnification shows that increase in numerical aperture increases resolution</li> <li>• at higher magnifications shorter wavelengths of light would need to be used to achieve maximum resolution</li> </ul>

Level	Marks	
0	0	No awardable content
1	1-2	<p>Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.</p> <p>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p><b>Attempts to comment on each of the factors but fails to understand that a small value represents better resolution</b></p>
2	3-4	<p>Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.</p> <p>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.</p> <p><b>Understands that a small value means better resolution and correct comments made about two variables using quoted data.</b></p>
3	5-6	<p>Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.</p> <p>Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.</p> <p><b>Correct comments made about the interaction of the three variables on resolution.</b></p>

Q5.

Question Number	Answer	Additional Guidance	Mark
i	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>Gram positive bacteria have a thick layer of peptidoglycan in their cell wall (1)</li> <li>some antibiotics inhibit (enzymes involved in) the formation of peptidoglycan so are effective against Gram positive bacteria (1)</li> <li>some antibiotics are not able to cross the peptidoglycan layer so they are {more / only} effective against Gram negative bacteria (1)</li> </ul>	accept converse, accept reference to teichoic acid	(3)

Question Number	Answer	Additional Guidance	Mark
ii	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>because viruses are not living cells (1)</li> <li>because viruses do not have a cell wall (1)</li> </ul>	accept antibiotics usually target {cell walls / cell membranes / replication / translation / metabolism }	(2)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>benzylpenicillin</li> </ul>		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to one of the following:</p> <ul style="list-style-type: none"> <li>human cells are {eukaryotic / lack cell wall / lack peptidoglycan} (1)</li> <li>human cells have different {ribosomes / enzymes} (1)</li> </ul>	<b>ACCEPT</b> these antibiotics only affect prokaryotes	(1)

Q7.

Question Number	Answer	Mark
(i)	<p>The only correct answer is C</p> <p><i>A is not correct because cellulose is not found in a bacterial cell</i></p> <p><i>B is not correct because cellulose and nucleoli are not found in a bacterial cell</i></p> <p><i>D is not correct because nucleoli are not found in a bacterial cell</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p>The only correct answer is C</p> <p><i>A is not correct because Ebola contains RNA</i></p> <p><i>B is not correct because HIV contains RNA</i></p> <p><i>D is not correct because tobacco mosaic virus contains RNA</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>the resolution is higher / better (1)</li> <li>because wavelength of electrons is short(er) (1)</li> </ul>	<p><b>ACCEPT</b> converse</p> <p><b>ACCEPT</b> smaller wavelength</p>	(2)

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>length of scale line given in <math>\mu\text{m}</math></li> <li>magnification calculated</li> </ul>	<p><math>1.7 \times 10000</math> / 17000</p> <p><math>1.7 \times 10^3</math> / <math>0.0017 \times 10^6</math></p>	

Question Number	Answer	Additional Guidance	Mark
(ii)	width of GM aperture divided by width of non-modified aperture	In the range of 1.3 to {4 / 4.0} to no more than 1 decimal place DO NOT ACCEPT with units or %	

Q9.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>correct calculation of magnification (<math>\times 10\,000</math>)</li> <li>correct calculation of diameter (1)</li> </ul>	<p>Example of calculation:</p> <p>magnification: <math>10\,000\ \mu\text{m} \div 1\ \mu\text{m} = \times 10\,000</math></p> <p>diameter: <math>54\ \text{mm} \div 10\,000 = 5.4\ \mu\text{m}</math></p> <p><b>Accept</b> range between <math>5.3\ \mu\text{m}</math> to <math>5.5\ \mu\text{m}</math></p> <p>Correct answer with units gains full marks</p>	(2)

Q10.

Question Number	Answer	Mark
	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"><li>• pollen grains put in {water / sugar / sucrose / mineral ions / glycerol} solution (1)</li><li>• use of a (microscope) slide / cavity slide / use a coverslip (1)</li><li>• use low power lens first / use increasing magnification (1)</li></ul>	(3)

Q11.

Question Number	Answer	Additional Guidance	Mark
	9 / 90		(1)

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to three of the following:</p> <p><b>Similarity</b></p> <ul style="list-style-type: none"> <li>both have peptidoglycan (1)</li> </ul> <p><b>Two differences from:</b></p> <ul style="list-style-type: none"> <li>positive has {more / thicker layer of} peptidoglycan than negative / positive has a thicker cell wall than negative (1)</li> <li>positive has teichoic acid, negative does not (1)</li> <li>negative has outer membrane, positive does not (1)</li> <li>negative (most) has periplasmic space, positive does not (1)</li> <li>negative has {more lipid / lipopolysaccharide / porin proteins}, positive does not (1)</li> </ul>	Accept periplasm	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>subtraction using values from graph (1)</li> <li>calculation of percentage change (1)</li> </ul>	$10^8 - 10^2 = 99\,999\,900$ $\div 10^8 \times 100 = \mathbf{99.9999}$ Correct answer gains full marks, with no working shown.	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>it is effective if irradiation longer than 3 hours (1)</li> <li>it is effective against E. coli which infect the intestine (1)</li> <li>not all species of {pathogenic bacteria / bacteria causing food poisoning} investigated / only three types of bacteria investigated (1)</li> <li>toxins may remain in food (1)</li> </ul>	Accept effectiveness depends on how long it is irradiated for	(4)

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>• maximum width × magnification (1)</li> <li>• correct gap width with appropriate units (1)</li> </ul>	$20 \times 10^{-3} \times 12\,000 = 240$ $= 0.24 \text{ mm} / 240 \mu\text{m} / 240\,000 \text{ nm} / 24 \times 10^4 \text{ nm}$ <b>Accept</b> correct minimum gap width with appropriate units for 1 mark	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• because the resolution of the microscope is {not high enough / is too low} (1)</li> <li>• as the membranes are too close together to be distinguished as separate structures (1)</li> </ul>	<p><b>Do not accept</b> magnification</p> <p><b>Accept</b> as separate lines <b>Do not accept</b> magnification</p>	(2)

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>• <i>Salmonella</i> (species) (1)</li> </ul>	<p>Candidates may name other types of bacteria, each of which will need looking up</p> <p><b>ACCEPT</b> phonetic spellings  <b>ACCEPT</b> <i>Shigella, Neisseria, Escherichia, Pseudomonas, Klebsiella, Proteus, Providencia, Escherichia, Morganella, Aeromonas, Citrobacter</i>  <b>ACCEPT</b> specific examples e.g. <i>E.coli</i>  <b>IGNORE</b> pathogens  <b>DO NOT ACCEPT</b> gram positive bacteria e.g. <i>Actinomyces, Clostridium, Mycobacterium, Streptococci, Staphylococci, Nocardia</i></p>	(1) EXP



Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>gram negative bacteria have {a thinner peptidoglycan cell wall / an (outer) lipopolysaccharide (layer) / an outer membrane } (1)</li> </ul>	<p><b>ACCEPT converse for gram positive bacteria</b></p> <p><b>ACCEPT</b> less peptidoglycan murein for peptidoglycan larger periplasm (space) no teichoic acid (in cell wall)</p>	(1) GRAD

Q15.

Question Number	Answer	Mark
	D	(1) comp

Q16.

Question Number	Answer	Mark
	A	(1) comp

Q17.

Question Number	Answer				Mark
					(2) clerical
	Organelle	Organelle found in			
		both prokaryotic cells and animal cells	prokaryotic cells only	animal cells only	
	P	X			
	Q			X	

Q18.

Question Number	Answer	Mark
	C	(1) comp

Q19.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: <ul style="list-style-type: none"> <li>so that some organelles are clearly visible (1)</li> </ul>	<b>Accept</b> converse  Allow named organelles	(1)

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>Gram positive bacteria have more peptidoglycan than Gram negative bacteria (1)</li> <li>Gram positive stains {purple / blue} (with Gram stain), but Gram negative do not stain {purple / blue} (with Gram stain) (1)</li> <li>Gram positive contains {teichoic acid / lots of murein} but Gram negative do not (1)</li> <li>Gram positive have no {periplasmic space /outer membrane} but Gram negative do (1)</li> </ul>	<p>Allow Gram positive have a thicker cell wall than Gram negative</p> <p>Allow Gram positive stains {purple / blue} (with Gram stain), but Gram negative stain red (with Gram stain)</p> <p>Allow Gram positive have low {lipid / phospholipid} content but Gram negative have high {lipid / phospholipid} content</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>conversion of micrometres to mm (1)</li> <li>calculation of speed (1)</li> </ul>	<p>Example calculation</p> <p><math>1\mu\text{m} = 0.001\text{ mm}</math></p> <p><math>0.001 \times 100 = 0.1\text{ (mm s}^{-1}\text{)}</math></p> <p>Correct answer with no working gains full marks</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>BvB can kill gram negative bacteria (1)</li> <li>without side effects for humans (1)</li> <li>therefore could be useful when treating resistant bacterial infections (1)</li> </ul>	<p>Allow bacteria cannot become resistant to BvB</p>	(2)

Q21.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>{fewer / smaller} cristae / less folding of the inner membrane / reduced surface area of inner membrane</li> </ul>		(1)
(ii)	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>(fewer cristae / lower surface area) therefore reduced electrontransport chain (1)</li> <li>because ribosomes prevented from synthesising {enzymes / ATPase / electron transport molecules} (1)</li> <li>credit reason linked to protein not made (1)</li> </ul>	<p>e.g. no enzymes to catalyse steps in Krebs cycle, noATPase channels for {protons to pass through / phosphorylation of ADP}, no ETC so no redox reactions</p> <p><b>ACCEPT</b> less intermembrane space foraccumulation of protons = 1 mark</p>	(2)
(iii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>no ATP will be produced (if both inhibited / glycolysis inhibited) (1)</li> <li>therefore no {energy / ATP} for metabolic process / named metabolic processes / cell division} (1)</li> </ul>		(2)

Q22.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <p><b>Similarities</b></p> <ul style="list-style-type: none"> <li>• cytoplasm (1)</li> <li>• cell membrane (1)</li> <li>• ribosomes (1)</li> </ul> <p><b>Differences</b></p> <ul style="list-style-type: none"> <li>• eukaryotic cells contain {Membrane-bound organelles / named example e.g. mitochondria }, prokaryotic cells do not (1)</li> <li>• eukaryotic cells have 80S ribosomes, prokaryotic cells have 70S ribosomes (1)</li> <li>• eukaryotic cells have {a nucleus / nuclear envelope }, prokaryotic cells {have a nucleoid / do not have a nucleus} (1)</li> <li>• some eukaryotic cells have a cellulose cell wall and prokaryotic cells have a {murein / peptidoglycan} cell wall (1)</li> </ul>	<p>Max of 3 marks if only differences given</p> <p><b>ACCEPT</b> eukaryotic cells have larger ribosomes</p> <p><b>ACCEPT</b> as comparison: prokaryotes have free-floating genetic material (in the cytoplasm)</p>	(4)

Q23.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• large numbers of mitochondria (1)</li> <li>• to provide ATP for active uptake of {glucose / salts / amino acids} (1)</li> <li>• microvilli providing large surface area (1)</li> <li>• for many carrier proteins for {glucose / salts / amino acids} (1)</li> </ul>	<b>Accept</b> correct named minerals	<b>4</b>

Q24.

Question Number	Answer	Additional Guidance	Mark
(i)	B matrix	<p>A is incorrect because crista are folds in the membrane</p> <p>C is incorrect because stroma is in chloroplasts D is incorrect because thylakoids are in chloroplasts</p>	

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• because the resolution of the microscope used for P is {lower / worse} (1)</li> <li>• to distinguish {the small distance between the two membranes / the membranes as separate structures} (1)</li> </ul>	<p>ACCEPT converse for Q throughout</p> <p>DO NOT ACCEPT magnification</p> <p>ACCEPT (inter membrane) space can be seen between membranes / the inner and outer membrane can be seen / two lines can be seen</p>	

Q25.

Question Number	Answer	Additional Guidance	Mark
	conversion of mm into $\mu\text{m}$ conversion of $\mu\text{m}$ into mm conversion of $\mu\text{m}$ into cm (1)  divide image size by actual size (1)	Correct answer gains full marks, with no working shown  $27 \text{ mm} = 27\,000 \mu\text{m} / 20 \div 1000 = 0.02 \text{ mm} / 20 \div 10\,000 = 0.002 \text{ cm}$  $27\,000 \div 20 = (\times)$ $1350 / 13.5 \times 10^2 / 1.35 \times 10^3$	<b>(2)</b>

Q26.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: <ul style="list-style-type: none"> <li>• locate specimen by using {low power / medium power} objective lens (1)</li> <li>• (focus) using {low power / medium power} objective lens before the high power objective lens (1)</li> <li>• only use fine focus with high power lens (1)</li> </ul>		<b>(3)</b>

Q27.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>A drawing that includes the following:</p> <ul style="list-style-type: none"> <li>only cell K drawn (1)</li> <li>the shape of the cell and its nuclei are representative of those in the photograph (1)</li> <li>there is no sketching or other structures shown (1)</li> <li>drawn cell is twice the size of cell in the photograph (1)</li> </ul>		(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>measure the length of the blood cells using an {eye piece / stage } micrometer (1)</li> <li>divide the length by the magnification of the objective / calibrate the graticule using a stage micrometer (1)</li> <li>more than one measurement taken (1)</li> <li>divide this value into the length of the blood cells in the drawing (1)</li> </ul>	<p><b>ACCEPT</b> use an eyepiece graticule</p> <p>E.g. repeats, length and breadth</p>	(4)



Q28.

Question Number	Answer	Additional Guidance	Mark
	<p>A drawing that shows the following:</p> <p>Drawing marks :</p> <ul style="list-style-type: none"> <li>• 2 membranes drawn (1)</li> <li>• (continuous) inner membrane (of two) folded (1)</li> </ul> <p>Label marks :</p> <p>Any <b>two</b> from</p> <ul style="list-style-type: none"> <li>• {inner membrane / crista} and outer membrane (1)</li> <li>• inter-membrane space (1)</li> <li>• matrix (1)</li> <li>• ribosome (1)</li> </ul>		<b>(4)</b>

Q29.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• a tissue is (a group of) similar cells (1)</li> <li>• an organ is tissues working together to perform {one / several} functions (1)</li> </ul>		<b>(2)</b> EXP

Q30.

Question Number	Answer	Additional Guidance	Mark
	Q: nucleus	Do not accept nucleolus	(1)

Q31.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>• multiplication (1)</li> <li>• division (1)</li> </ul>	$3.142 \times 0.2^2 / 3.142 \times 0.04 =$ $0.126 / 0.1257 /$ $0.12568$  $18 \div 0.126 = 143$  Allow one mark if answer is 142.857 / 143.198 / 143.220  Correct answer gains full marks, with no working shown	(2)

Q32.

Question Number	Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because Q (chloroplast), R (mitochondria) and T (nucleus) all have DNA</i></p> <p><i>B is not correct because Q (chloroplast), R (mitochondria) and T (nucleus) all have DNA</i></p> <p><i>D is not correct because because only Q (chloroplast), R (mitochondria) and T (nucleus) have DNA. P is a ribosome, S is the Golgi and each of the organelles containing DNA each has a double membrane</i></p>	(1)

Q33.

Question Number	Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because Q describes a chloroplast which is not found in an animal cell</i></p> <p><i>B is not correct because chloroplasts are not found in animal cells, but they are found in plant cells, animal cells would also contain mitochondria (R)</i></p> <p><i>D is not correct because chloroplasts are not found in animal cells, plant cells would also contain mitochondria (R)</i></p>	(1)

Q34.

Question Number	Answer	Mark
	<p>The only correct answer is A</p> <p><i>B is not correct because 6 <math>\mu\text{m}</math> is 6000 nm which is bigger than 2500nm</i></p> <p><i>C is not correct because <math>10^{-9}</math> m is a nanometer so the smallest not the largest organelle</i></p> <p><i>D is not correct because they are listed from largest to smallest in this sequence</i></p>	(1)

Q35.

Question Number	Answer	Additional Guidance	Mark
i	C rough endoplasmic reticulum		(1)

Question Number	Answer	Additional Guidance	Mark
ii	B X		(1)

Question Number	Answer	Additional Guidance	Mark
iii	working shown (1) (1)	correct answer	(2)

Question Number	Answer	Additional Guidance	Mark
iv	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>organelle Z produces ATP (1)</li> <li>which supplies the energy for the synthesis of proteins (1)</li> <li>which supplies energy for {modification / transport / secretion} of proteins (1)</li> </ul>	accept enzymes / hormones  accept active transport / exocytosis	(3)

Q36.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: <ul style="list-style-type: none"> <li>light has a longer wavelength than electrons (1)</li> <li>therefore a light microscope has a lower resolution (than the electron microscope) (1)</li> </ul>		(2)

Q37.

Question Number	Answer	Additional Guidance	Mark
(i)	C 2  <i>A is incorrect as the nucleus and mitochondria have double membranes</i> <i>B is incorrect as the nucleus and mitochondria have double membranes</i> <i>D is incorrect as only the nucleus and mitochondria have double membranes</i>		1

Question Number	Answer	Additional Guidance	Mark
(ii)	A 1 only  <i>B is incorrect because voltage gated channels will not open when light affects rod cells</i> <i>C is incorrect because less neurotransmitter is released when light affects rod cells</i> <i>D is incorrect because less neurotransmitter is released when light affects rod cells</i>		<b>1</b>

Q38.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following:  <ul style="list-style-type: none"> <li>• release energy / make ATP (1)</li> <li>• for {ion pump / Na<sup>+</sup> - K<sup>+</sup> pump / active transport of ions / regeneration of rhodopsin / combine opsin and retinal /convert trans retinal into cis retinal} (1)</li> </ul>	<b>DO NOT ACCEPT</b> active transport alone	<b>(2)</b>

Q39.

Question Number	Answer	Mark
	<b>The only correct answer is C</b>  <i>A is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall</i>  <i>B is not correct because Salmonella are gram negative bacteria so will have a thin peptidoglycan cell wall and they produces endotoxins</i>  <i>D is not correct because Salmonella produces endotoxins</i>	<b>(1)</b>

Q40.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>would not have membrane bound organelles</li> </ul>	ACCEPT would not have named organelle e.g nucleus / nuclear envelope / mitochondria / Golgi apparatus / RER  ACCEPT could have smaller ribosomes / cell wall / nucleoid / plasmid	(1)

Q41.

Question Number	Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because this describes Endoplasmic reticulum which is involved in protein synthesis not modification</i></p> <p><i>B is not correct because this describes centrioles</i></p> <p><i>D is not correct because this describes a ribosome which is involved in synthesis (not modification) and is much smaller</i></p>	(1)

Q42.

Question Number	Answer	Mark
	<p>The only correct answer is C</p> <p><i>A is not correct because there are no plasmids in an animal cell</i></p> <p><i>B is not correct because Prokaryotes do not have a nucleolus</i></p> <p><i>D is not correct because Prokaryotes do have ribosomes and plasmids</i></p>	(1)

Q43.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li>• liver has smaller percentage of cell membrane as there are more organelles inside it (1)</li> <li>• liver has less RER (membrane) because it is {making / transporting} less protein OR liver has more SER (membrane) as it is {making / transporting} more lipid (1) OR liver has more RER (membrane) as it makes steroids and pancreas has more SER (membrane) as it makes insulin</li> <li>• liver has more mitochondria (membrane) as it is more metabolically active (1)</li> <li>• liver has less Golgi as it is {modifying / secreting} fewer proteins OR pancreas {may have more / has} secretory granules for exocytosis of proteins (1)</li> </ul>	<p><b>ACCEPT</b> converse throughout for pancreas correctly named proteins throughout e.g. pancreas - insulin</p> <p><b>ACCEPT</b> because of liver's role in producing lipids and pancreas' role in producing proteins</p> <p><b>ACCEPT</b> stores lipid steroids / cholesterol metabolism of toxins</p> <p><b>ACCEPT</b> requires more energy / more (aerobic) respiration</p>	(3) EXP

Q44.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li>• vesicles containing protein from rER {move to / fuse with} Golgi (1)</li> <li>• proteins {modified / glycosylated / carbohydrates / lipids attached} (1)</li> <li>• proteins leave (Golgi) in vesicles (1)</li> <li>• vesicles fuse with cell membrane (1)</li> </ul>	<p><b>Accept</b> quaternary structure formed / conjugated protein formed</p> <p><b>Accept</b> package into vesicles</p>	(3)

Q45.

Question Number	Answer	Additional Guidance	Mark
(i)	The only correct answer is: <b>D</b> smooth endoplasmic reticulum  <i>A is incorrect as centriole has microtubules</i> <i>B is incorrect as a nucleus has a nucleolus</i> <i>C is incorrect as there are no ribosomes</i>		<b>1</b> <b>comp</b>

Question Number	Answer	Additional Guidance	Mark
(ii)	The only correct answer is: <b>D P S R</b>  <i>A is incorrect because the SER is not involved in protein synthesis</i> <i>B is incorrect because Golgi should be after the RER</i> <i>C is incorrect because the SER is not involved in protein synthesis</i>		<b>1</b> <b>comp</b>

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following:  <ul style="list-style-type: none"> <li>(because lysosomes)</li> </ul> contain enzymes (1) and <b>one</b>  from  <ul style="list-style-type: none"> <li>to {digest / hydrolyses} {pathogens / bacteria / viruses / proteins / antigens} (1)</li> <li>to digest (old) organelles (1)</li> <li>for apoptosis / autolysis of cells (1)</li> </ul>	<b>Accept</b> correct named hydrolytic enzyme, e.g. protease / lysozyme  <b>Accept</b> other correct biological molecules  <b>Accept</b> breakdown pathogens / bacteria / viruses / proteins / antigens <b>with</b> hydrolytic / digestive enzymes for <b>2 marks</b>  <b>Accept</b> self-digest (damaged) cell	<b>2 exp</b>



Q46.

Question Number	Answer	Mark
(i)	<p><b>The only correct answer is C</b></p> <p><i>A is not correct because there are no chloroplasts in an animal cell</i></p> <p><i>B is not correct because lysosomes do not have a folded inner membrane</i></p> <p><i>D is not correct because ribosomes are much smaller and do not have a membrane</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p><b>The only correct answer is B</b></p> <p><i>A is not correct because it is not at the cell surface</i></p> <p><i>C is not correct because the rough endoplasmic reticulum is irregular in shape and is labelled P in the diagram</i></p> <p><i>D is not correct because the structure has ribosomes on the surface</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>A calculation that shows:</p> <ul style="list-style-type: none"> <li>• image size measured correctly (1)</li> <li>• image size / 9000 with suitable units (1)</li> </ul>	<p><u>Example of calculation</u></p> <p>8mm</p> <p><math>8/9000 = 0.00089\text{mm} // 0.0009\text{mm} / 0.89\mu\text{m} / 0.9\mu\text{m} / 889\text{nm} / 8.9 \times 10^{-7}</math></p> <p>Allow ECF from image size +/- 1mm for one mark correct answer gets both marks</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(iv)	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• P is (rough endoplasmic reticulum) where {translation / protein synthesis} takes place (1)</li> <li>• S is (Golgi apparatus) where protein is {packaged / sorted / quaternary structure produced} (1)</li> <li>• T are (vesicles) in which {proteins / enzymes} are transported to the cell membrane (1)</li> </ul>	<p><b>Allow exocytosis</b></p>	(3)

Q47.

Question Number	Answer	Additional guidance	Mark
(i)	<p>A description that makes reference to two the following:</p> <ul style="list-style-type: none"> <li>• DNA strands separate (1)</li> <li>• antisense strand used as template (for mRNA) (1)</li> <li>• RNA polymerase synthesises mRNA (1)</li> </ul>		(2)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>A description that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>• mRNA leaves through nuclear pores (1)</li> <li>• {translation occurs at / mRNA travels to} ribosomes / rough endoplasmic reticulum (1)</li> <li>• codons (on mRNA) pair with anticodons on tRNA / tRNA brings amino acid (to the ribosome) (1)</li> <li>• peptide bonds form between amino acids (1)</li> <li>• amylase enters Golgi and is {modified / processed} / amylase {is packaged into vesicles / travels in vesicles} (1)</li> <li>• exocytosis releases {amylase / protein} (1)</li> </ul>	<p>Accept protein for amylase</p> <p>Accept description for exocytosis</p>	(5)

Q48.

Question Number	Answer	Additional Guidance	Mark
i	An explanation that makes reference to two of the following: <ul style="list-style-type: none"> <li>• a light microscope has limited (useful) magnification (1)</li> <li>• because a light microscope has limited resolution (1)</li> <li>• because the wavelength of visible light is more than a beam of electrons (1)</li> </ul>	accept converse for electron microscope	(2)

Question Number	Answer	Additional Guidance	Mark
ii	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>• provides greater contrast (1)</li> <li>• because the stain {attaches to / is taken up by} specific {parts / types of} cell (1)</li> </ul>		(2)

Q49.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> <li>• diameter measured and mean value calculated (1)</li> <li>• 2 000 / 2 300 / 2 320 / 2 316 (1)</li> </ul>	Example of calculation:  $44 \text{ (mm)} / 4.4 \text{ (cm)} \text{ and } 0.019 \text{ (mm)}$  Ecf if either 44 (mm) or 0.019 used and answer rounded up to whole number correctly e.g. (45 and 0.019 =) 2 368  Correct answer with no working gets 2 marks	(2) EXP

Q50.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"><li>• use an (eye piece) graticule to measure the diameter (1)</li><li>• take several measurements and calculate the mean (for each cell) (1)</li><li>• calibrate the (eye piece) graticule (1)</li><li>• using a stage micrometer (1)</li></ul>	<p><b>ACCEPT</b> length / size</p> <p><b>ACCEPT</b> a description of how this is done</p>	<p>(3) EXP</p>