AQA A-LEVEL · 7402

BIOLOGY



EXAM QUESTION PACK

3.2.1 CELL STRUCTURE

SCORE	PERCENTAGE
/557	%

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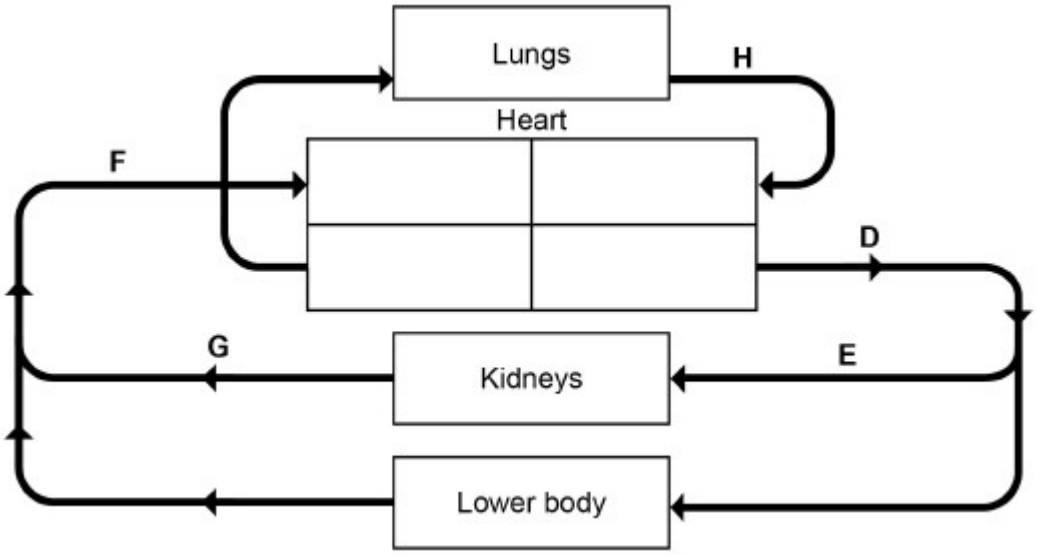
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Q1.

(a) **Figure 1** shows part of the blood circulation in a mammal.

Figure 1



Use **Figure 1** to give the letter that represents each of these blood vessels.

Aorta ☐

Renal vein ☐

Vena cava ☐

(3)

(b) Name the blood vessels that carry blood to the heart **muscle**.

_____

(1)

(c) **Figure 2** shows a photograph of part of a mitochondrion from a mouse liver cell taken using a transmission electron microscope at × 62 800 magnification.

Figure 2



Produce a scientific drawing of the mitochondrion in **Figure 2** in the box below.

Label the following parts of the mitochondrion on your drawing.

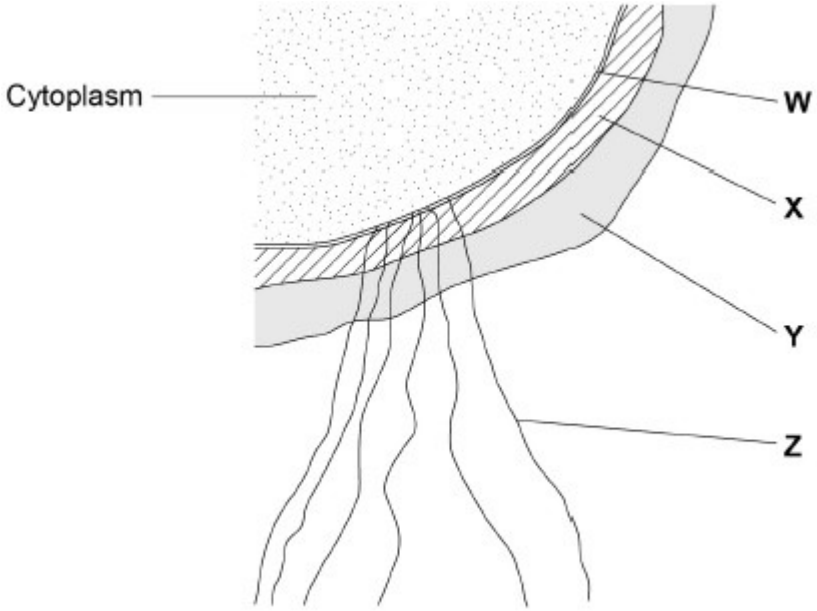
- Matrix
- Crista

(4)

(Total 8 marks)

Q2.

The diagram shows part of a prokaryotic cell.



(a) Name the structures labelled **W** to **Z** in the diagram.

W _____

X _____

Y _____

Z _____

(2)

(b) Name the main biological molecule in:

W _____

X _____

(2)

(c) Name the process by which prokaryotic cells divide.

_____

(1)

(d) Some prokaryotic cells can divide every 30 minutes. A liquid culture contained a starting population of 1.35×10^4 cells.

Assuming each cell divides every 30 minutes, calculate how many cells there will be after 3 hours. Assume no cells die during this time.

Answer = _____

(2)

(Total 7 marks)

Q3.

(a) Structures **A** to **E** are parts of a plant cell.

A Cell Wall
B Chloroplast
C Nucleus
D Mitochondrion
E Golgi apparatus

Complete the table by putting the correct letter, **A**, **B**, **C**, **D** or **E** in the box next to each statement.

Statement	**Letter**
Has stacked membranes arranged in parallel and contains DNA.	
Is made of polysaccharide.	
Is an organelle and is **not** surrounded by two membranes.	

(3)

(b) Human breast milk is produced and secreted by gland cells. These gland cells have adaptations that include many mitochondria and many Golgi vesicles. The milk contains a high concentration of protein.

Explain the role of these cell adaptations in the production and secretion of breast milk.

_____

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(2)

(Total 5 marks)

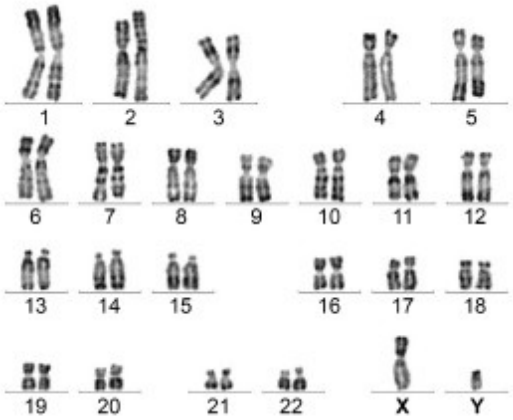
Q4.

Figure 1 shows all the chromosomes present in one human cell during mitosis. A scientist stained and photographed the chromosomes. In **Figure 2**, the scientist has arranged the images of these chromosomes in homologous pairs.

Figure 1



Figure 2



(a) Give **two** pieces of evidence from **Figure 1** that this cell was undergoing mitosis. Explain your answers.

1. _____

_____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

_____

(2)

(b) Tick (✓) **one** box that gives the name of the stage of mitosis shown in **Figure 1**.

A Anaphase ☐

B Interphase ☐

C Prophase ☐

D Telophase ☐

(1)

(c) When preparing the cells for observation the scientist placed them in a solution that had a slightly higher (less negative) water potential than the cytoplasm. This did not cause the cells to burst but moved the chromosomes further apart in order to reduce the overlapping of the chromosomes when observed with an optical microscope.

Suggest how this procedure moved the chromosomes apart.

(2)

(d) The dark stain used on the chromosomes binds more to some areas of the chromosomes than others, giving the chromosomes a striped appearance.

Suggest **one** way the structure of the chromosome could differ along its length to result in the stain binding more in some areas.

(1)

(e) In **Figure 2** the chromosomes are arranged in homologous pairs.
What is a homologous pair of chromosomes?

_____

_____

_____

(1)

(f) Give **two** ways in which the arrangement of prokaryotic DNA is different from the arrangement of the human DNA in **Figure 1**.

1. _____

_____

_____

_____

2. _____

_____

_____

_____

(2)

(Total 9 marks)

Q5.

(a) Describe the gross structure of the human gas exchange system and how we breathe in and out.

_____

_____

_____

_____

_____

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_____

(6)

(b) Mucus produced by epithelial cells in the human gas exchange system contains triglycerides and phospholipids.

Compare and contrast the structure **and** properties of triglycerides and phospholipids.

(5)

(c) Mucus also contains glycoproteins. One of these glycoproteins is a polypeptide with the sugar, lactose, attached.

Describe how lactose is formed and where in the cell it would be attached to a polypeptide to form a glycoprotein.

(4)

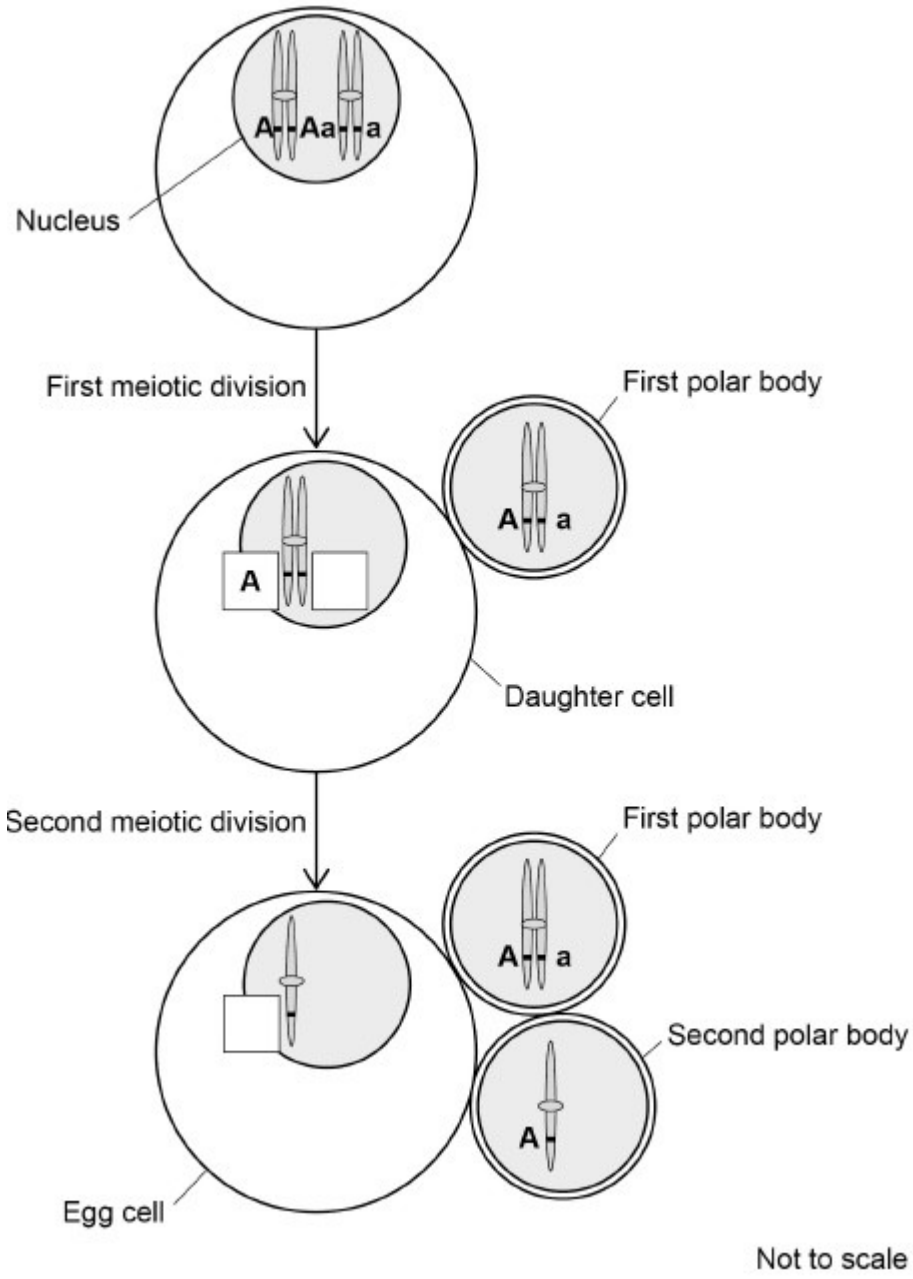
(Total 15 marks)

Q6.

In women, the first division of meiosis produces one daughter cell that has almost all of the cytoplasm. The other daughter cell consists of a nucleus surrounded by a very small amount of cytoplasm and a cell-surface membrane. This very small daughter cell is called a polar body. Polar bodies do not usually divide. The same process occurs in the second

division of meiosis, resulting in one egg cell and two polar bodies.

The diagram shows the formation of an egg cell and two polar bodies during meiosis. It also shows what happens to one pair of homologous chromosomes. This pair carries two alleles of gene A.



(a) Complete the diagram by putting **A** or **a** in the boxes. One box has been completed for you with **A**.

(1)

(b) Put a tick (✓) in the box next to the name of the process that produced the combination of alleles on the chromosome in the first polar body in the diagram.

Anaphase ☐

Crossing over ☐

Independent assortment ☐

Semi-conservative replication ☐

(1)

(c) A scientist measured the diameter of a polar body and the diameter of the nucleus inside it. The diameter of the polar body was 10.4 μm and the diameter of the nucleus was 7.0 μm. The density of mitochondria in the cytoplasm of the polar body (outside of the nucleus) was 0.08 mitochondria per μm^3.

Calculate the number of mitochondria in the polar body. You should assume polar bodies and nuclei are spherical.

The formula for the volume of a sphere is $\frac{4}{3}\pi r^3$ where $\pi = 3.14$

Show your working.

Number of mitochondria =_____

(2)

(d) Mitochondrial diseases are caused by faulty mitochondria. All of a person's mitochondria are inherited from their mother via the egg cell. An egg cell contains approximately 3×10^5 mitochondria.

One proposed treatment to prevent passing on faulty mitochondria involves

- removing the nucleus from an egg cell donated by a woman with healthy mitochondria
- replacing this nucleus with the contents of the polar body from a woman whose egg cells are affected by mitochondrial disease.

Suggest how this treatment prevents inheritance of mitochondrial diseases.

_____

_____

_____

_____

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_____

_____

_____

(2)

(e) If most of the mitochondria in a cell are faulty, this prevents many important enzyme-catalysed reactions taking place or slows them down.

Suggest and explain **one** reason why.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

Q7.

Scientists investigated the role of a protein called CENP-W in mitosis. Their method involved cell fractionation and ultracentrifugation.

(a) The scientists began by lysing (breaking open) cells and organelles using a detergent that dissolves lipids in water.

Suggest how the detergent releases CENP-W from cells.

_____

_____

_____

_____

_____

(2)

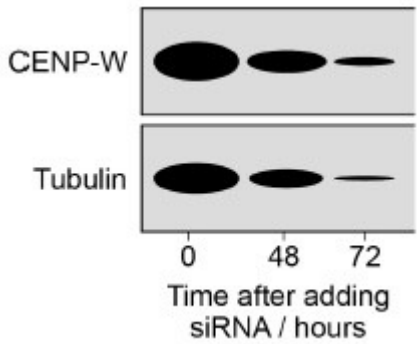
(b) Explain how ultracentrifugation separates CENP-W from other molecules.

(2)

(c) CENP-W is involved in the formation of spindle fibres in mitosis. Spindle fibres are made of molecules of a protein called tubulin.

The scientists treated cells in a culture with small interfering RNA (siRNA). This siRNA causes RNA interference of expression of the *CENP-W* gene. The scientists took samples of cells at 0, 48 and 72 hours after adding the siRNA. They then used gel electrophoresis to separate CENP-W and tubulin from these samples.

The diagram shows the results of the electrophoresis. The size of each band is proportional to the amount of CENP-W or tubulin present.



Suggest how the siRNA produced these results.

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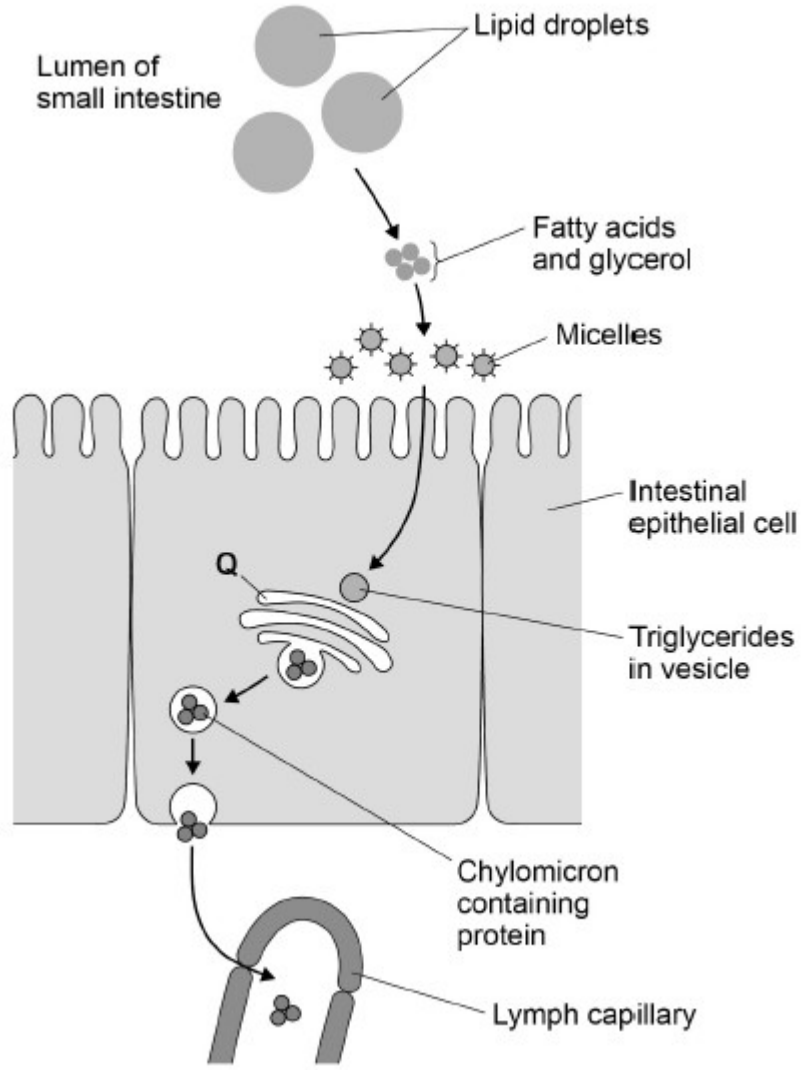
_____

(3)

(Total 7 marks)

Q8.

The diagram outlines the digestion and absorption of lipids.



(a) Tick (✔) the box by the name of the process by which fatty acids and glycerol enter the intestinal epithelial cell.

Active transport	☐
Diffusion	☐
Endocytosis	☐
Osmosis	☐

(1)

(b) Explain the advantages of lipid droplet and micelle formation.

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Name structure **Q** in the diagram above and suggest how it is involved in the absorption of lipids.

Name _____

How it is involved _____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q9.

(a) Describe how you would use cell fractionation techniques to obtain a sample of chloroplasts from leaf tissue. Do **not** include in your answer information about any solutions.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) The table shows features of a mitochondrion and a chloroplast. Complete the table with ticks where a feature is present.

Feature	Mitochondrion	Chloroplast
Double outer membrane		
Starch grains		
Diffusion of oxygen into the organelle		

(3)

(c) Give the function of a mitochondrion.

_____

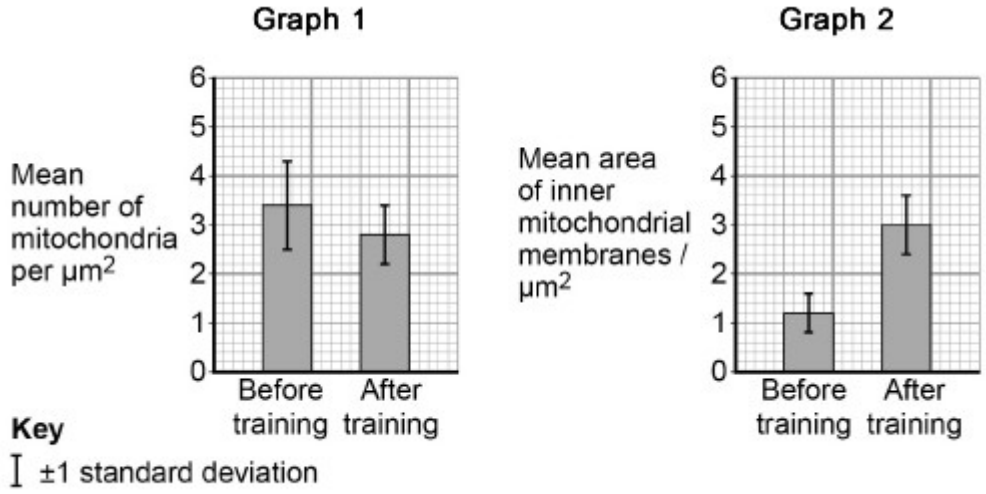
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(1)

(d) Scientists investigated the effect of an exercise programme on the number and size of mitochondria in skeletal muscle. They took samples of muscle from a large number of volunteers before and after the exercise programme. From each sample, they cut thin sections and used these to determine the mean number of mitochondria per μm^2 and the mean area of inner mitochondrial membranes.

Their results are shown in **Graph 1** and **Graph 2**.



What do the data in **Graph 1** and **Graph 2** suggest about the effect of the exercise programme on mitochondria?

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

Q10.

(a) Glycogen and cellulose are both carbohydrates.
Describe **two** differences between the structure of a cellulose molecule and a glycogen molecule.

1. _____

_____

_____

2. _____

_____

_____

(2)

(b) Starch is a carbohydrate often stored in plant cells.
Describe and explain **two** features of starch that make it a good storage molecule.

1. _____

_____

_____

2. _____

_____

_____

(2)

(c) Tick (✔) the box that identifies the test which would be used to show the presence of starch.

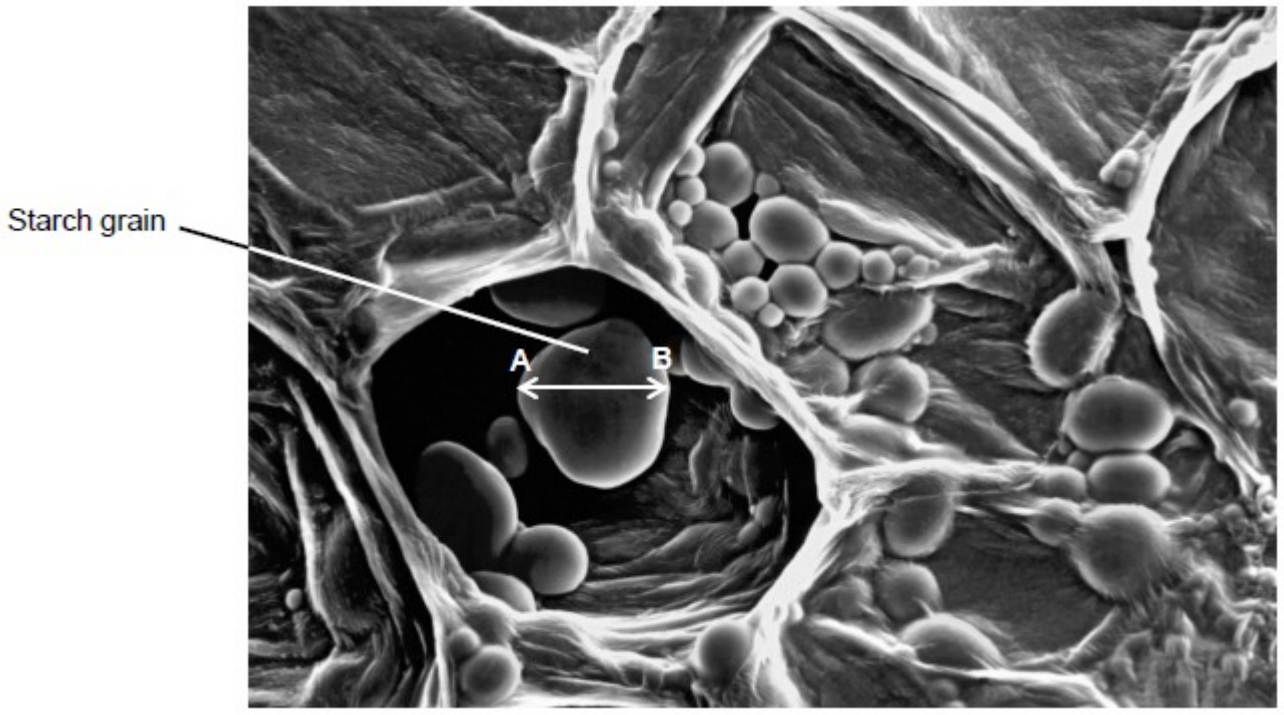
Acid hydrolysis test	☐
Benedict's test	☐

Emulsion test ☐

Iodine/potassium iodide test ☐

(1)

(d) The diagram shows a section through a plant tissue at a magnification of ×500.



Calculate the actual diameter of the starch grain between points **A** and **B**.

Answer = _____ µm

(2)

(e) What type of microscope was used to obtain the image shown in the diagram above?

Give **one** piece of evidence to support your answer.

Type of microscope _____

Evidence _____

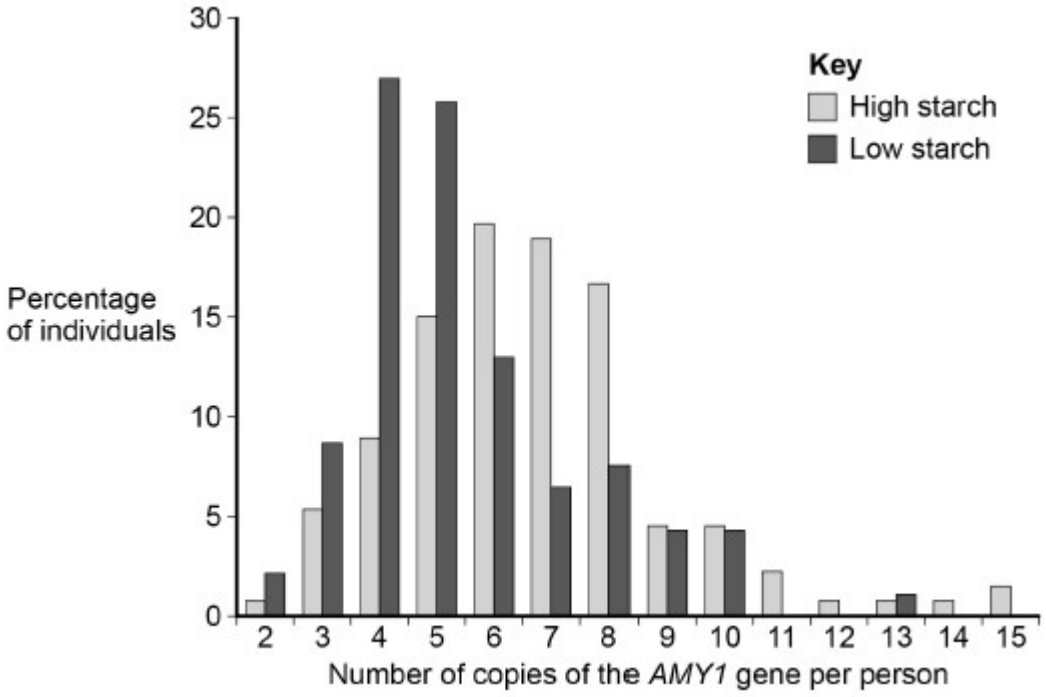
(2)

(Total 9 marks)

Q11.

(a) Most human cells contain two copies of each gene. However, there might be up to 15 copies of the gene for amylase (*AMY1*). Scientists investigated the number of copies of the *AMY1* gene in individual people in two populations. One population had a high-starch diet and the other population had a low-starch diet.

The graph below shows their results.



Describe what their results show.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Multiple copies of the *AMY1* gene is an adaptation to a high-starch diet.

Use your knowledge of protein synthesis and enzyme action to explain the advantage of this adaptation.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Multiple copies of the *AMY1* gene is an adaptation to a high-starch diet.

Suggest how this evolved through natural selection.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q12.

2,4-D is a selective herbicide that kills some species of plants but not others. 2,4-D disrupts cell-surface membranes but the extent of disruption differs in different species.

Scientists investigated the effect of 2,4-D on wheat plants (a crop) and on wild oat plants (a weed).

They grew plants of both species in glasshouses. They put plants of each species into one of two groups, **W** and **H**, which were treated as follows:

- Group **W** – leaves sprayed with water
- Group **H** – leaves sprayed with a solution of 2,4-D.

After spraying, they cut 40 discs from the leaves of plants in each group and placed them in flasks containing 10 cm^3 de-ionised water. After 5 minutes, they calculated the disruption to cell-surface membranes by measuring the concentration of ions released into the water from the leaf discs.

Their results are shown in the table below.

The lowest significant difference (LSD), is the smallest difference between two means that

would be significant at P≤0.05

Group	Treatment	Mean concentration of ions in water / arbitrary units	
		Wheat	Wild oats
W	Water	26	45
H	2,4-D	27	70
Lowest significant difference (LSD)		7	10

(a) Give **three** environmental variables that should be controlled when growing the plants before treatment with the different sprays.

1. _____

_____

2. _____

_____

3. _____

_____

(2)

(b) Evaluate the use of 2,4-D as a herbicide on a wheat crop that contains wild oats as a weed. Use all the information provided.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) The scientists incubated the flasks containing the leaf discs at 26 °C and gently shook the flasks.

Suggest **one** reason why the scientists ensured the temperature remained constant and **one** reason why the leaf discs were shaken.

Temperature _____

_____

_____

Shaken _____

_____

_____

(2)

(Total 8 marks)

Q13.

(a) Contrast how an optical microscope and a transmission electron microscope work **and** contrast the limitations of their use when studying cells.

_____

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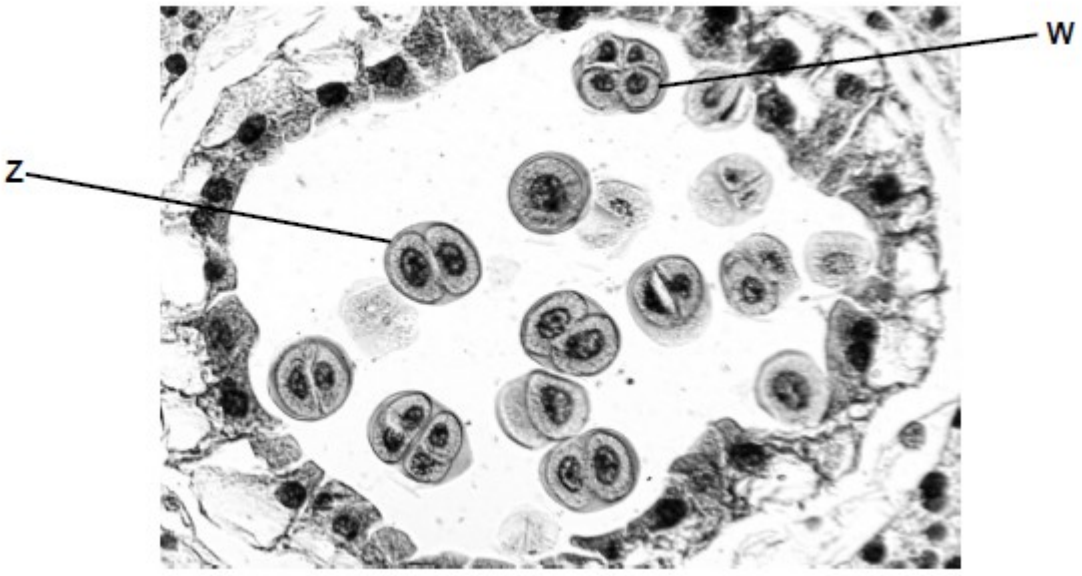
_____

_____

_____

(6)

(b) The diagram shows an image from an optical microscope of meiosis occurring in a flower bud of a flowering plant. **W** and **Z** are undergoing meiosis.



Explain the appearance of **W** and **Z**.

(4)

(c) An environmental scientist investigated a possible relationship between air pollution and the size of seeds produced by one species of tree.

He was provided with a very large number of seeds collected from a population of trees in the centre of a city and also a very large number of seeds collected from a population of trees in the countryside.

Describe how he should collect and process data from these seeds to investigate whether there is a difference in seed size between these two populations of trees.

_____

_____

_____

_____

_____

(5)

(Total 15 marks)

Q14.

(a) When a nerve impulse arrives at a synapse, it causes the release of neurotransmitter from vesicles in the presynaptic knob.

Describe how.

_____

_____

_____

_____

_____

_____

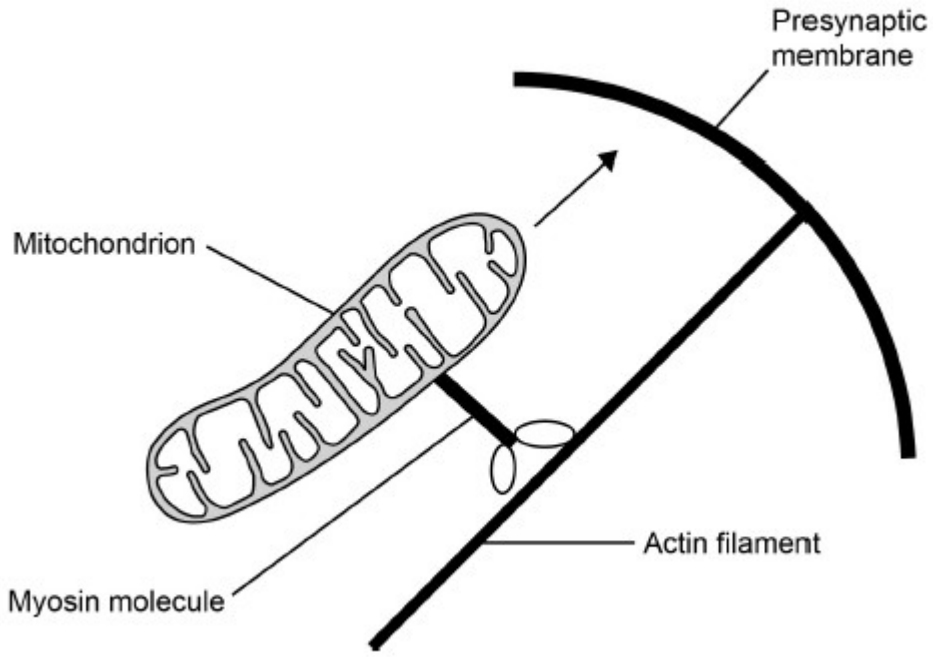
_____

_____

(3)

(b) The presynaptic knob contains actin filaments and myosin molecules.

The myosin molecules can attach to mitochondria and move them towards the presynaptic membrane, as shown in the diagram.



Use your knowledge of how myosin and actin interact to suggest how the myosin molecule moves the mitochondrion towards the presynaptic membrane.

Do **not** include the roles of calcium ions and tropomyosin in your answer.

_____

_____

_____

_____

_____

_____

(2)

(c) This movement of mitochondria happens when nerve impulses arrive at the synapse.

Suggest and explain **one** advantage of the movement of mitochondria towards the presynaptic membrane when nerve impulses arrive at the synapse.

_____

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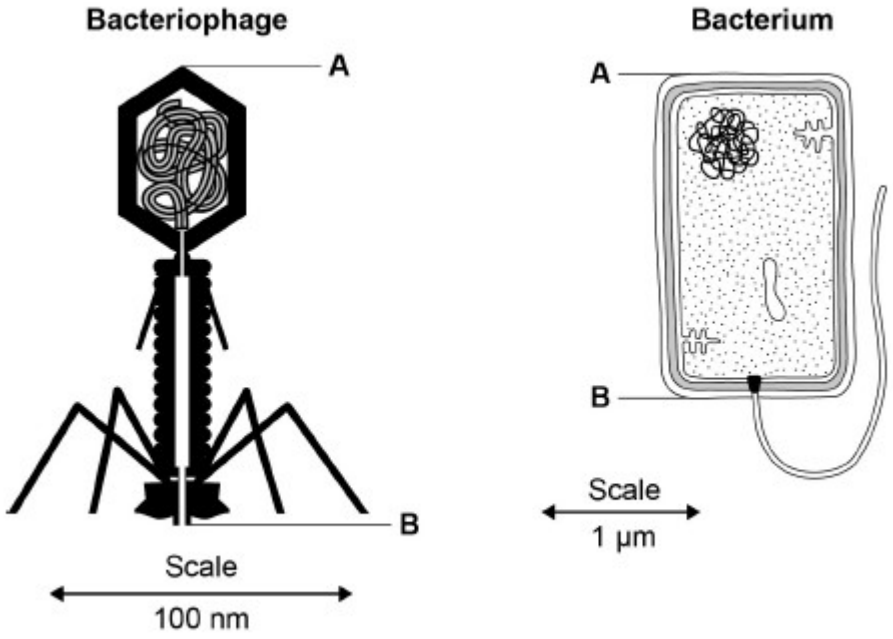
(2)

(Total 7 marks)

Q15.

Bacteriophages are viruses that kill bacteria.

The diagram below shows drawings of a bacteriophage and a bacterium.



(a) Using the diagram and your own knowledge, put a tick (✔) in the box next to the **only** correct statement about the structures of the bacteriophage and the bacterium

Both have ribosomes. ☐

Both have a cell-surface membrane. ☐

The bacteriophage has a capsid and the bacterium has a cell-surface membrane. ☐

The bacteriophage has a cell wall and the bacterium has a capsid. ☐

(1)

(b) Using the scales in the diagram above, calculate how many times longer the bacterium is than the bacteriophage.

Use the distance between the points labelled **A** and **B** on each drawing in your calculations. Show your working.

The bacterium is _____ times longer

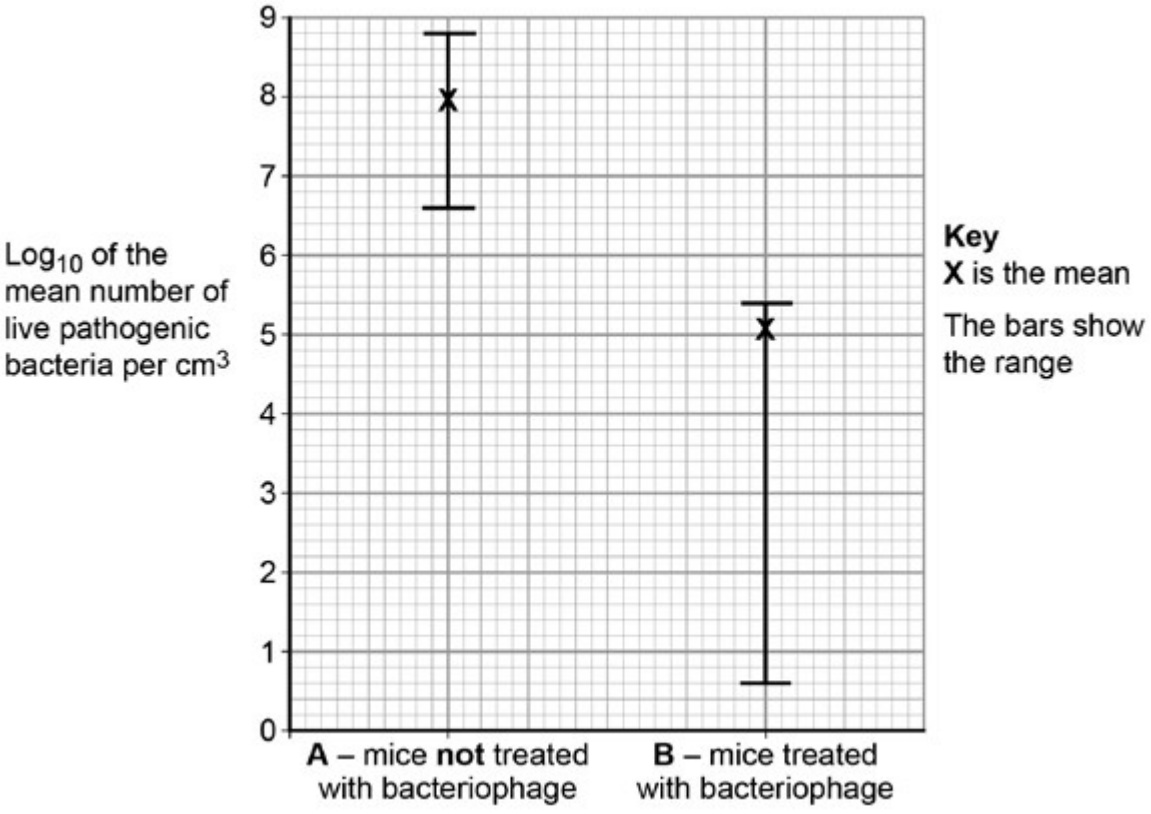
(2)

(c) Scientists investigated the use of bacteriophages to treat lung infections caused by bacteria. They infected the lungs of mice with a pathogenic species of bacterium. The mice were then divided into two groups, **A** and **B**.

- The mice in group **A** were **not** treated with bacteriophage.
- The mice in group **B** were treated by breathing in a spray containing bacteriophage particles.

After 3 days, the scientists killed the mice and removed their lungs. They washed out each set of lungs with a set volume of liquid. The scientists determined the number of live bacteria in the liquid.

The graph below shows the scientists' results. The graph shows the mean and the range of the data about the mean for each group. Standard deviations of the means are **not** shown.



What would the scientists' null hypothesis be for this investigation?

_____

_____

_____

(1)

(d) With some samples, the scientists decided they needed to carry out a series of dilutions of the sample before counting the bacteria.

Use evidence from the graph above to explain why dilutions were necessary for some samples but not for others.

_____

_____

_____

_____

_____

_____

(2)

(e) Using only the graph above, what can you conclude from these data about the effectiveness of the bacteriophage in treating this lung infection in mice?

Do **not** consider statistical analyses in your answer.

_____

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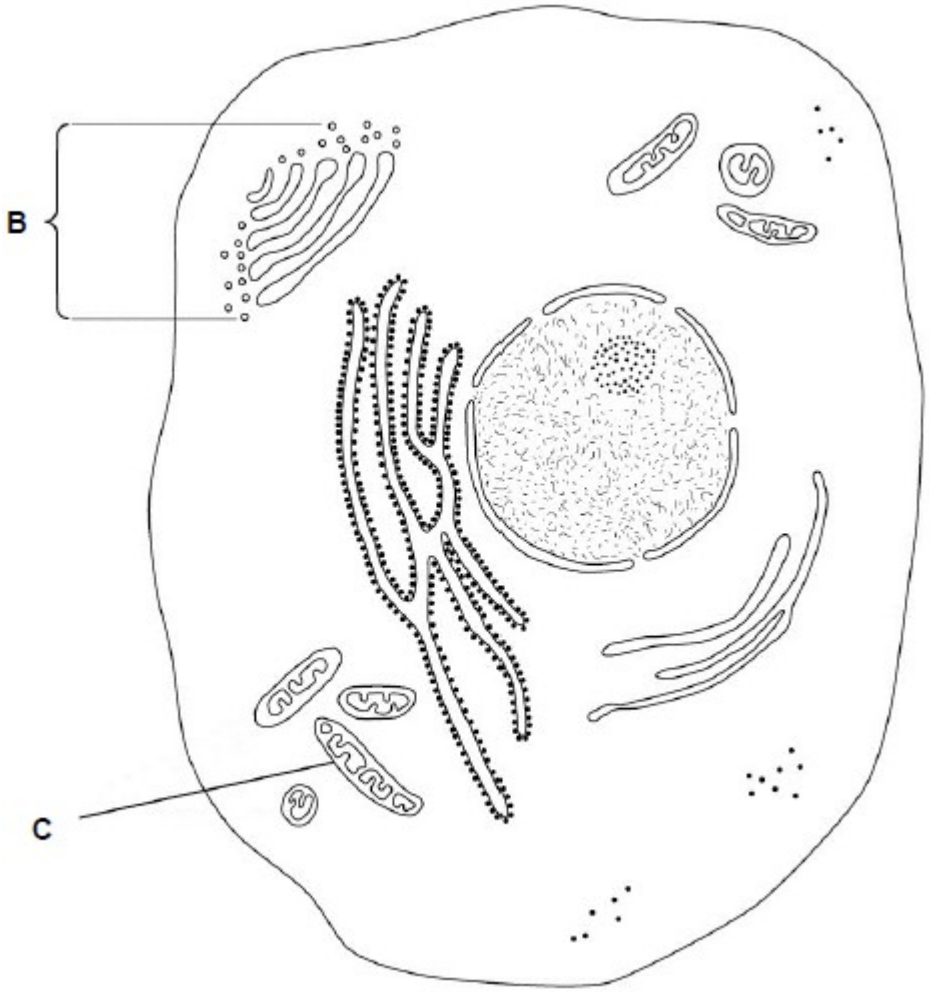
_____

(3)

(Total 9 marks)

Q16.

Below is a diagram of an animal cell.



(a) Name the organelles labelled:

B _____

C _____

(2)

(b) Name **two** structures present in plant cells that are **not** present in animal cells.

1. _____

2. _____

(1)

A biologist prepared a sample of organelles labelled **C** from liver. He used the following method.

1. Added to the liver tissues an ice-cold, buffered solution with the same water potential as the liver tissue.
2. Mixed the liver and solution in a blender.
3. Filtered the mixture from the blender.
4. Spun the filtered liquid in a centrifuge at a low speed. A pellet appeared in the bottom of the centrifuge tube.
5. Poured off the liquid above the pellet into a second centrifuge tube and spun this at a higher speed to obtain the sample of organelles labelled **C**.

(c) Explain why the solution the biologist used was ice-cold, buffered and the same water potential as the liver tissue (step 1).

Ice-cold_____

_____

Buffered_____

_____

Same water potential_____

_____

(3)

(d) Explain why the biologist used a blender and then filtered the mixture (steps 2 and 3).

_____

_____

_____

_____

_____

(2)

(e) Name the organelle that made up most of the first pellet after centrifuging at a low speed (step 4).

_____

(1)

(f) The second centrifuge tube was spun at a higher speed to obtain the sample of organelles labelled **C** in the diagram (step 5).

Suggest why.

_____

_____

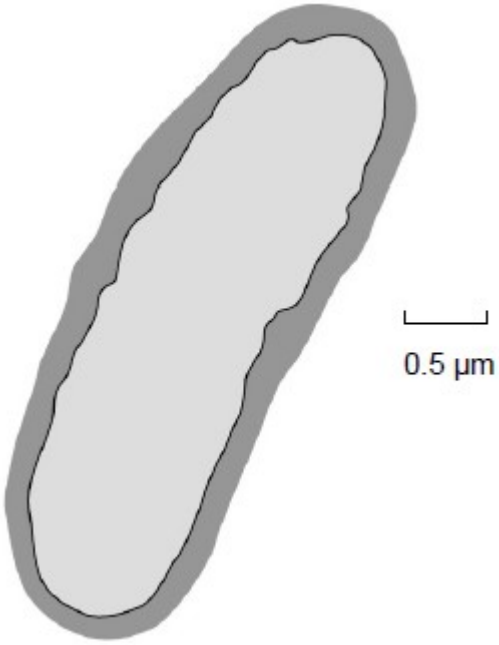
_____

(1)

(Total 10 marks)

Q17.

A bacterium is shown in the diagram.



(a) Calculate the magnification of the image.

Magnification = _____

(1)

(b) Complete the table to show the features of a bacterium and a virus.

Put a tick (✔) in the box if the feature is shown.

Surface	**Bacterium**	**Virus**
Cell-surface membrane		
Nucleus		
Cytoplasm		
Capsid		

(2)

(c) DNA and RNA can be found in bacteria.

Give **two** ways in which the nucleotides in DNA are different from the nucleotides in RNA.

1. _____

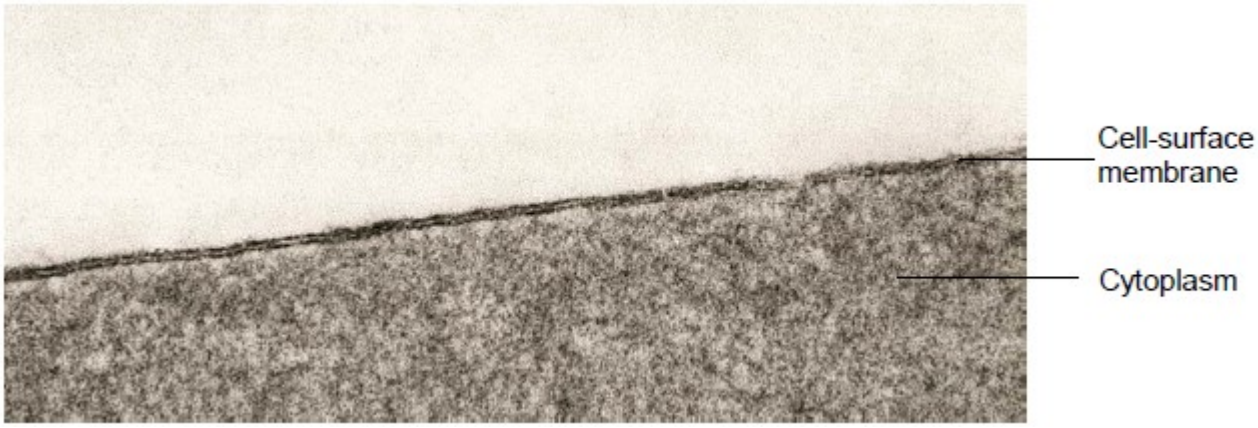
2. _____

(2)

(Total 5 marks)

Q18.

The image below shows the cell-surface membrane of a red blood cell seen with a transmission electron microscope.



(a) The cell-surface membrane can be seen with a transmission electron microscope but **not** with an optical microscope.

Explain why.

_____

_____

_____

(1)

(b) No organelles are visible in the cytoplasm of this red blood cell.

Suggest why.

_____

_____

_____

(1)

(c) Before the cell was examined using the electron microscope, it was stained. This stain caused parts of the structure of the cell-surface membrane to appear as two dark lines.

Suggest an explanation for the appearance of the cell-surface membrane as two dark lines.

_____

_____

_____

_____

_____

_____

_____

(3)

(d) Describe how substances move across cell-surface membranes by facilitated diffusion.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q19.

Bacterial meningitis is a potentially fatal disease affecting the membranes around the brain. *Neisseria meningitidis* (Nm) is a leading cause of bacterial meningitis.

(a) In the UK, children are vaccinated against this disease. Describe how vaccination can lead to protection against bacterial meningitis.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(b) Penicillin has been the antibiotic of choice for the treatment of bacterial meningitis. Since the year 2000, strains of *Neisseria meningitidis* that are resistant to penicillin, sulfonamides and rifampin have been discovered in the UK.

Describe how a population of *Neisseria meningitidis* (Nm) can become resistant to these antibiotics.

(4)

(c) Contrast the structure of a bacterial cell and the structure of a human cell.

(5)

(Total 15 marks)

Q20.

(a) Describe how you could use cell fractionation to isolate chloroplasts from leaf tissue.

_____

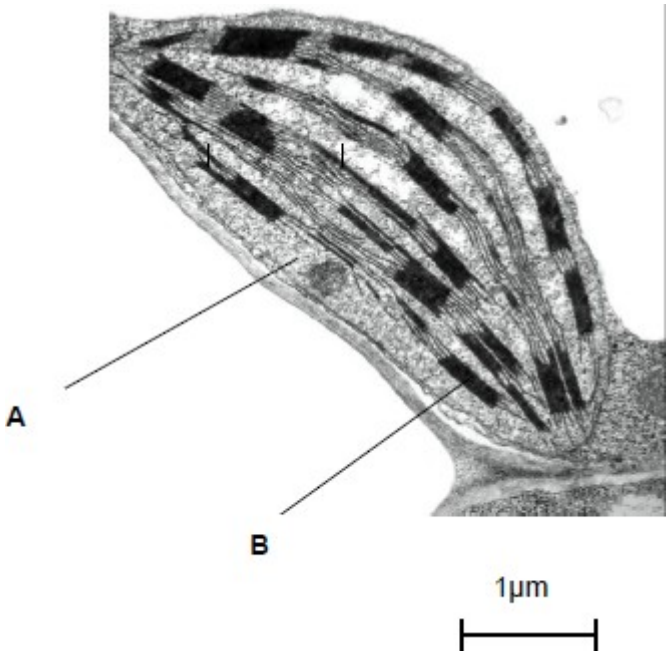
_____

_____

_____

(3)

The figure below shows a photograph of a chloroplast taken with an electron microscope.



© Science Photo Library

(b) Name the parts of the chloroplast labelled **A** and **B**.

Name of **A** _____

Name of **B** _____

(2)

(c) Calculate the length of the chloroplast shown in the figure above.

Answer _____

(1)

(d) Name **two** structures in a eukaryotic cell that **cannot** be identified using an optical microscope.

1. _____

2. _____

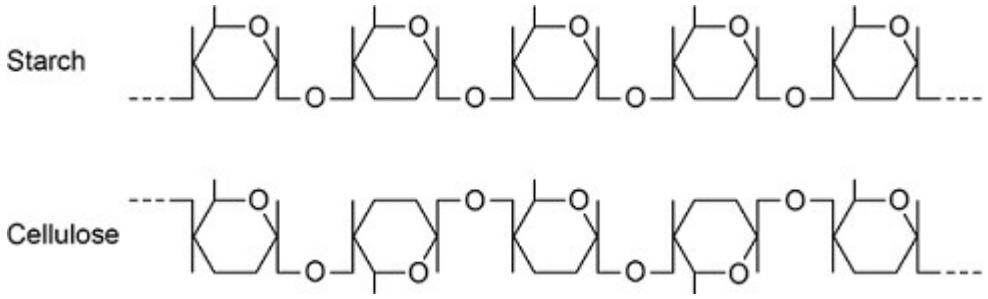
(1)

(Total 7 marks)

Q21.

Starch and cellulose are two important plant polysaccharides.

The following diagram shows part of a starch molecule and part of a cellulose molecule.



(a) Explain the difference in the structure of the starch molecule and the cellulose molecule shown in the diagram above.

_____

_____

_____

_____

(2)

(b) Starch molecules and cellulose molecules have different functions in plant cells. Each molecule is adapted for its function.

Explain **one** way in which starch molecules are adapted for their function in plant cells.

_____

_____

_____

_____

(2)

(c) Explain how cellulose molecules are adapted for their function in plant cells.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

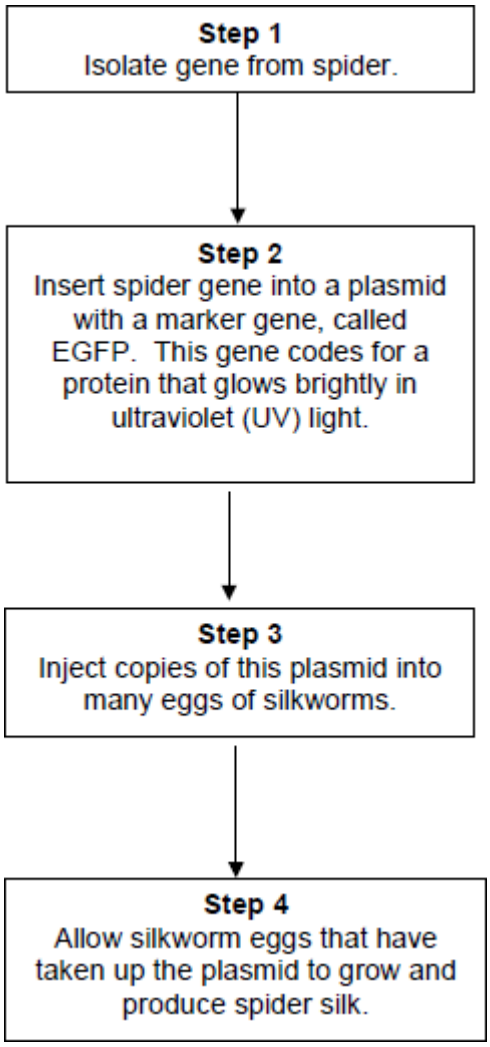
Q22.

Silkworms secrete silk fibres, which are harvested and used to manufacture silk fabric.

Scientists have produced genetically modified (GM) silkworms that contain a gene from a spider.

The GM silkworms secrete fibres made of spider web protein (spider silk), which is stronger than normal silk fibre protein.

The method the scientists used is shown in the figure below.



(a) Suggest why the plasmids were injected into the eggs of silkworms, rather than into the silkworms.

_____

_____

_____

_____

(2)

(b) Suggest why the scientists used a marker gene and why they used the EGFP gene.

_____

_____

_____

_____

(2)

The scientists ensured the spider gene was expressed only in cells within the silk glands.

(c) What would the scientists have inserted into the plasmid along with the spider gene to ensure that the spider gene was only expressed in the silk glands of the silkworms?

_____

(1)

(d) Suggest **two** reasons why it was important that the spider gene was expressed only in the silk glands of the silkworms.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q23.

(a) Describe how you could make a temporary mount of a piece of plant tissue to observe the position of starch grains in the cells when using an optical (light) microscope.

_____

_____

_____

_____

_____

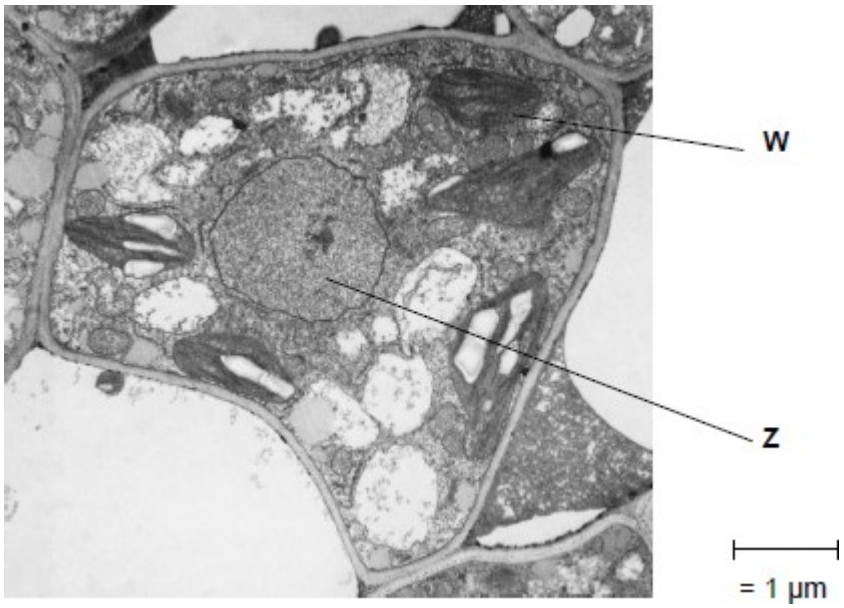
_____

_____

_____

(4)

The figure below shows a microscopic image of a plant cell.



© Science Photo Library

(b) Give the name and function of the structures labelled **W** and **Z**.

Name of **W**_____

Function of **W**_____

Name of **Z** _____

Function of **Z** _____

(2)

(c) A transmission electron microscope was used to produce the image in the figure above.
Explain why.

_____

_____

_____

_____

_____

(2)

(d) Calculate the magnification of the image shown in the figure in part (a).

Answer = _____

(1)

(Total 9 marks)

Q24.

(a) The table below shows features of a bacterium and the human immunodeficiency virus (HIV) particle.

Complete the table by putting a tick (✔) where a feature is present.

Feature	**Bacterium**	**Human immunodeficiency virus (HIV) particle**
RNA		
Cell wall		
Enzyme molecules		
Capsid		

(2)

(b) When HIV infects a human cell, the following events occur.

- A single-stranded length of HIV DNA is made.
- The human cell then makes a complementary strand to the HIV DNA.

The complementary strand is made in the same way as a new complementary strand is made during semi-conservative replication of human DNA.

Describe how the complementary strand of HIV DNA is made.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) Contrast the structures of DNA and mRNA molecules to give **three** differences.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 8 marks)

Q25.

Cells constantly hydrolyse ATP to provide energy.

(a) Describe how ATP is resynthesised in cells.

_____

_____

_____

_____

(2)

(b) Give **two** ways in which the hydrolysis of ATP is used in cells.

1. _____

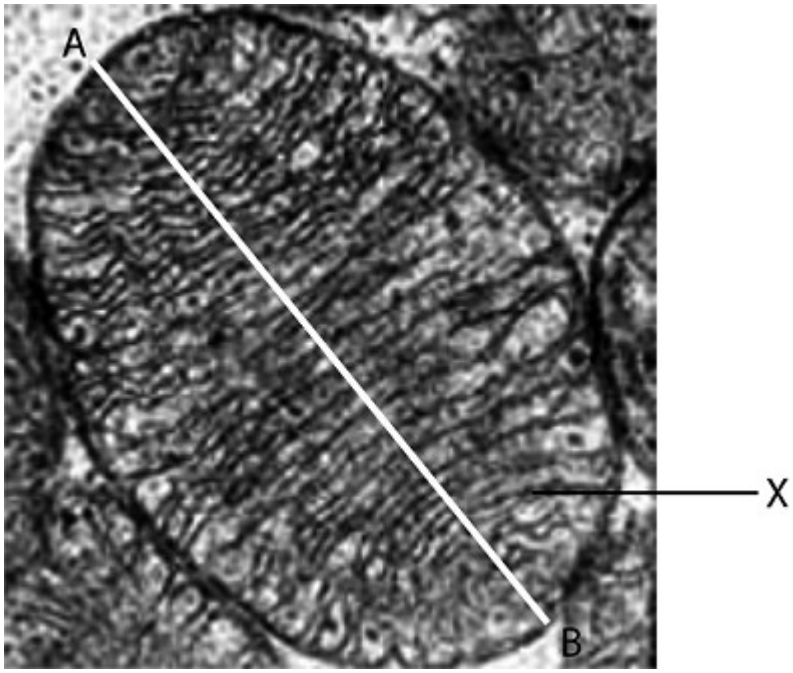
_____

2. _____

_____

(2)

(c) This is a photograph (micrograph) of a mitochondrion taken using a scanning electron microscope.



What is the evidence that a scanning electron microscope was used to take this photograph?

_____

_____

_____

(1)

(d) Name the part of the mitochondrion labelled **X** in the photograph.

_____

(1)

(e) The actual length of the mitochondrion between points **A** and **B** in the photograph is 4 µm.

What is the magnification of the mitochondrion in the photograph?

Show your working.

Magnification _____

(2)

(Total 8 marks)

Q26.

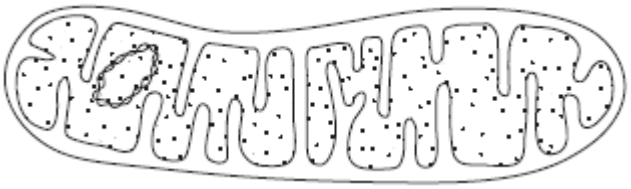
(a) The table shows some parts of cells and two different types of cell.

Complete the table by putting a tick in a box if the structure is present in the type of cell.

	Cell wall	**Cell-surface membrane**	**Nucleus**
White blood cell			
Bacterial cell			

(2)

(b) The diagram is of a mitochondrion at a magnification of × 30 000.



Calculate the actual length of this mitochondrion in micrometres (μm). Show your working.

Answer = _____ μm

(2)

(c) Some scientists support the theory that mitochondria are organelles that evolved from prokaryotic cells.

(i) Give **one** piece of evidence that supports the theory that mitochondria evolved from prokaryotic cells.

_____

_____

_____

(1)

(ii) What is the advantage to cells of having mitochondria?

_____

_____

_____

_____

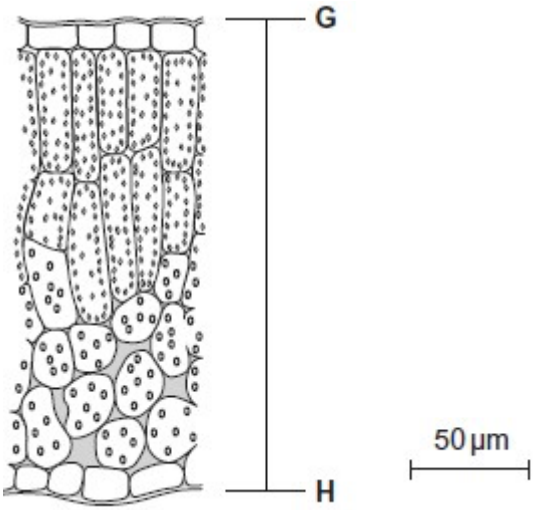
_____

(2)

(Total 7 marks)

Q27.

A scientist examined the structure of mustard plant leaves. He viewed temporary mounts of leaf tissues with an optical microscope. The figure below shows a drawing of typical results.



(a) Describe how temporary mounts are made.

_____

_____

_____

_____

_____

(2)

(b) Calculate the distance in micrometres between **G** and **H** on the leaf.

Answer = _____ µm

(2)

(c) Describe how the scientist could have used the temporary mounts of leaves to determine the mean number of chloroplasts in mesophyll cells of a leaf.

_____

_____

_____

_____

_____

_____

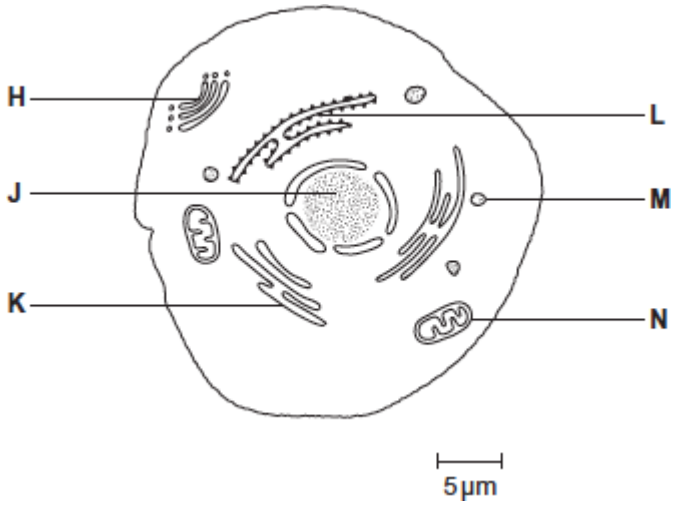
_____

(3)

(Total 7 marks)

Q28.

The diagram shows a eukaryotic cell.



(a) Complete the table by giving the letter labelling the organelle that matches the function.

Function of organelle	Letter
Protein synthesis	
Modifies protein (for example, adds carbohydrate to protein)	
Aerobic respiration	

(3)

(b) Use the scale bar in the diagram above to calculate the magnification of the drawing.
Show your working.

Answer = _____

(2)

(Total 5 marks)

Q29.

A stomach ulcer is caused by damage to the cells of the stomach lining. People with stomach ulcers often have the bacterium *Helicobacter pylori* in their stomachs.

A group of scientists was interested in trying to determine how infection by *H. pylori* results in the formation of stomach ulcers.

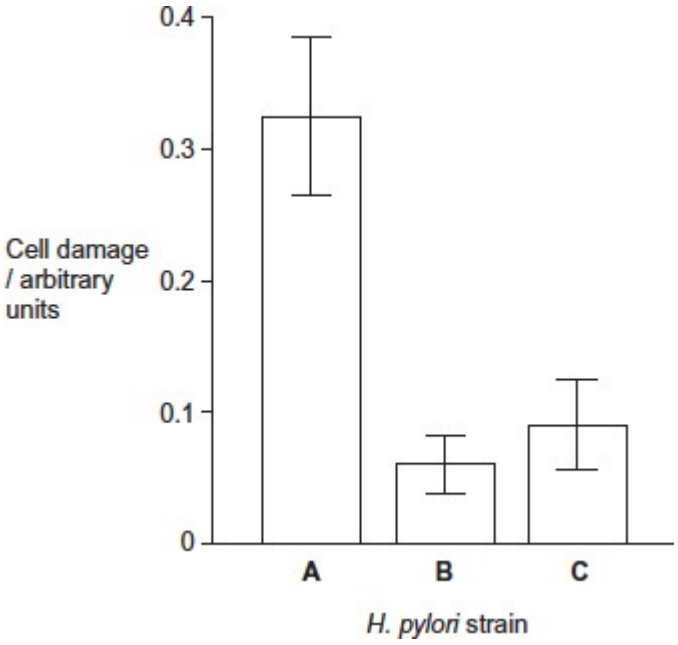
The scientists grew different strains of *H. pylori* in liquid culture.

The table below shows the substances released by each of these strains.

***H. pylori* strain**	**Substances released by the *H. pylori* cells**	
	Toxin	**Enzyme that neutralises acid**
A	✓	✓
B	×	✓
C	✓	×

The scientists centrifuged the cultures of each strain to obtain cell-free liquids. They added each liquid to a culture of human cells. They then recorded the amount of damage to the human cells.

Their results are shown below. The error bars show ± 1 standard deviation.



(a) Describe and explain how centrifuging the culture allowed the scientists to obtain a cell-free liquid.

(3)

(b) The scientists measured cell damage by measuring the activity of lysosomes.
Give **one** function of lysosomes.

(1)

(c) *H. pylori* cells produce an enzyme that neutralises acid.
Suggest **one** advantage to the *H. pylori* of producing this enzyme.

(2)

(d) What do these data suggest about the damage caused to human cells by the toxin and by the enzyme that neutralises acid?
Explain your answer.

(3)

(e) The scientists carried out a further investigation. They treated the liquid from **strain**

A with a protein-digesting enzyme before adding it to a culture of human cells. No cell damage was recorded.
Suggest why there was no damage to the cells.

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

Q30.

(a) Describe how phospholipids are arranged in a plasma membrane.

_____

_____

_____

_____

(2)

(b) Cells that secrete enzymes contain a lot of rough endoplasmic reticulum (RER) and a large Golgi apparatus.

(i) Describe how the RER is involved in the production of enzymes.

_____

_____

_____

_____

(2)

(ii) Describe how the Golgi apparatus is involved in the secretion of enzymes.

_____

_____

_____

(1)

(Total 5 marks)

Q31.

(a) Describe how bacteria are destroyed by phagocytes.

_____

_____

_____

_____

_____

_____

(3)

(b) Give **two** structures a bacterial cell may have that a white blood cell does not have.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

Q32.

Read the following passage.

Whooping cough is caused by the bacterium *Bordetella pertussis*. The first vaccines for whooping cough contained whole bacterial cells that had been heated for several minutes. Today, most vaccines only contain between one and three parts of the bacterial cells. People given whole-cell vaccines were more likely to develop harmful side effects than the people given the vaccines containing parts of the bacterial cells. Those given whole-cell vaccines produced a greater range of antibodies against the bacterium.

There have been suggestions that whooping cough vaccines may not work very well. These suggestions are due to recent reports of large rises in the number of cases of whooping cough. Doctors who examined a group of patients with coughs diagnosed about 17% of them as having whooping cough. Scientists tested the blood of the same group of patients for antibodies against a toxin produced by *Bordetella pertussis*. They concluded that 4% of this group actually had whooping cough.

Use the information in the passage and your own knowledge to answer the following questions.

(a) (i) People given whole-cell vaccines were more likely to develop harmful side effects than the people given the vaccines containing parts of the bacterial cells (lines 4–6).

Suggest reasons why.

_____

_____

_____

_____

_____

_____

(3)

(ii) People given whole-cell vaccines produced a greater range of antibodies against the bacterium than the people given the vaccines containing parts of the bacterial cells (lines 7–8).

Explain why.

_____

_____

_____

_____

(2)

(b) The scientists concluded from their test that 4% of patients with long-term coughs actually had whooping cough (line 15).

Explain how they used the results of their test to reach this conclusion.

_____

_____

_____

_____

_____

_____

(3)

(c) What does the scientists' work suggest about reports of large rises in the number of cases of whooping cough (lines 10–11)?

Explain your answer.

_____

_____

_____

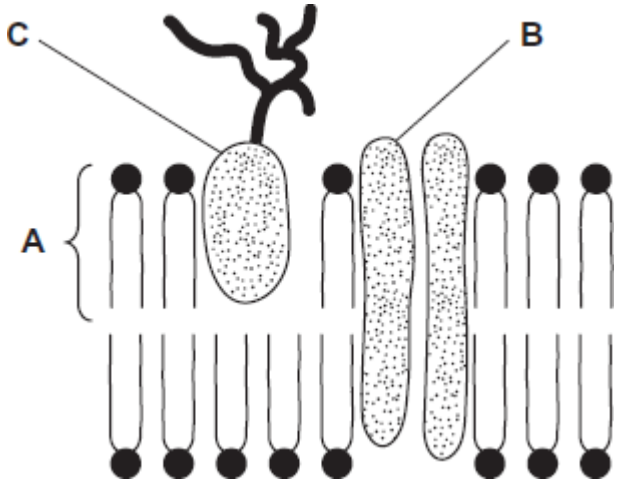
_____

(2)

(Total 10 marks)

Q33.

The diagram shows the structure of the cell-surface membrane of a cell.



(a) Name **A** and **B.**

A _____

B _____

(2)

(b) (i) **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

_____

(1)

(ii) Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle_____

Description of role _____

_____

_____

_____

(2)

(Total 5 marks)

Q34.

Read the following passage.

Microfold cells are found in the epithelium of the small intestine. Unlike other epithelial cells in the small intestine, microfold cells do not have adaptations for the absorption of food.

Microfold cells help to protect against pathogens that enter the intestine. They have receptor proteins on their cell-surface membranes that bind to antigens on the surface of pathogens. The microfold cells take up the antigens and transport them to cells of the immune system. Antibodies are then produced which give protection against the pathogen.

Scientists believe that it may be possible to develop vaccines that make use of microfold cells. These vaccines could be swallowed in tablet form.

Use information from the passage and your own knowledge to answer the following questions.

(a) (i) Microfold cells have receptor proteins on their cell-surface membranes that bind to antigens (line 5). What is an antigen?

_____

_____

_____

(1)

(ii) Microfold cells take up the antigens and transport them to cells of the immune system (lines 6-7). Antigens are not able to pass through the cell-surface membranes of other epithelial cells. Suggest **two** reasons why.

_____

_____

_____

_____

_____

(2)

(b) Scientists believe that it may be possible to develop vaccines that make use of microfold cells (lines 9-10). Explain how this sort of vaccine would lead to a person developing immunity to a pathogen.

_____

_____

_____

_____

_____

_____

_____

_____

_____

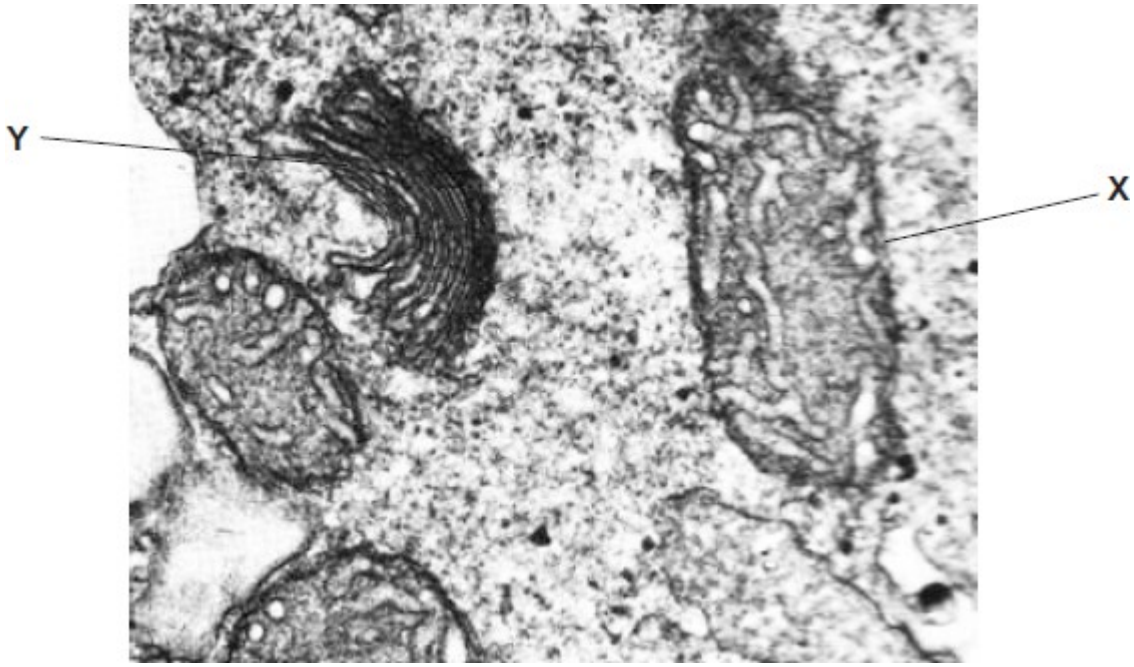
_____

(5)

(Total 8 marks)

Q35.

The photograph shows part of the cytoplasm of a cell.



(a) (i) Organelle **X** is a mitochondrion.

What is the function of this organelle?

_____

_____

(1)

(ii) Name organelle **Y.**

_____

(1)

(b) This photograph was taken using a transmission electron microscope. The structure of the organelles visible in the photograph could not have been seen using an

optical(light) microscope. Explain why.

_____

_____

_____

_____

_____

(2)

(Total 4 marks)

Q36.

(a) The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

Statement	Starch	Cellulose	Glycogen
Found in plant cells			
Contains glycosidic bonds			
Contains β-glucose			

(3)

(b) Name the type of reaction that would break down these carbohydrates into their monomers.

_____

(1)

(c) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature _____

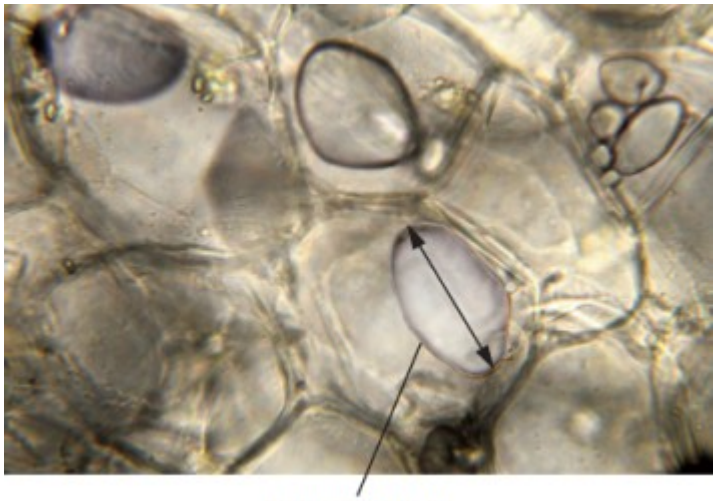
Explanation _____

_____

_____

(2)

(d) The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 μm. Use this information and the arrow line to calculate the magnification of the picture. Show your working.



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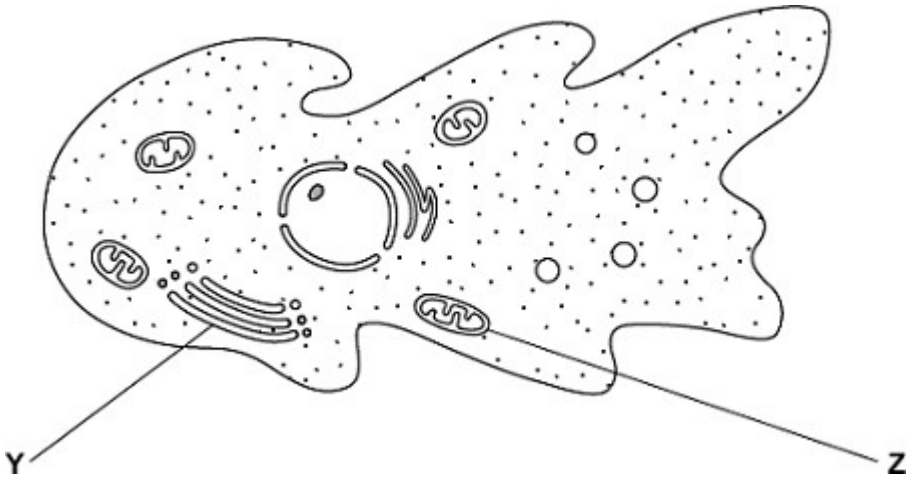
Magnification _____ times

(2)

(Total 8 marks)

Q37.

An amoeba is a single-celled, eukaryotic organism. Scientists used a transmission electron microscope to study an amoeba. The diagram shows its structure.



(a) (i) Name organelle **Y**.

_____

(1)

(ii) Name **two** other structures in the diagram which show that the amoeba is a eukaryotic cell.

1. _____

2. _____

(2)

(b) What is the function of organelle **Z**?

_____

_____

_____

(1)

(c) The scientists used a transmission electron microscope to study the structure of the amoeba. Explain why.

_____

_____

_____

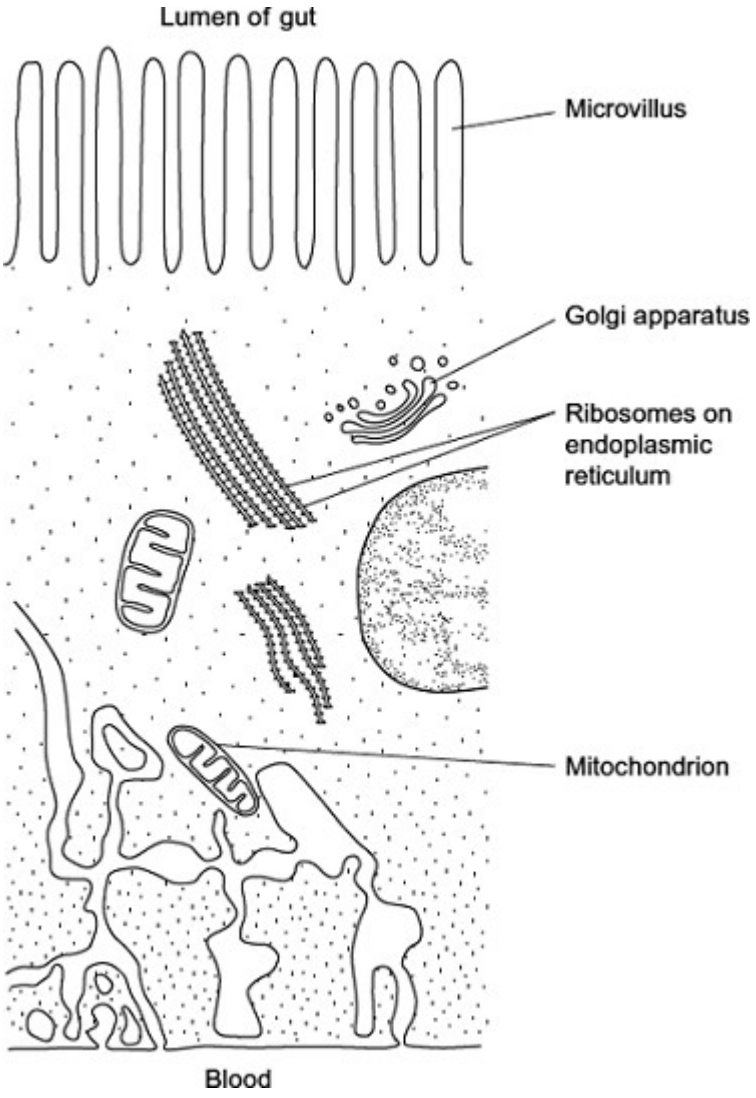
_____

(2)

(Total 6 marks)

Q38.

The diagram shows part of an epithelial cell from an insect's gut.



This cell is adapted for the three functions listed below. Use the diagram to explain how this cell is adapted for each of these functions.

Use a **different** feature in the diagram for each of your answers.

(a) the active transport of substances from the cell into the blood

_____

_____

_____

_____

_____

_____

(2)

(b) the synthesis of enzymes

_____

_____

_____

_____

_____

(2)

(c) rapid diffusion of substances from the lumen of the gut into the cytoplasm

_____

_____

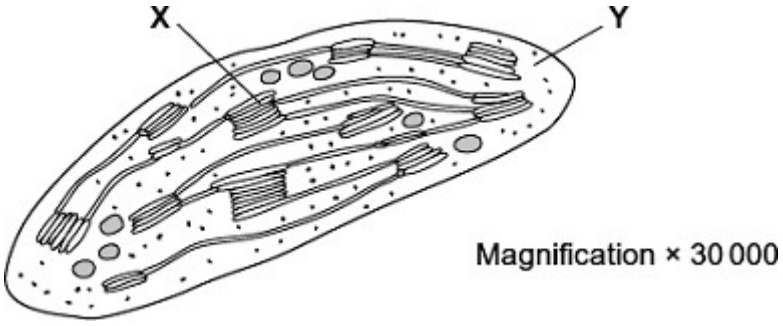
_____

(1)

(Total 5 marks)

Q39.

The diagram shows a chloroplast as seen with an electron microscope.



(a) Name **X** and **Y**.

X _____

Y _____

(2)

(b) Describe the function of a chloroplast.

_____

_____

_____

_____

_____

(2)

(c) Calculate the maximum length of this chloroplast in micrometres (μm). Show your working.

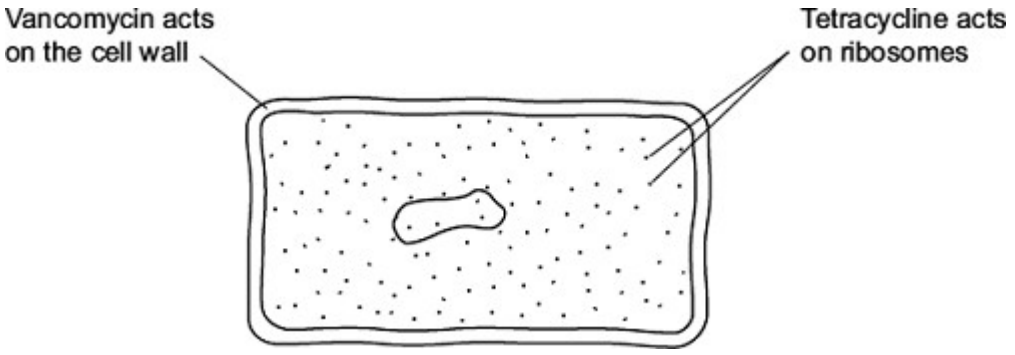
Answer _____ μm

(2)

(Total 6 marks)

Q40.

The diagram shows the structure of a bacterium and the sites of action of two antibiotics.



(a) (i) Use information in the diagram to explain why vancomycin does **not** affect human cells.

_____

_____

(1)

(ii) Use information in the diagram to explain how tetracycline prevents bacterial growth.

_____

_____

(1)

(b) Frequent treatment with vancomycin can result in resistant strains of bacteria. Explain how.

_____

_____

_____

_____

_____

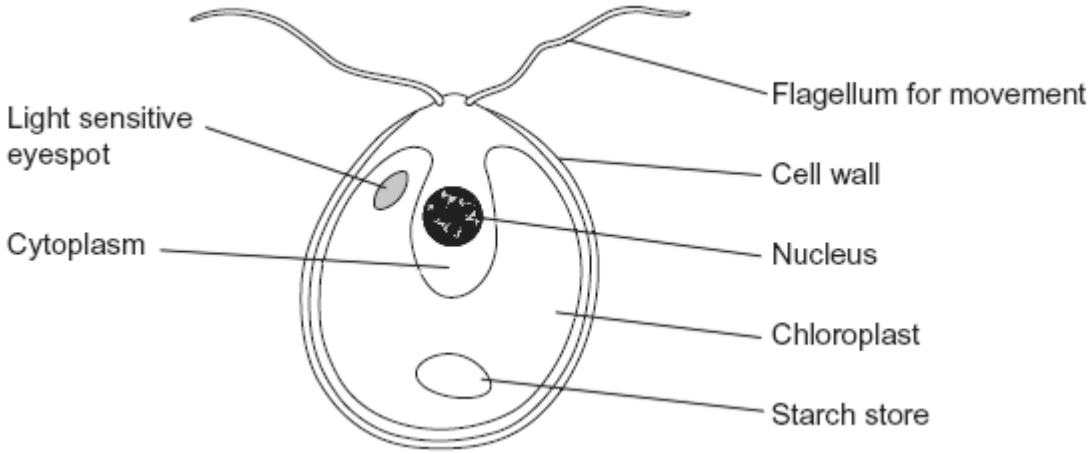
_____

(2)

(Total 4 marks)

Q41.

The diagram shows an organism called *Chlamydomonas*.



(a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1. _____

_____

2. _____

_____

(2)

(b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

_____

_____

_____

_____

_____

(2)

(c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis.

Use information in the diagram to explain what these adaptations are.

_____

_____

_____

_____

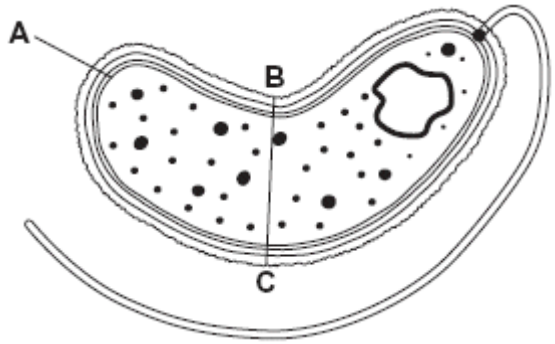
_____

(3)

(Total 7 marks)

Q42.

The diagram shows a cholera bacterium. It has been magnified 50 000 times.



(a) Name **A**.

_____

(1)

(b) Name **two** structures present in an epithelial cell from the small intestine that are **not** present in a cholera bacterium.

1. _____

2. _____

(2)

(c) Cholera bacteria can be viewed using a transmission electron microscope (TEM) or a scanning electron microscope (SEM).

(i) Give **one** advantage of using a TEM rather than a SEM.

_____

_____

(1)

(ii) Give **one** advantage of using a SEM rather than a TEM.

_____

_____

_____

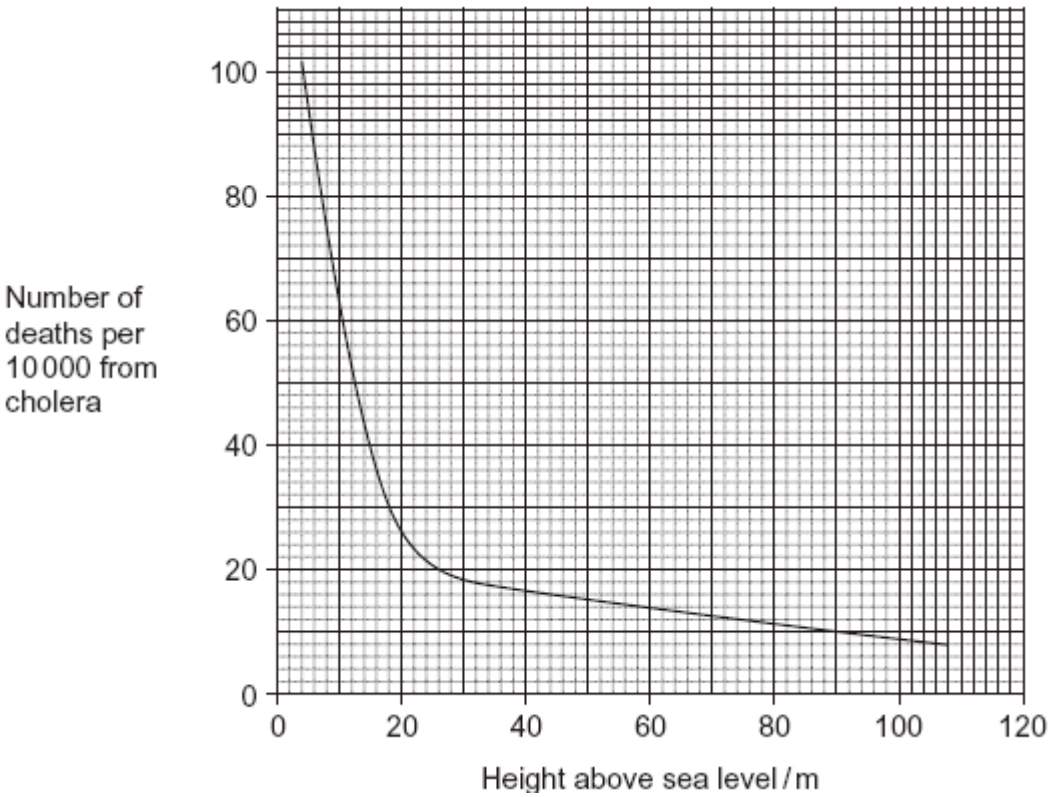
(1)

(d) Calculate the actual width of the cholera bacterium between points **B** and **C**.
Give your answer in micrometres and show your working.

_____ μm

(2)

(e) An outbreak of cholera occurred in London in 1849. The graph shows the relationship between the number of deaths from cholera and the height at which people lived above sea level.



Describe the relationship between the number of deaths from cholera and the height at which people lived above sea level.

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

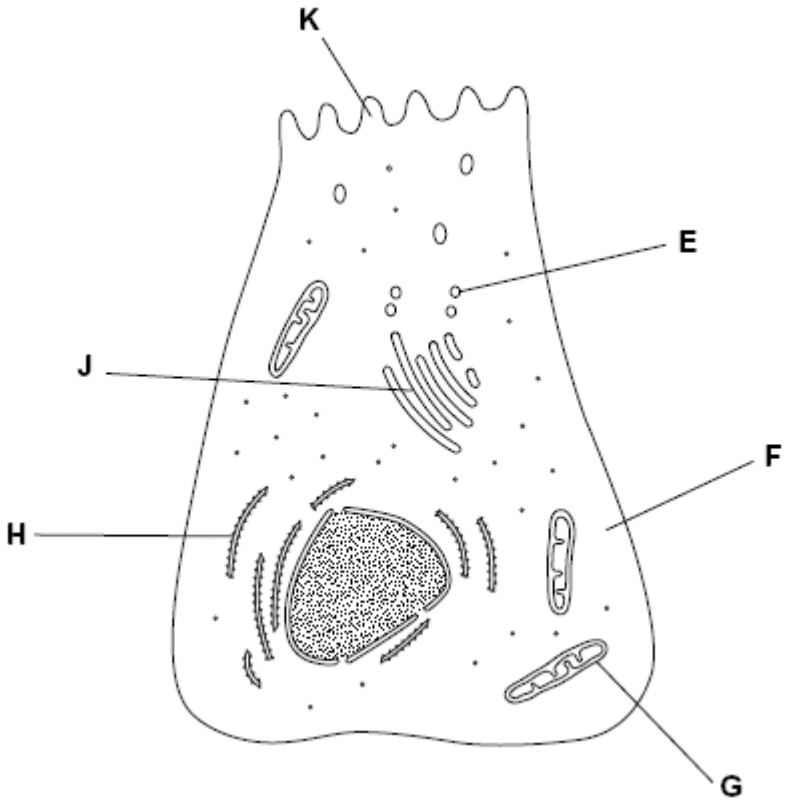
Q43.

(a) Name the type of bond that joins amino acids together in a polypeptide.

_____

(1)

The diagram shows a cell from the pancreas.



(b) The cytoplasm at **F** contains amino acids. These amino acids are used to make proteins which are secreted from the cell.

Place the appropriate letters in the correct order to show the passage of an amino acid from the cytoplasm at **F** until it is secreted from the cell as a protein at **K**.

F				**K**

(2)

(c) There are lots of organelle **G** in this cell. Explain why.

_____

_____

_____

_____

(2)

(d) A group of scientists homogenised pancreatic tissue before carrying out cell fractionation to isolate organelle **G**.

Explain why the scientists

(i) homogenised the tissue

_____

_____

(1)

(ii) filtered the resulting suspension

_____

_____

(1)

(iii) kept the suspension ice cold during the process

_____

_____

(1)

(iv) used isotonic solution during the process.

_____

_____

_____

_____

(2)

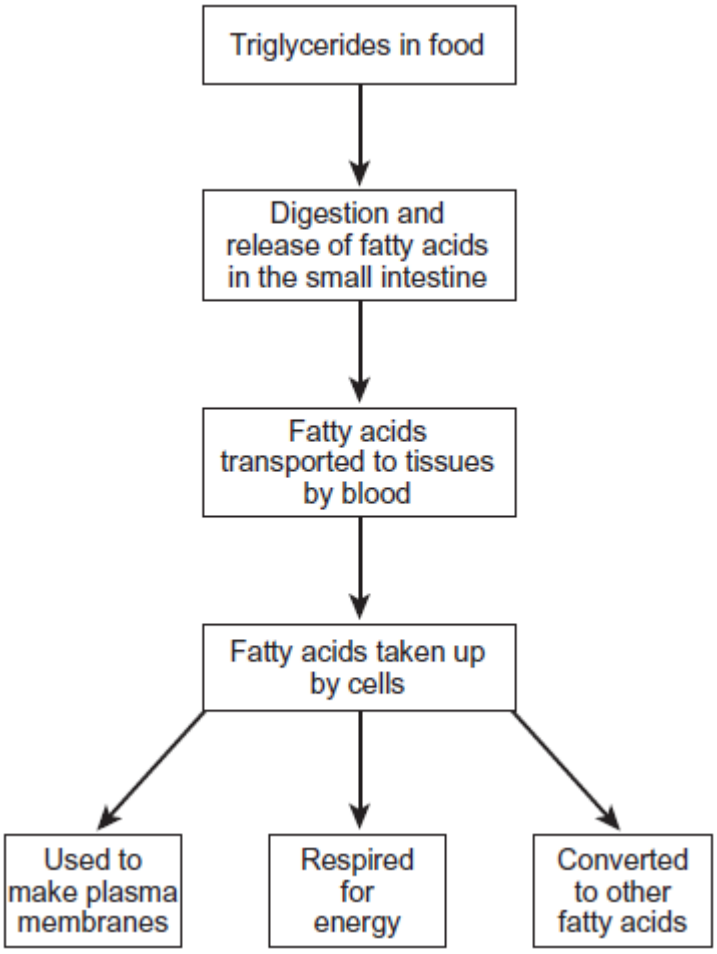
(Total 10 marks)

Q44.

Triglycerides are taken into the body as part of a balanced diet. These triglycerides contain fatty acids including omega-3 fatty acids. It has been discovered that omega-3 fatty acids are associated with health benefits. The benefits include faster development of nerve cells and clearer vision. Omega-3 fatty acids are also associated with protection

from heart disease, arthritis and cancer.

The following figure shows how omega-3 and other fatty acids are taken in and used by the bodies of animals including humans.



Use the information in the figure to explain **two** ways in which fatty acids are important in the formation of new cells.

1. _____

_____

_____

_____

2. _____

_____

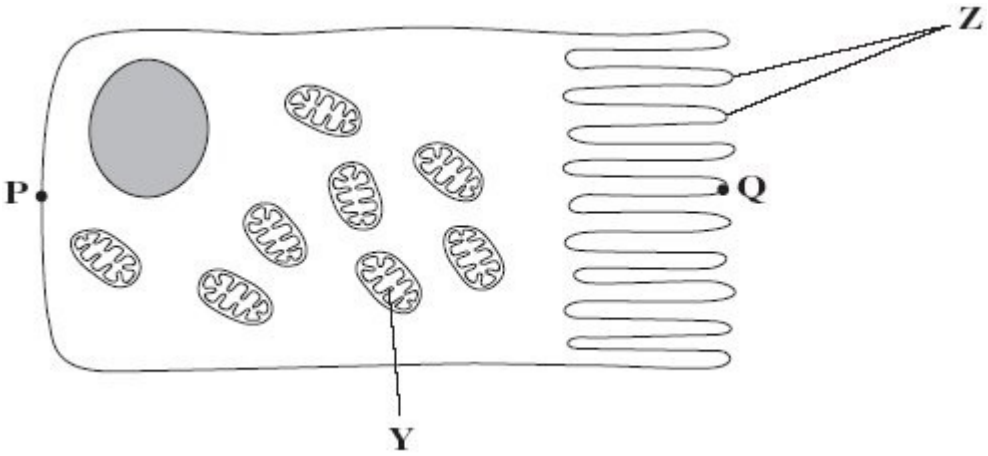
_____

_____

(Total 4 marks)

Q45.

The diagram shows an epithelial cell from the small intestine.



(a) (i) Name organelle **Y**.

_____

(1)

(ii) There are large numbers of organelle **Y** in this cell. Explain how these organelles help the cell to absorb the products of digestion.

_____

_____

_____

_____

_____

(2)

(b) This diagram shows the cell magnified 1000 times. Calculate the actual length of the cell between points **P** and **Q**. Give your answer in µm. Show your working.

Answer _____ µm

(2)

(c) Coeliac disease is a disease of the human digestive system. In coeliac disease, the structures labelled **Z** are damaged.

Although people with coeliac disease can digest proteins they have low concentrations of amino acids in their blood.

Explain why they have low concentrations of amino acids in their blood.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

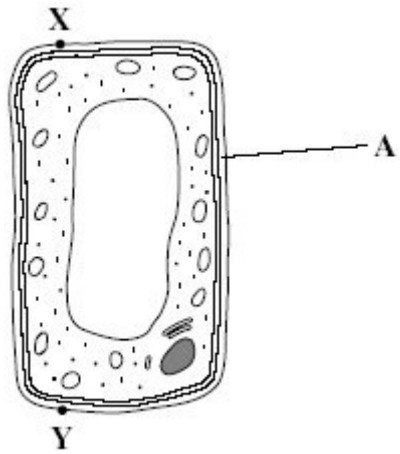
Q46.

(a) Name the process in which cells become adapted for different functions.

_____

(1)

(b) Palisade cells are found in leaves. The diagram shows a palisade cell.



(i) Name structure **A**.

_____

(1)

(ii) The real length of this cell between **X** and **Y** is 20 micrometres (μm). By how many times has it been magnified? Show your working.

Answer _____

(2)

(iii) Explain **one** way in which this cell is adapted for photosynthesis.

_____

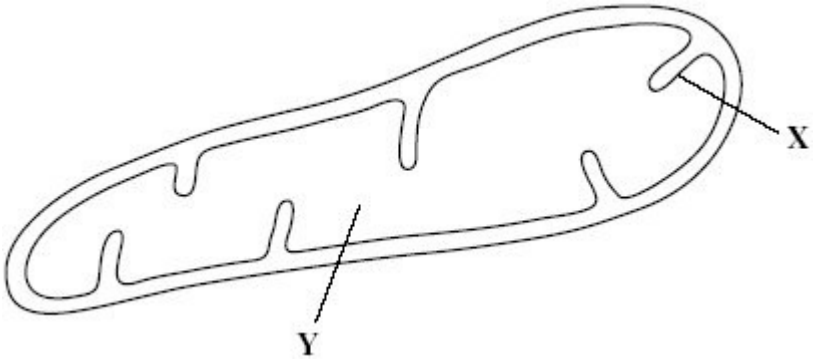
_____

(1)

(Total 5 marks)

Q47.

The diagram shows a mitochondrion.



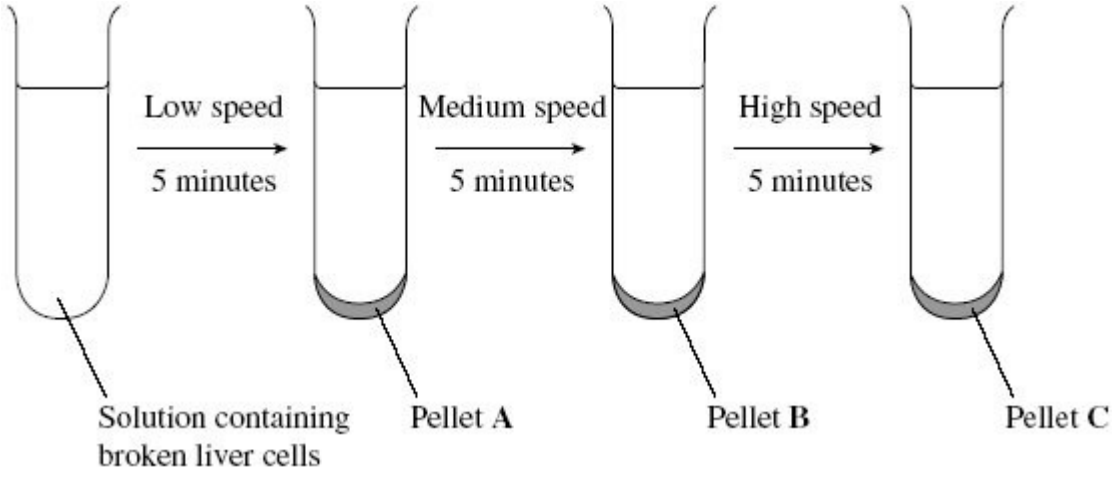
(a) Name the parts labelled **X** and **Y**.

(i) **X** _____

(ii) **Y** _____

(2)

Scientists isolated mitochondria from liver cells. They broke the cells open in an ice-cold, isotonic solution. They then used a centrifuge to separate the cell organelles. The diagram shows some of the steps in the process of centrifugation.



(b) Suggest which pellet, **A**, **B** or **C** contained the mitochondria.



(1)

(c) Explain why the solution used was

(i) ice-cold

_____

_____

(1)

(ii) isotonic.

_____

_____

_____

_____

(2)

(d) People with mitochondrial disease have mitochondria that do not function properly.

Some people with mitochondrial disease can only exercise for a short time. Explain why a person with mitochondrial disease can only exercise for a short time.

_____

_____

_____

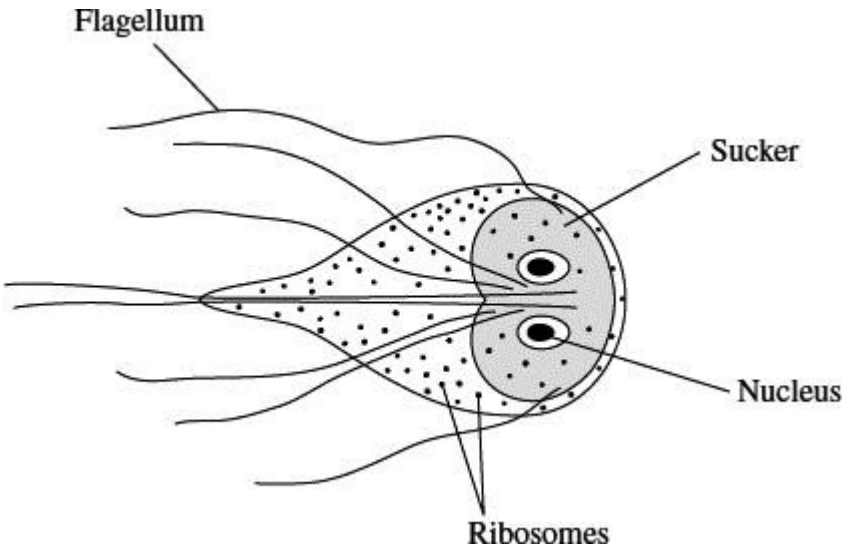
_____

(2)

(Total 8 marks)

Q48.

Giardiasis is an intestinal disease. It is caused by the microorganism *Giardia lamblia*. The drawing shows some of the structures present in *G. lamblia*.



(a) Name **one** structure shown in the drawing which confirms that *G. lamblia* is a eukaryotic organism.

_____

(1)

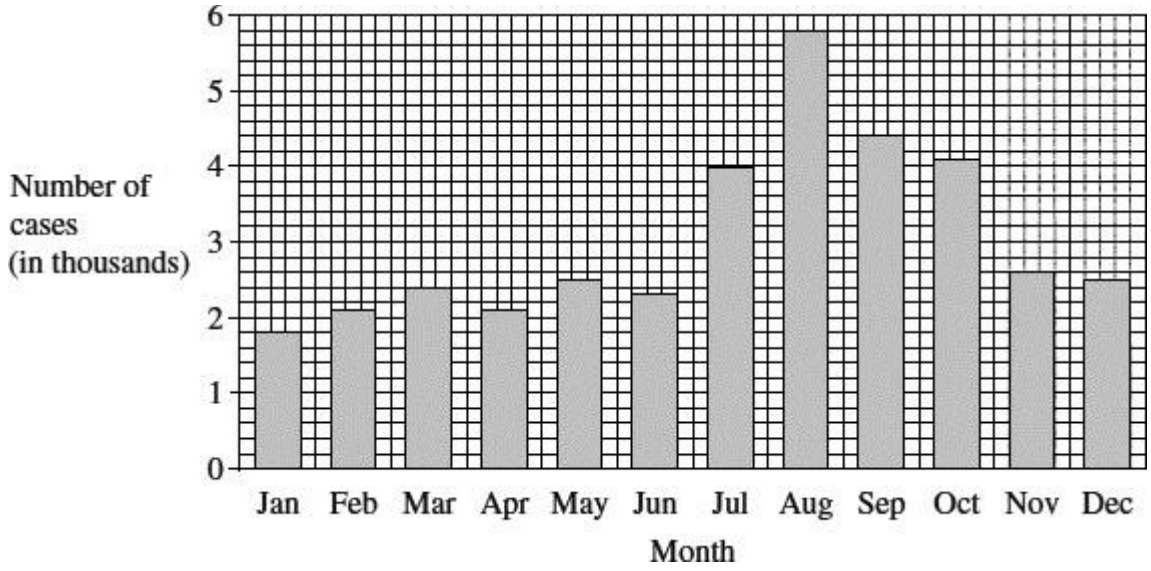
(b) *G. lamblia* can attach itself with its sucker. Explain how this is an adaptation to living in the intestines.

_____

_____

(1)

(c) Giardiasis is one of the main causes of diarrhoea in the USA. It is usually transmitted by drinking contaminated water. The bar chart shows the number of cases of giardiasis in one state of the USA during one year.



(i) Calculate the percentage increase in the number of cases of giardiasis from January to August. Show your working.

Answer _____

(2)

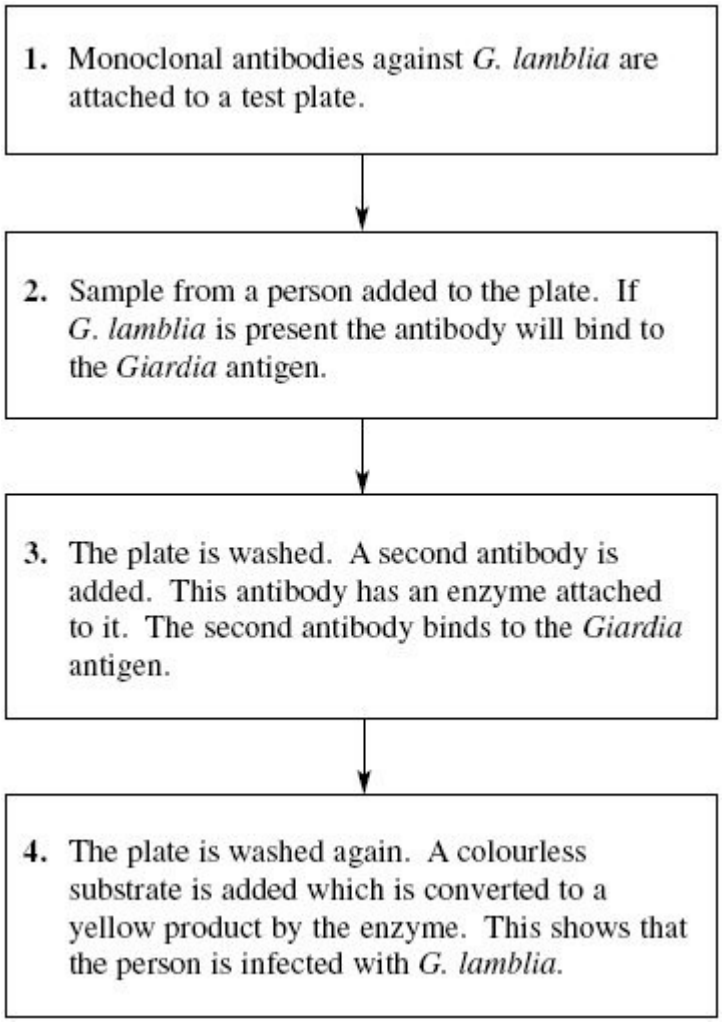
(ii) Suggest **one** reason for the number of cases being highest in the late summer months.

_____

_____

(1)

(d) A test has been developed to find out whether a person is infected with *G. lamblia.* The test is shown in the flow chart.



(i) Explain why the antibodies used in this test must be monoclonal antibodies.

_____

_____

(1)

(ii) Explain why the *Giardia* antigen binds to the antibody in step **2**.

_____

_____

(1)

(iii) The plate must be washed at the start of step **4**, otherwise a positive result could be obtained when the *Giardia* antigen is not present. Explain why a positive result could be obtained if the plate is not washed at the start of step **4**.

_____

_____

_____

_____

(2)
(Total 9 marks)

Q49.

(a) What is a tissue?

_____

_____

(1)

(b) A student cut a thin section of tissue from a potato and examined it with an optical microscope.

(i) Starch was present in the cells of this tissue. Describe how the student could find out where in the cells the starch was present.

_____

_____

_____

_____

_____

(2)

(ii) The student cut a thin section of the tissue. Explain why it was important that the section was thin.

_____

_____

_____

_____

_____

(2)

(c) The cell walls of potato cells contain cellulose. Cellulose and starch are both carbohydrates. Describe **two** ways in which molecules of cellulose are similar to molecules of starch.

_____

_____

_____

_____

(2)
(Total 7 marks)

Q50.

Scientists use optical microscopes and transmission electron microscopes (TEMs) to investigate cell structure. Explain the advantages and the limitations of using a TEM to investigate cell structure.

_____

_____

_____

_____

_____

_____

_____

_____

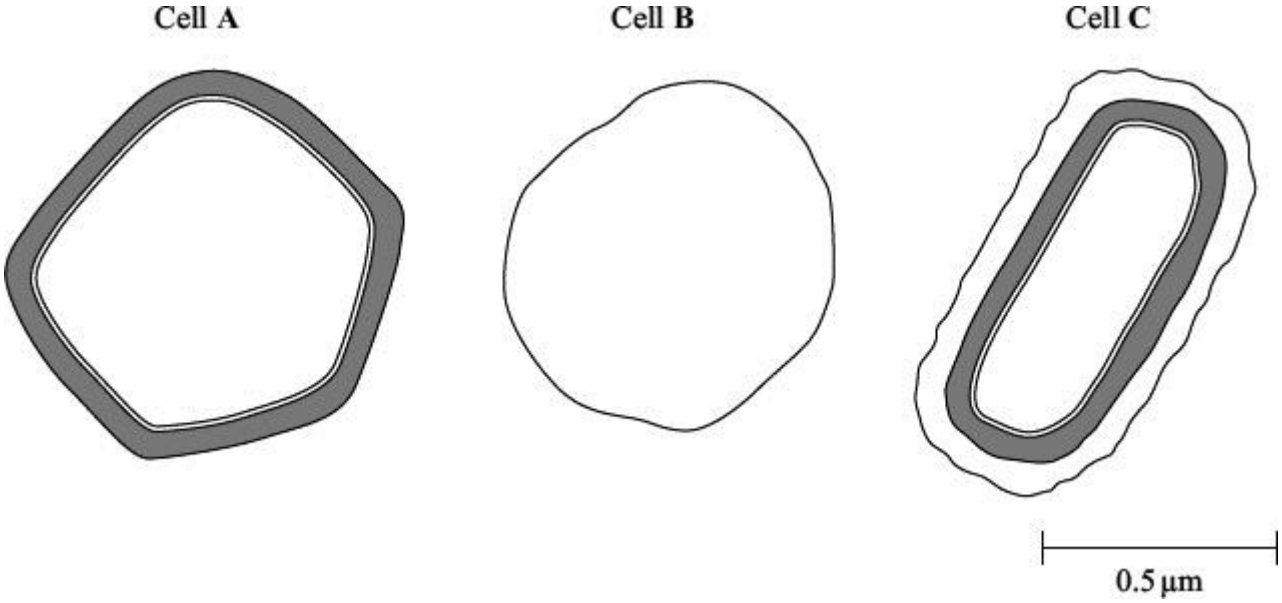
_____

_____

(Total 5 marks)

Q51.

The diagram shows the outer layers of three different cells, **A**, **B** and **C**.



(a) What is the evidence from the diagram that

(i) cell **B** is an animal cell,

_____

_____

(1)

(ii) cell **C** is a prokaryotic cell?

_____

_____

(1)

(b) Explain how you would calculate the magnification of cell **C**.

_____

_____

(1)

(c) Cell **A** is a plant cell. Name a polysaccharide which may be found in cell **A** but would not be found in the animal cell.

_____

(1)

(d) Penicillin is an antibiotic. It prevents the formation of bacterial cell walls. As a result, bacterial cells that have been treated with penicillin swell and burst as water enters.

(i) Explain how water enters a bacterial cell.

_____

_____

_____

_____

(2)

(ii) Suggest why penicillin has no effect on plant cells.

_____

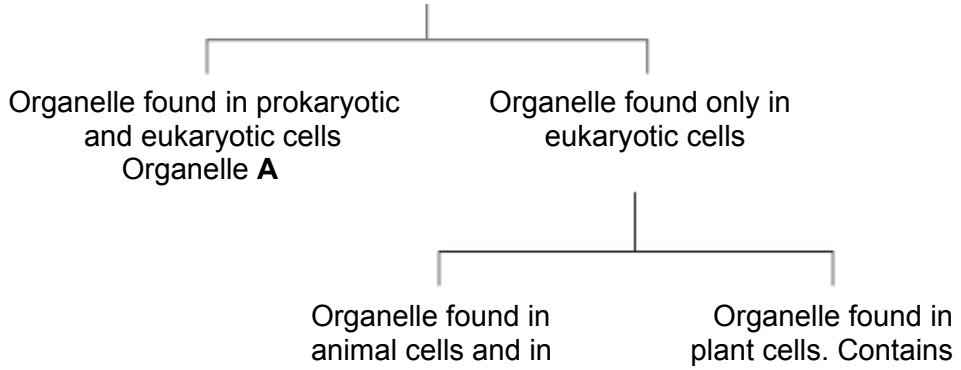
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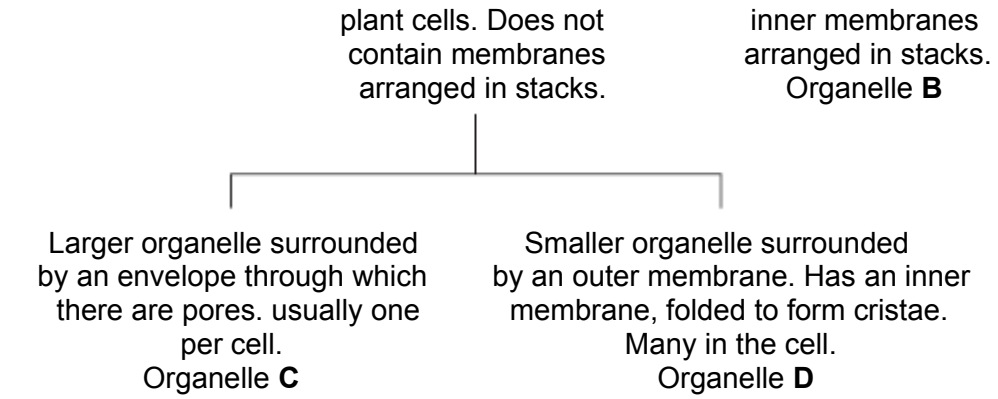
(1)

(Total 7 marks)

Q52.

The diagram shows how some organelles may be distinguished from each other.





(a) (i) Name organelle **B**.

_____

(1)

(ii) Describe the function of organelle **B**.

_____

_____

_____

_____

(2)

(b) Which of organelles **A**, **B**, **C** or **D**

(i) is a ribosome;

_____

(1)

(ii) contains most of the DNA found in a plant cell?

_____

(1)

(c) Some liver tissue was ground, filtered and centrifuged to make a suspension of organelle **D**.

(i) Explain why the solution in which the liver tissue was ground should be ice-cold.

_____

_____

(1)

(ii) The ground liver was centrifuged at low speed. The pellet that formed at the bottom of the centrifuge tube was thrown away and the supernatant centrifuged again at higher speed. Explain why it was necessary to first centrifuge the ground liver at low speed in order to obtain a suspension of organelle **D**.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q53.

(a) A plant cell was observed with an optical microscope. Describe how the length of the cell could be estimated.

_____

_____

_____

_____

(2)

(b) The water potential of a plant cell is –400 kPa. The cell is put in a solution with a water potential of –650 kPa. Describe and explain what will happen to the cell.

_____

_____

_____

_____

_____

_____

(3)

(c) A group of students investigated the effect of sucrose concentration on the change in length of cylinders of tissue cut from a young carrot. They measured the initial lengths of the carrot cylinders, then placed one in each of a number of sucrose solutions. After 18 hours, they removed the carrot cylinders and measured their final lengths. Some of the results are shown in the table.

Concentration of sucrose / mol dm^{-3}	**Percentage decrease in length of carrot cylinder**
0.4	4.2
0.5	8.7
0.6	13.0
0.7	16.8

0.8	18.1
0.9	18.1
1.0	18.1

(i) The carrot cylinders were left for 18 hours in the sucrose solutions. Explain why they were left for a long time.

_____

_____

(1)

(ii) Explain how you would use a graph to predict the concentration of sucrose that would result in no change in length of the carrot cylinders.

_____

_____

_____

_____

(2)

(iii) Young carrots store sugars in their tissues but, in older carrots, some of this is converted to starch. How would using cylinders of tissue from older carrots affect the results obtained for a sucrose solution of 0.6 mol dm^{-3}? Give a reason for your answer.

_____

_____

_____

_____

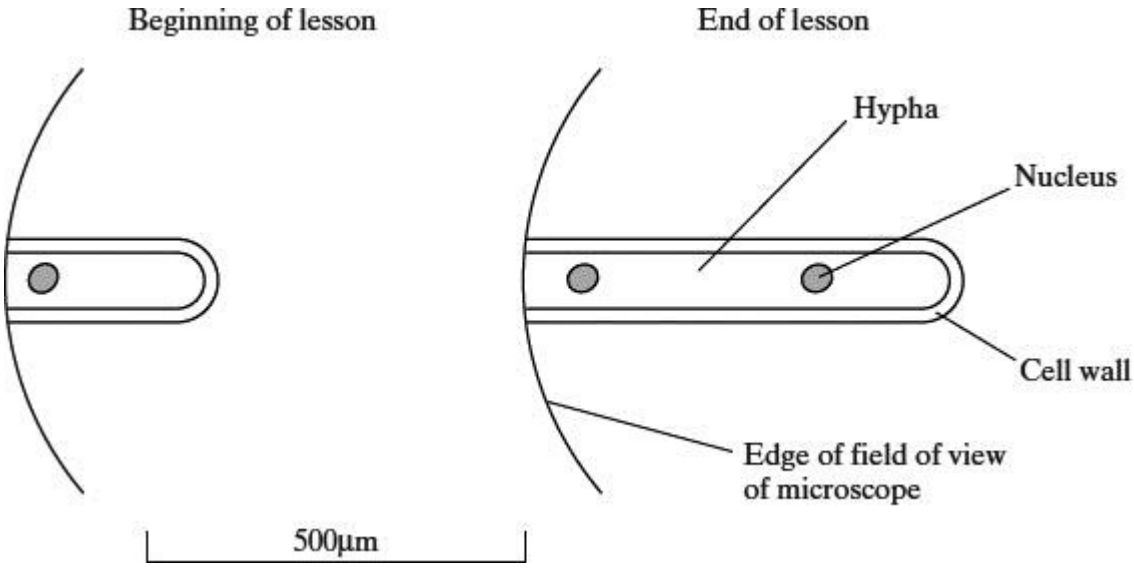
(2)

(Total 10 marks)

Q54.

Moulds belong to a group of organisms called fungi. When mould is examined with a microscope it is seen to consist of long, colourless threads called hyphae.

A student investigated the growth of fungal hyphae. The diagram shows part of a hypha seen under a microscope at the beginning of a lesson and again at the end of the lesson.



(a) Give **one** piece of evidence from the diagram that fungi are eukaryotic.

_____

_____

(1)

(b) (i) By how much had the hypha grown during the lesson? Show your working.

Answer: _____ µm

(2)

(ii) Explain how you could use your answer to calculate the rate of growth of this hypha.

_____

_____

(1)

(c) Under the microscope, small granules were seen in the hypha. Describe how you could show that these granules consisted of starch.

_____

_____

_____

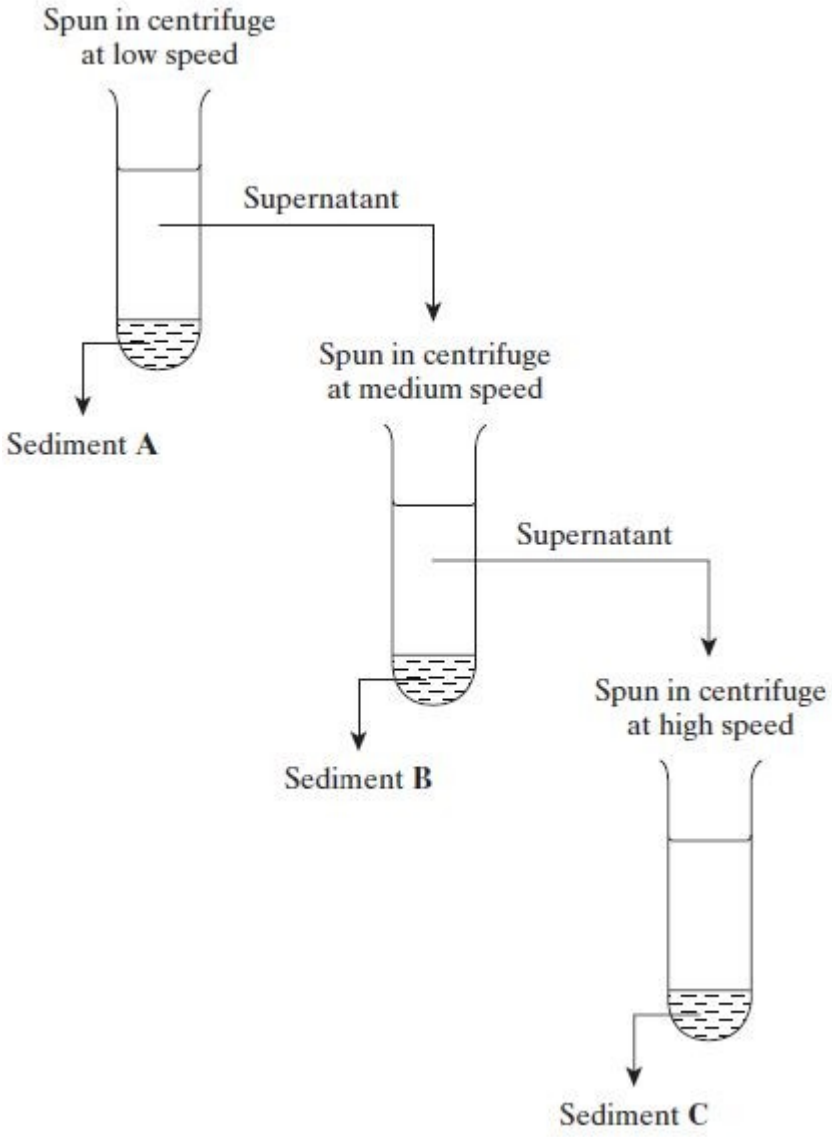
_____

(2)

(Total 6 marks)

Q55.

Liver was ground to produce a homogenate. The diagram shows how fractions containing different cell organelles were produced from the filtered homogenate.



(a) Explain why the homogenate was filtered before spinning at low speed in the centrifuge.

_____

_____

_____

_____

(2)

(b) The main organelles present in sediment **B** were mitochondria. Suggest the main organelles present in

(i) sediment **A**;

_____

(1)

(ii) sediment **C**.

_____

(1)

(c) What property of cell organelles allows them to be separated in this way?

_____

_____

(1)

(d) Explain why the organelles in sediment **C** could be seen with a transmission electron microscope but not with an optical microscope.

_____

_____

_____

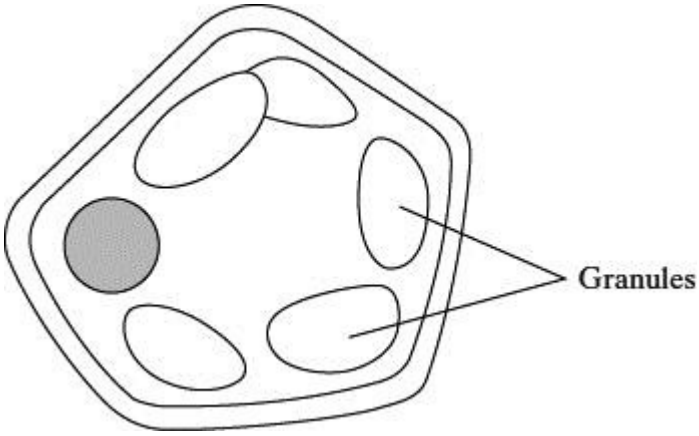
_____

(2)

(Total 7 marks)

Q56.

The diagram shows a cell from a potato.



(a) Give **two** features which may be found in a prokaryotic cell which would not be found in this cell.

1. _____

2. _____

(2)

(b) (i) Describe how you could confirm that the granules contained starch.

_____

_____

(1)

_____

(ii) Name **one** polysaccharide other than starch that would be found in this cell.

_____

(1)

(c) Explain **one** advantage of storing starch rather than glucose in potato cells.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q57.

Read the following passage.

In a human, there are over 200 different types of cell clearly distinguishable from each other. What is more, many of these types include a number of different varieties. White blood cells, Wfor example, include lymphocytes and granulocytes.

Although different animal cells have many features in common, each type has adaptations. associated with its function in the organism. As an example, most cells contain the same organelles, but the number may differ from one type of cell to another. Muscle cells contain many mitochondria, while enzyme-secreting cells from salivary glands have particularly large amounts of rough endoplasmic reticulum.

The number of a particular kind of organelle may change during the life of the cell. An example of this change is provided by cells in the tail of a tadpole. As a tadpole matures into a frog, its tail is gradually absorbed until it disappears completely. Absorption is associated with an increase in the number of lysosomes in the cells of the tail.

Use information from the passage and your own knowledge to answer the following questions.

(a) Explain the link between.

(i) mitochondria and muscle cells (lines 6 - 7);

_____

_____

_____

_____

_____

(3)

(ii) rough endoplasmic reticulum and enzyme-secreting cells from salivary glands (lines 7 - 8).

_____

_____

_____

_____

(2)

(b) Use information in the passage to explain how a tadpole's tail is absorbed as a tadpole changes into a frog.

_____

_____

_____

_____

(2)

(c) Starting with some lettuce leaves, describe how you would obtain a sample of undamaged chloroplasts. Use your knowledge of cell fractionation and ultracentrifugation to answer this question.

_____

_____

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_____

_____

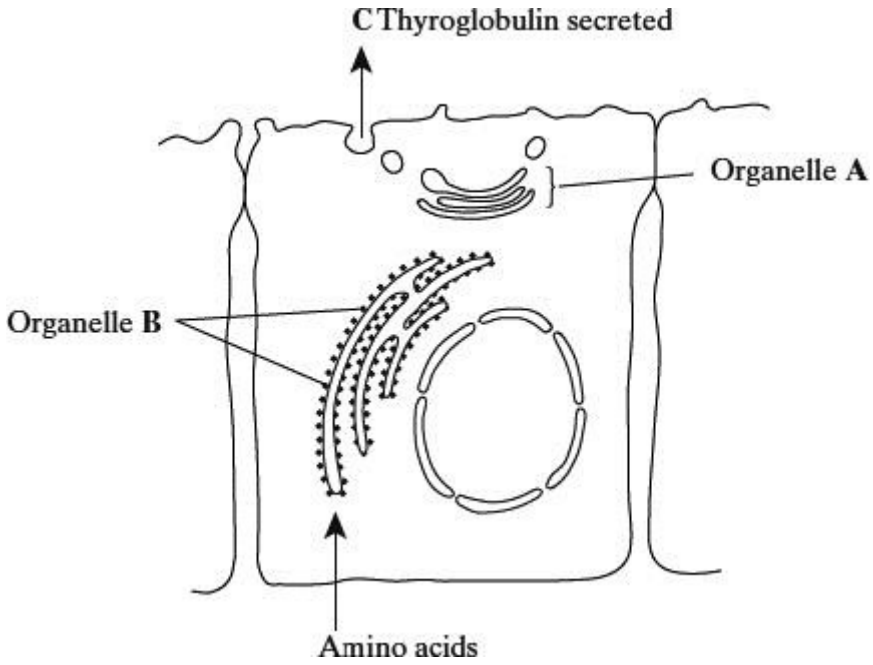
_____

(6)

(Total 13 marks)

Q58.

The thyroid gland is an organ in the neck. The diagram shows the process in which epithelial cells from the thyroid gland make and secrete a protein called thyroglobulin.



(a) Name

(i) organelle **A**;

_____

(1)

(ii) the process by which thyroglobulin is secreted from the cell at **C**.

_____

(1)

(b) (i) Describe the part played by the organelles labelled **B**.

_____

_____

(1)

(ii) Organelle **B** is very small. It cannot be seen when thyroid cells are examined with an optical microscope but it can be seen with an electron microscope. Explain why this organelle can be seen with an electron microscope.

_____

_____

_____

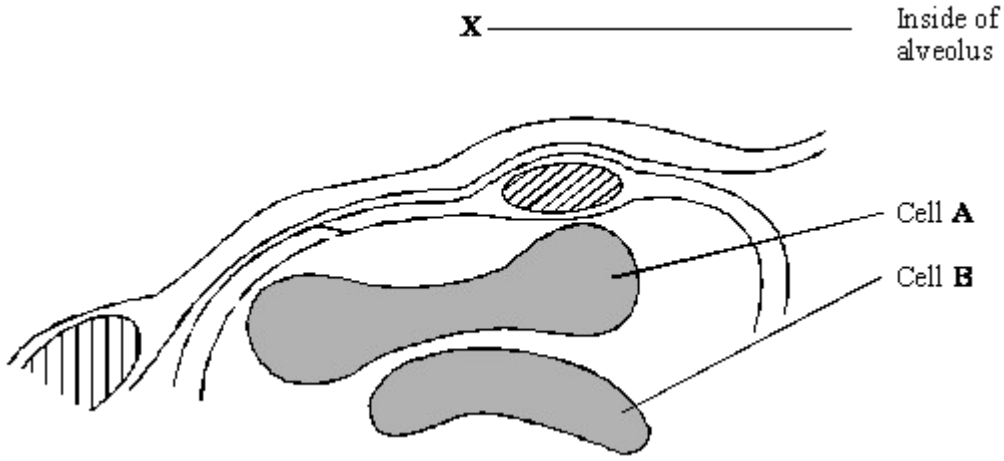
_____

(2)

(Total 5 marks)

Q59.

The drawing shows an electron micrograph of a section through part of an alveolus from a lung.



(a) Describe the path of a molecule of oxygen from the air in the alveolus at **X** to the plasma membrane of cell **A**.

_____

_____

(1)

(b) Cell **A** is a eukaryotic cell. Give **two** features that may be found in a prokaryotic cell which are not found in cell **A**.

1. _____

_____

2. _____

_____

(2)

(c) Cells **A** and **B** are biconcave discs. Explain **one** advantage of a biconcave disc over a spherical cell of the same volume in transporting oxygen.

_____

_____

_____

_____

(2)

(d) The diameter of a human red blood cell is 7 μm.

(i) Calculate the magnification of the drawing. Show your working.

Magnification = _____

(2)

(ii) In calculating the magnification, what assumption did you have to make about how the section was cut?

_____

_____

(1)

(Total 8 marks)

Q60.

Read the following passage.

Human milk contains all the nutrients a young baby needs in exactly the right proportions. It is formed in the mammary glands by small groups of milk-producing cells. These cells absorb substances from the blood and use them to synthesise the lipids, carbohydrates and proteins found in milk. Milk-producing cells are roughly cube-shaped and have a height to breadth ratio of approximately 1.2 : 1.

The main carbohydrate in milk is lactose. Lactose is a disaccharide formed by the condensation of two monosaccharides, glucose and galactose. (A molecule of galactose has the same formula as a molecule of glucose – the atoms are just arranged in a different way.)

Lactose is synthesised in the Golgi apparatus and transported in vesicles through the cytoplasm. Because lactose is unable to escape from these vesicles, they increase in diameter as they move towards the plasma membrane. The vesicle membranes fuse with the plasma membrane and the vesicles empty their contents out of the cell.

Use the information from the passage and your own knowledge to answer the following questions.

(a) (i) The breadth of a milk-producing cell is 26 μm. Calculate the height of this cell.

Height = _____ μm

(1)

(ii) Describe and explain how you would expect the height to breadth ratio of an epithelial cell from a lung alveolus to differ from the height to breadth ratio of a milk-producing cell.

_____

_____

_____

_____

(2)

(b) How many oxygen atoms are there in a molecule of

(i) galactose;

_____

(1)

(ii) lactose?

_____

(1)

(c) The lactose-containing vesicles increase in diameter as they move towards the plasma membrane of the milk-producing cell (lines 11-12). Use your knowledge of water potential to explain why.

_____

_____

_____

_____

(2)

(d) Suggest **one** advantage of milk-producing cells containing large numbers of mitochondria.

_____

_____

_____

_____

(2)

(e) Some substances pass through the plasma membrane of a milk-producing cell by diffusion. Describe the structure of a plasma membrane and explain how different substances are able to pass through the membrane by diffusion.

_____

_____

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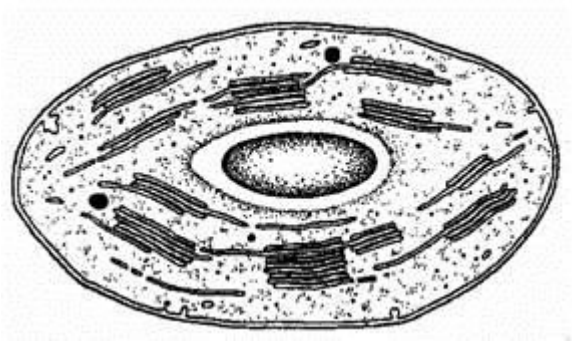
_____

(6)

(Total 15 marks)

Q61.

The diagram shows the structure of a chloroplast.



(a) Label the diagram with an **X** to show where the light-dependent reactions take place and with a **Y** to show where the light-independent reactions take place.

(1)

(b) The photolysis of water is an important part of the process of photosynthesis. Describe what happens in the photolysis of water.

_____

_____

_____

_____

(2)

(c) ATP and reduced NADP are two products of the light-dependent reactions. Describe **one** function of **each** of these substances in the light-independent reactions.

ATP _____

_____

Reduced NADP _____

_____

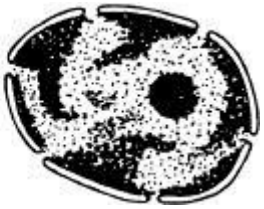
(2)

(Total 5 marks)

Q62.

(a) The diagram shows two organelles found in a eukaryotic cell.





A **B**

(i) Name the organelles.

A _____

B _____

(1)

(ii) Explain how the inner membrane is adapted to its function in organelle **A**.

_____

_____

_____

_____

(2)

(b) Give **one** feature of a prokaryotic cell that is not found in a eukaryotic cell.

_____

(1)

(c) Describe how a sample consisting only of chloroplasts could be obtained from homogenised plant tissue.

_____

_____

_____

_____

_____

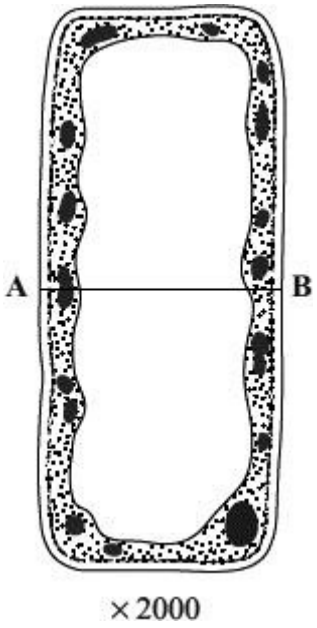
_____

(3)

(Total 7 marks)

Q63.

The figure shows a section through a palisade cell in a leaf as seen with a light microscope. The palisade has been magnified × 2000.



x 2000

(a) Calculate the actual width of the cell, measured from **A** to **B**, in μm. Show your working.

Answer _____ μm

(2)

(b) Palisade cells are the main site of photosynthesis. Explain **one** way in which a palisade cell is adapted for photosynthesis.

_____

_____

_____

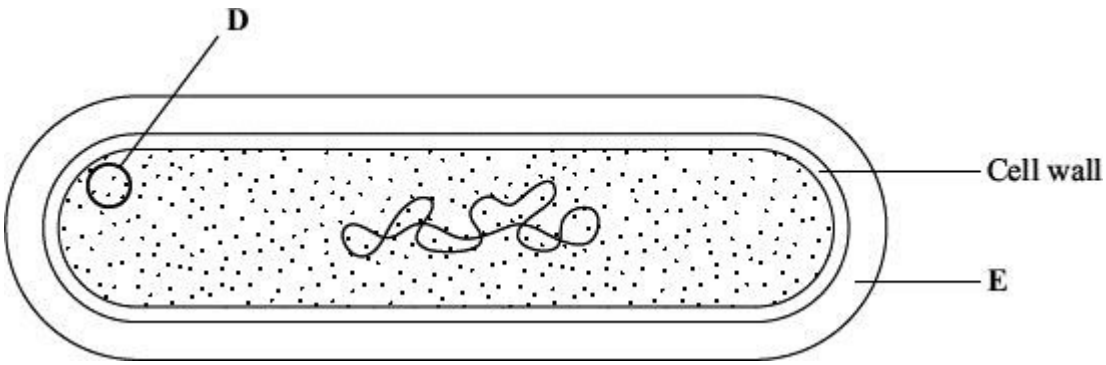
_____

(2)

(Total 4 marks)

Q64.

(a) The diagram shows a bacterial cell.



(i) Name the parts labelled **D** and **E.**

D _____

E _____

(2)

(ii) Give **one** function of the cell wall.

_____

_____

(1)

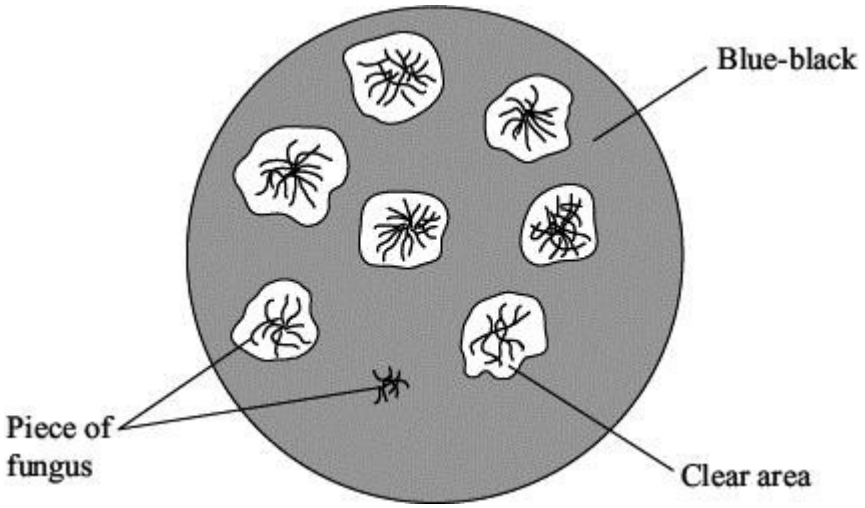
(b) Name **two** structures present in eukaryotic cells that are not present in the cells of prokaryotes.

1. _____

2. _____

(2)

(c) Several small pieces of a saprophytic fungus were placed on a starch agar plate. After 48 hours the iodine solution was poured over the starch agar. The result is shown in the diagram below.



(i) Explain why there is a clear area around most of the pieces of fungus.

_____

_____

_____

_____

(2)

(ii) Suggest why one piece of fungus has no clear area round it.

_____

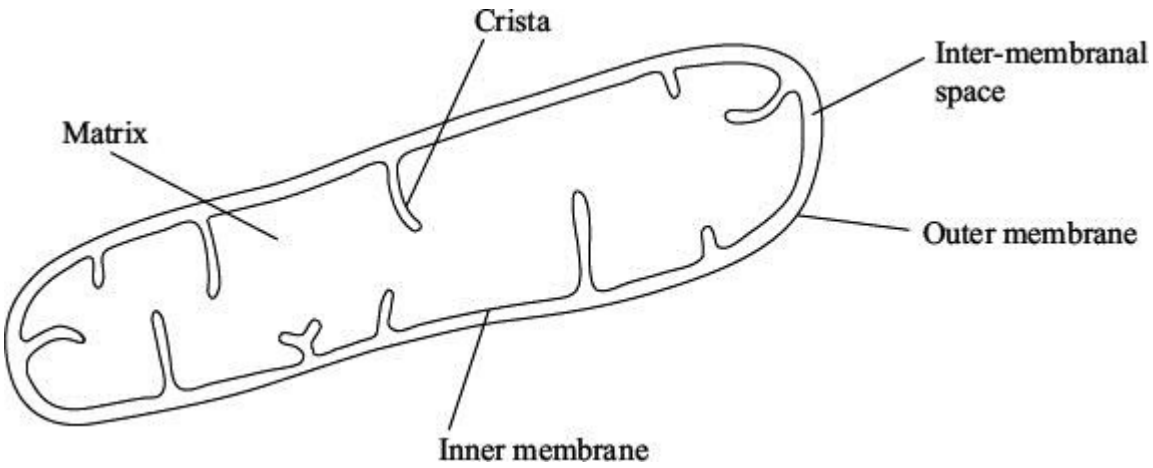
_____

(1)

(Total 8 marks)

Q65.

The diagram shows the structure of a mitochondrion.



(a) In which part of the mitochondrion does the Krebs cycle take place?

_____

(1)

(b) Name **two** substances for which there would be net movement into the mitochondrion.

1. _____

2. _____

(2)

(c) The mitochondria in muscles contain many cristae. Explain the advantage of this.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q66.

(a) Small samples of plant tissue were placed in a cold, isotonic solution and then treated to break open the cells to release the organelles. The different organelles were then separated. Describe a technique that could be used to

(i) break open the cells;

_____

_____

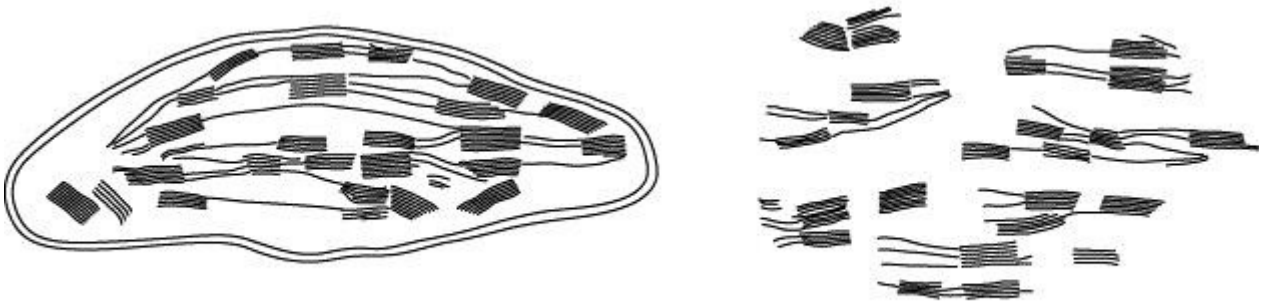
(ii) separate the organelles.

_____

_____

(2)

(b) One group of organelles was placed in a hypotonic solution. The diagram shows one of these organelles seen under an electron microscope before and after it was placed in the hypotonic solution.



Before

After

Name the organelle.

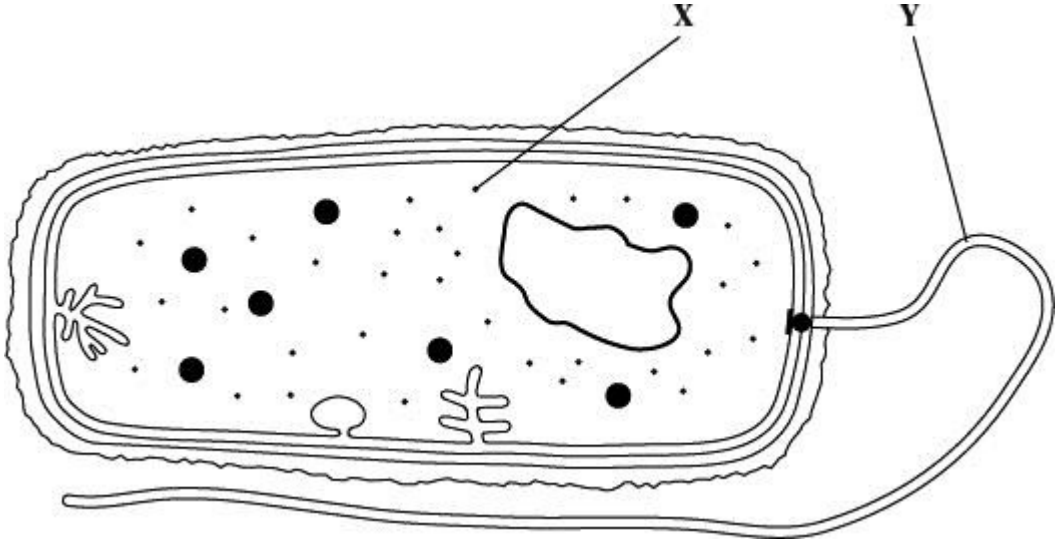
_____

(1)

(Total 3 marks)

Q67.

The diagram shows a bacterium.



(a) Give the function of

(i) organelle **X**;

_____

(ii) organelle **Y**.

_____

(2)

(b) (i) Give **two** ways in which the structure of this bacterium is similar to the structure of a cell lining the human small intestine.

1. _____

_____

2. _____

_____

(2)

(ii) Give **two** ways in which the structure of this bacterium differs from the structure of a cell lining the human small intestine.

1. _____

_____

2. _____

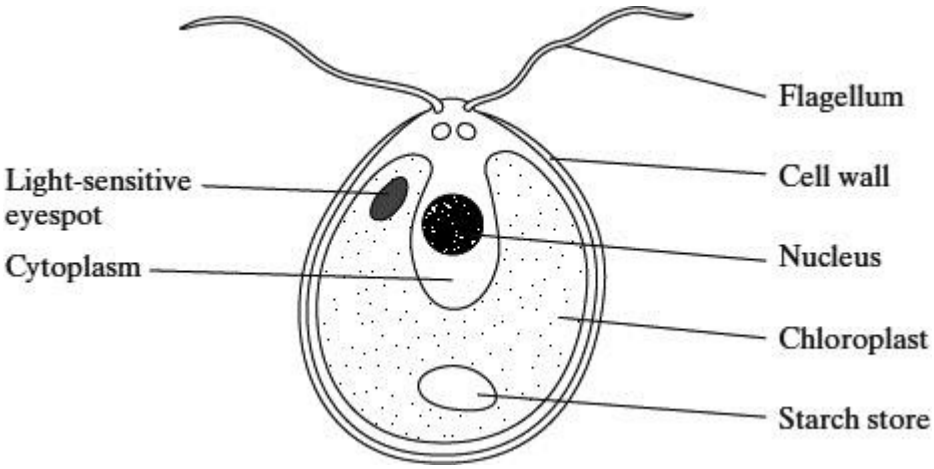
_____

(2)

(Total 6 marks)

Q68.

The diagram shows a single-celled organism called *Chlamydomonas*.



(a) *Chlamydomonas* lives in fresh-water ponds. It uses its flagella to swim towards light of moderate intensity but away from very bright light. Using information in the diagram, explain the advantage of this behaviour.

_____

_____

_____

_____

(2)

(b) A *Chlamydomonas* cell has two flagella. These flagella contain a single sort of protein. A flagellum consists of a bundle of 242 filaments. Each filament consists of 7500 protein molecules. Each protein molecule contains 900 amino acid units.

(i) What would be the minimum number of nucleotides in the coding region of the mRNA used to synthesise this protein?

_____

(1)

(ii) In an investigation, a culture of *Chlamydomonas* was treated in a way that caused them to lose their flagella without any other damage to the cells. The flagella grew back to their original length in 60 minutes.

How many amino acid molecules would be incorporated into each growing flagellum per minute? Show your working.

Answer _____

(2)

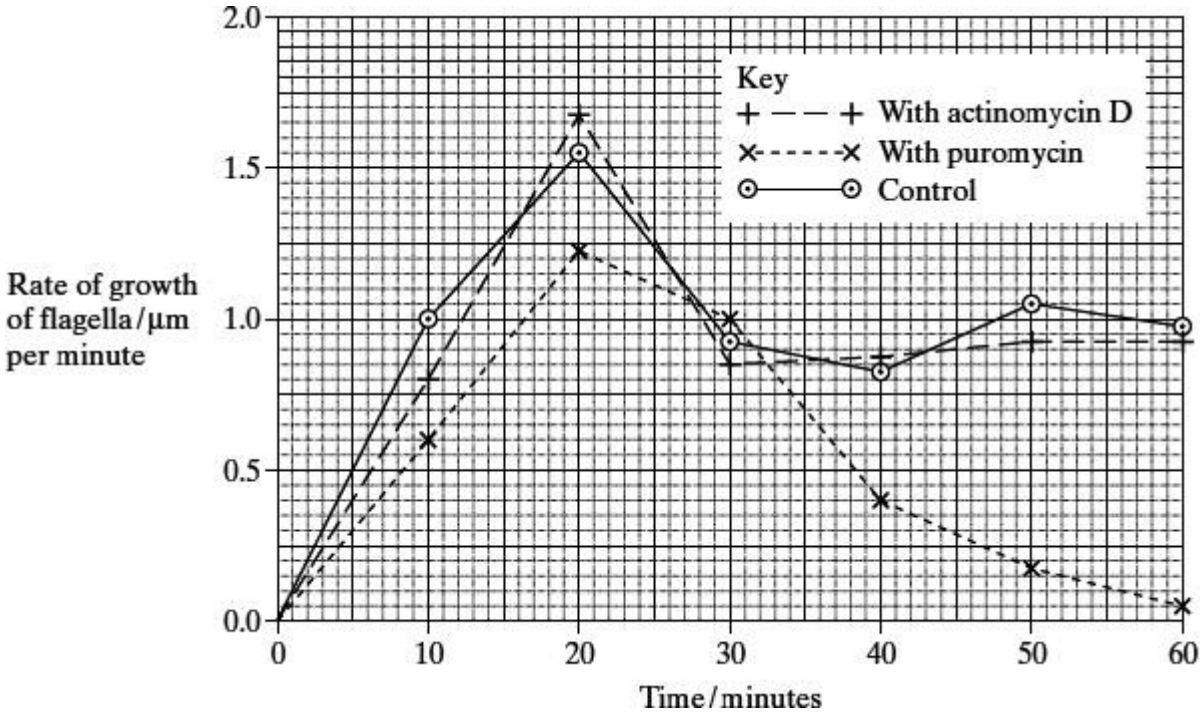
(c) The researchers investigated the rate at which the flagella grew in three different media.

1. A medium containing actinomycin D, which prevents transcription by binding to the guanine in DNA

2. A medium containing puromycin, which prevents translation by attaching to ribosomes

3. A control medium

The results are shown in the graph.



(i) Describe how the rate of growth was affected by puromycin.

_____

_____

_____

_____

(2)

(ii) The researchers concluded

1. that the cells used mRNA that is already present in the cytoplasm for the regrowth of the flagella;

2. that some of the regrowth uses protein molecules already present in the cell.

Explain the evidence for each of these conclusions.

1. _____

_____

_____

_____

2. _____

_____

_____

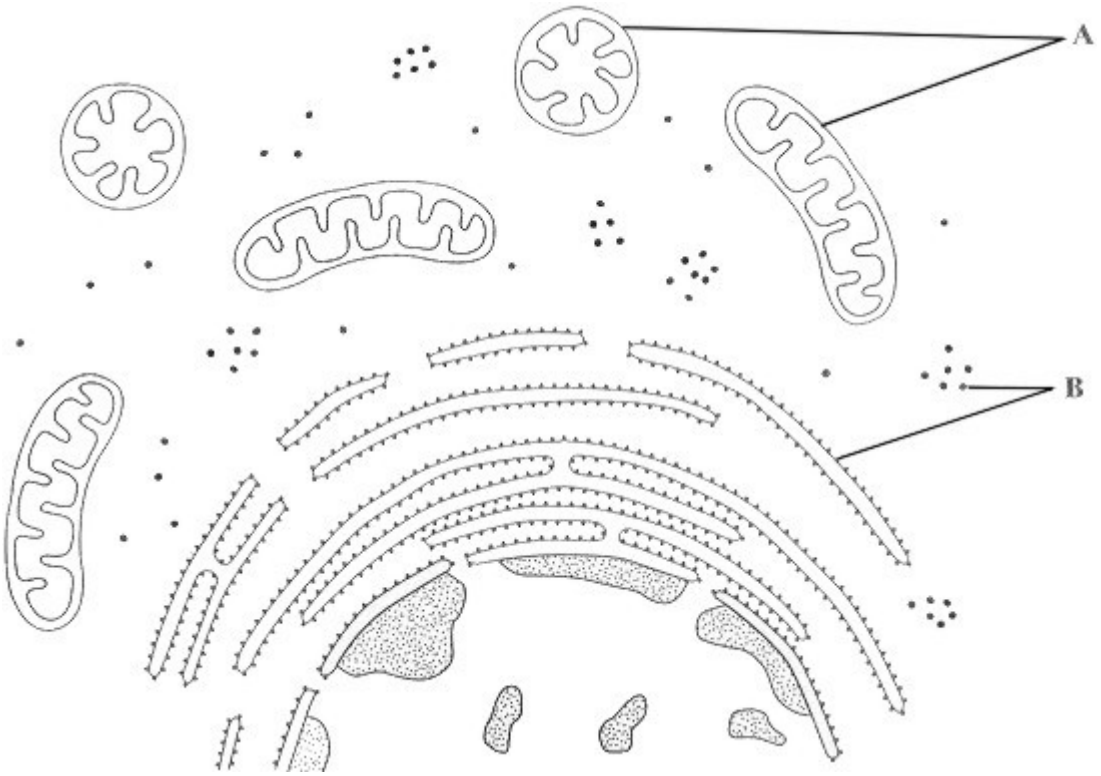
_____

(4)

(Total 11 marks)

Q69.

The diagram shows part of an animal cell as seen through an electron microscope.



(a) Name the organelles labelled **A** and **B**.

A _____

B _____

(2)

(b) Explain why the shapes of the two organelles labelled **A** appear different.

_____

_____

_____

_____

(2)

(c) Give the function of organelle **B**.

_____

_____

(1)

(d) The epithelial cells of the small intestine have large numbers of organelle **A**. Explain how this is an adaptation for the function of these cells.

_____

_____

_____

_____

_____

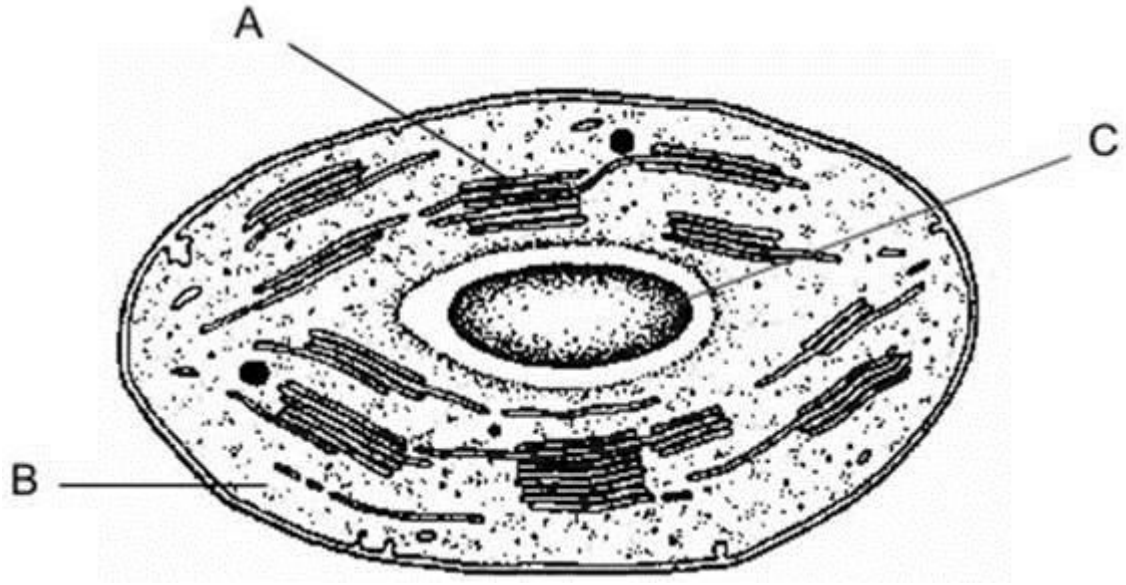
_____

(3)

(Total 8 marks)

Q70.

The electron micrograph shows part of a chloroplast.



(a) Name the parts labelled **A** and **B** and, for each, describe **one** role in the process of photosynthesis.

A Name _____

Role _____

B Name _____

Role _____

(4)

(b) (i) Name the main substance present in the part labelled **C**.

_____

(1)

(ii) How is this substance formed?

_____

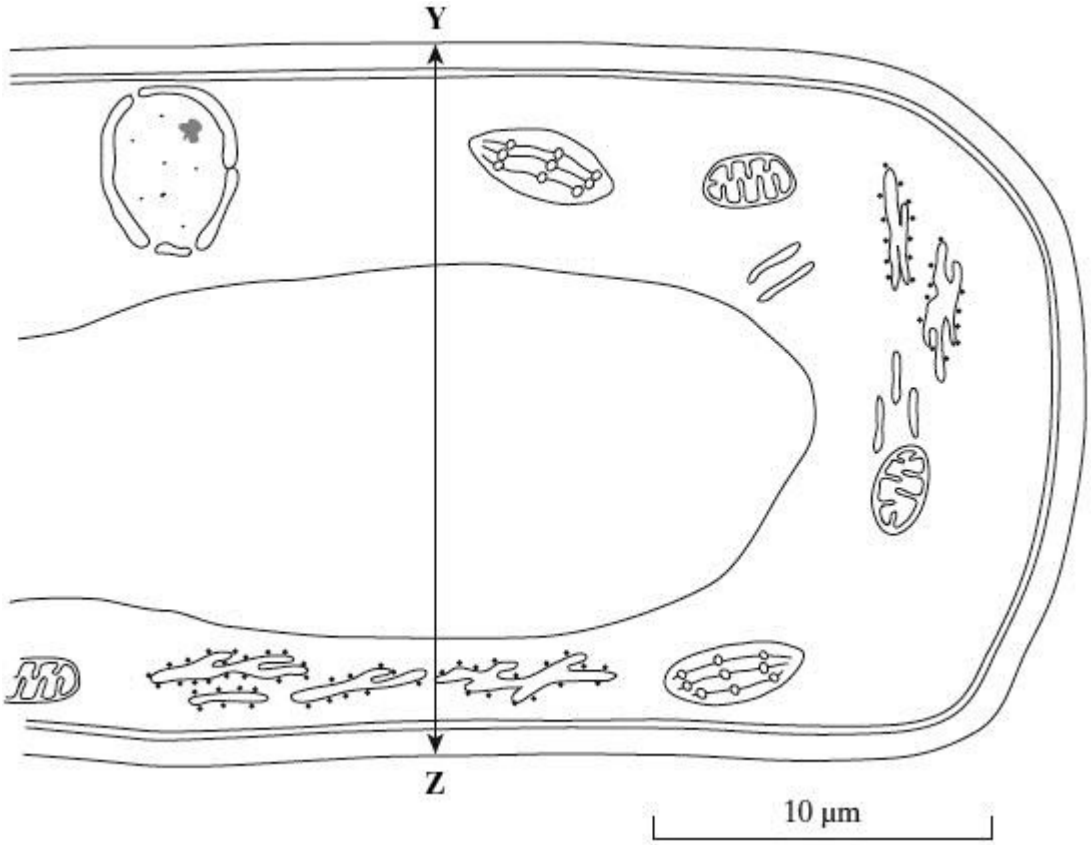
_____

(1)

(Total 6 marks)

Q71.

The drawing shows part of a plant cell as seen with an electron microscope.



(i) Give **two** features shown in the drawing which are evidence that this cell is eukaryotic.

1. _____

_____

2. _____

_____

(2)

(ii) Calculate the actual width of the cell from **Y** to **Z**. Give your answer in micrometres (μm) and show your working.

Answer _____ μm

(2)

(iii) Give **one** way in which a typical animal cell differs from the cell shown in the drawing.

_____

_____

(1)

(Total 5 marks)

Q72.

(a) Changes to the protein coat of the influenza virus cause antigenic variability. Explain how antigenic variability has caused some people to become infected more than once with influenza viruses.

_____

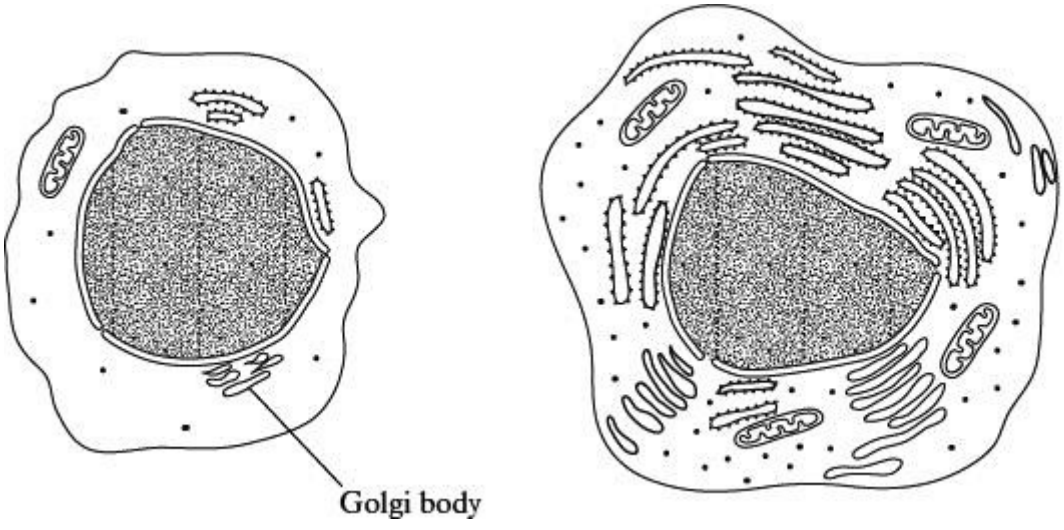
_____

_____

_____

(2)

(b) The drawings show the changes in a B lymphocyte after stimulation by specific antigens.



B lymphocyte before stimulation B lymphocyte after stimulation

(i) Describe the role of macrophages in stimulating B lymphocytes.

_____

_____

(1)

(ii) Explain how the changes shown in the drawings are related to the function of B lymphocytes.

_____

_____

_____

_____

_____

_____

_____

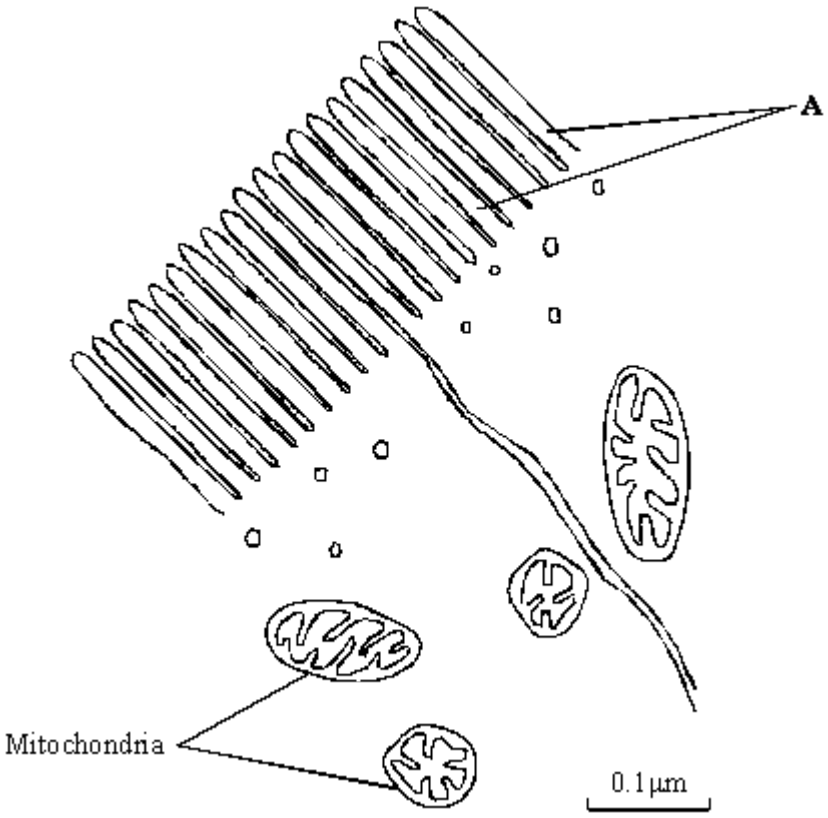
_____

(4)

(Total 7 marks)

Q73.

The drawing shows an electron micrograph of parts of epithelial cells from the small intestine.



(a) (i) Name the structures labelled **A**.

_____

(1)

(ii) Explain how these structures help in the absorption of substances from the small intestine.

_____

_____

(1)

(b) (i) The scale bar on this drawing represents a length of 0.1µm. Calculate the magnification of the drawing. Show your working.

Magnification _____

(2)

(ii) Explain why an electron microscope shows more detail of cell structure than a light microscope.

_____

_____

_____

(2)

(c) The length of mitochondria can vary from 1.5 µm to 10 µm but their width never exceeds 1µm. Explain the advantage of the width of mitochondria being no more than 1µm.

_____

_____

(1)

(Total 7 marks)

Q74.

Gorter and Grendel investigated the structure of the surface membrane of cells. They extracted the phospholipids from the surface membranes of red blood cells in 1 cm^3 of blood and placed them in the apparatus shown in **Figure 1**.

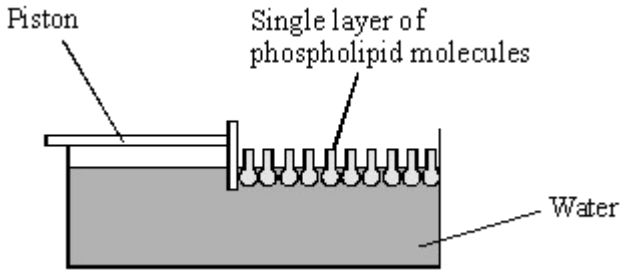


Figure 1

The piston was pushed across the surface of the water until the phospholipid molecules were tightly packed into a single layer. The area covered by the phospholipid molecules was measured. This area was compared with the estimated surface area of the red blood cells from which phospholipids were extracted.

Gorter and Grendel obtained the data shown in the table.

Number of red blood cells per cm^3 of blood	4.74×10^9
Estimated mean surface area of one red blood cell	99.4 μm^2
Surface area of membrane phospholipids extracted from 1cm^3 of blood	0.92 m^2

(a) Explain what these data suggest about the arrangement of phospholipids in the surface membranes of red blood cells. Support your explanation with suitable calculations.

Show your working.

_____

_____

_____

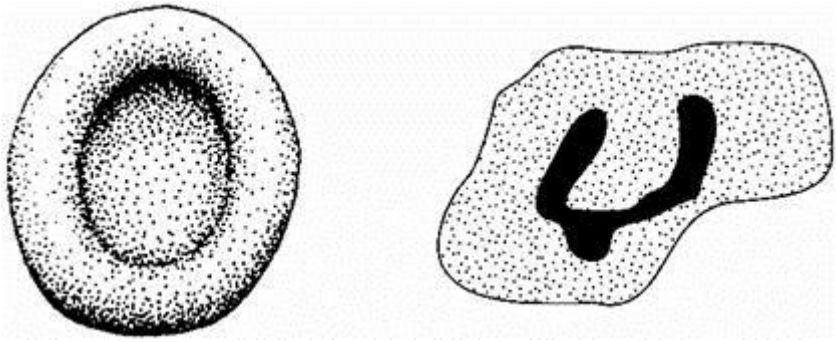
_____

_____

_____

(3)

(b) **Figure 2** shows a red blood cell and a white blood cell.



Red blood cell White blood cell

Figure 2

Explain why red blood cells were used in this investigation rather than white blood cells.

_____

_____

_____

_____

(2)

(Total 5 marks)