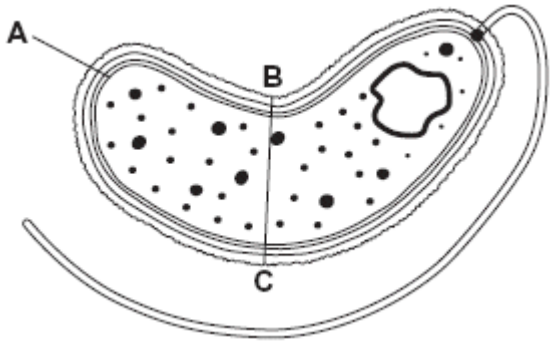
EXAM PAPERS PRACTICE

Studying cells 1

Level: CIE AS 9700
Subject: Biology
Exam Board: Suitable for all boards
Topic: Studying cells 1
Type: Questionnaire

To be used by all students preparing for CIE AS Biology 9700 foundation or higher tier but also suitable for students of other boards.

1 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.

_____

_____

_____

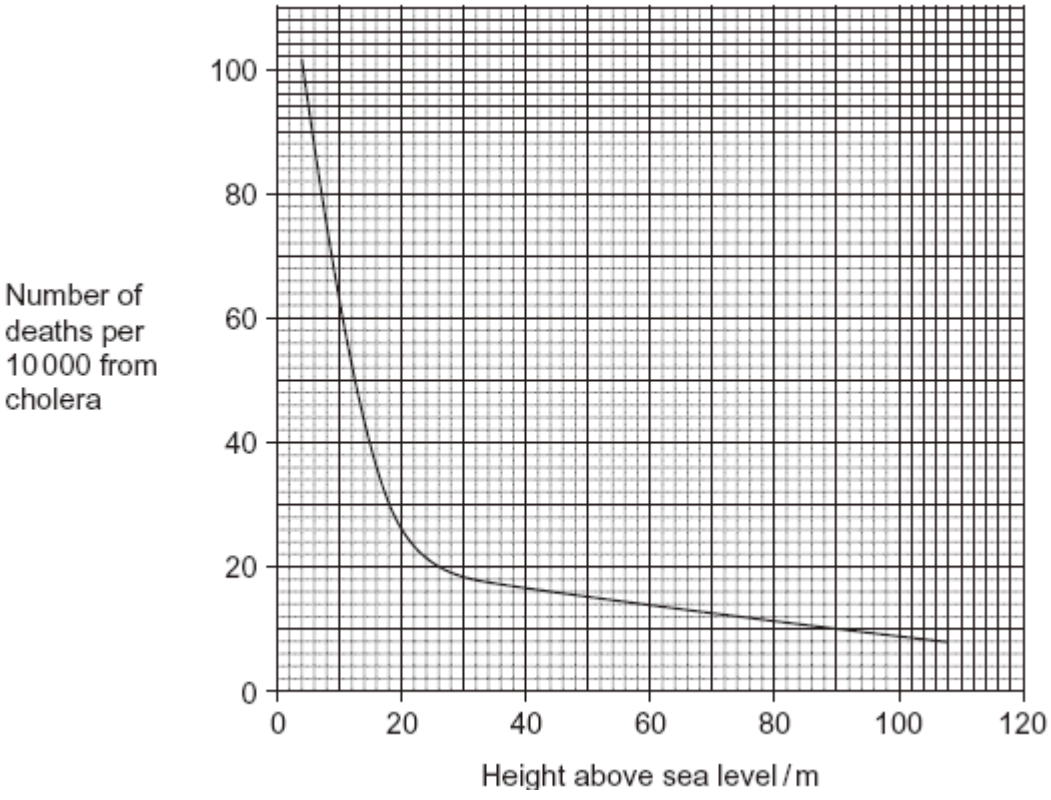
(1)

(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)

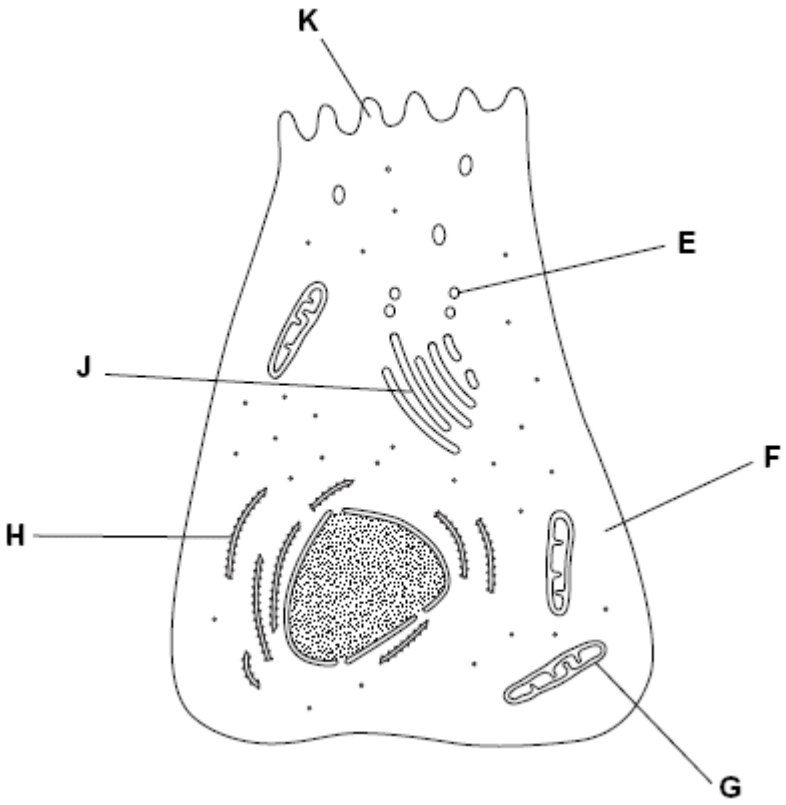
(Total 9 marks)

2 (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)

3 A student investigated mitosis in the tissue from an onion root tip.

(a) The student prepared a temporary mount of the onion tissue on a glass slide. She covered the tissue with a cover slip. She was then given the following instruction.

"Push down hard on the cover slip, but do not push the cover slip sideways."

Explain why she was given this instruction.

_____

_____

_____

_____

(2)

The image below shows one cell the student saw in the onion tissue.

© Ed Reschke/
Oxford Scientific/Getty Images

(b) The student concluded that the cell in the image above was in the anaphase stage of mitosis.
Was she correct? Give **two** reasons for your answer.

1. _____

_____

2. _____

_____

(2)

(c) The student counted the number of cells she observed in each stage of mitosis.
Of the 200 cells she counted, only six were in anaphase.

One cell cycle of onion root tissue takes 16 hours. Calculate how many minutes these cells spend in anaphase.

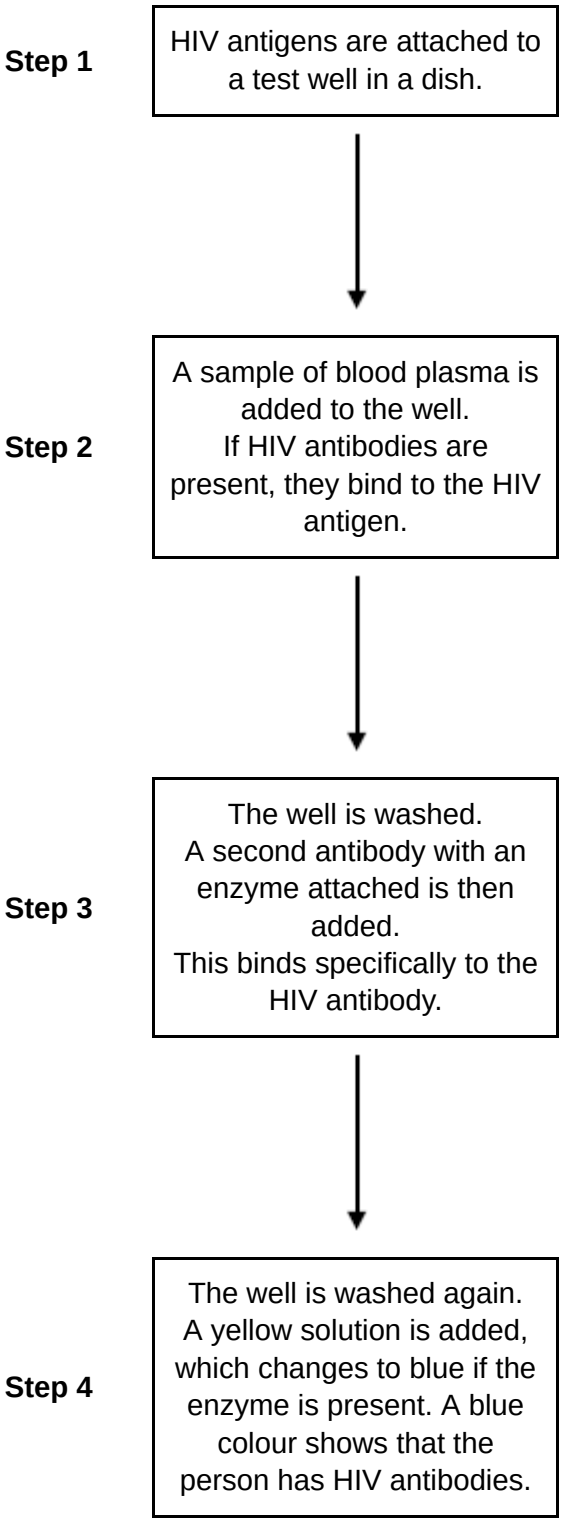
Show your working.

Answer = _____ minutes

(2)

(Total 6 marks)

4 The figure below shows a test that has been developed to find out if a person has antibodies to the human immunodeficiency virus (HIV) antigen.



(a) This test only detects the presence of HIV antibodies. Give **two** reasons why it cannot be used to find out if a person has AIDS.

1. _____

_____

2. _____

_____

(2)

(b) The solution will remain yellow if a person is **not** infected with HIV. Explain why.

_____

_____

_____

_____

(2)

(c) A mother who was infected with HIV gave birth to a baby. The baby tested positive using this test. This does not prove the baby is infected with HIV.
Explain why.

_____

_____

_____

_____

(2)

(d) A control well is set up every time this test is used. This is treated in exactly the same way as the test wells, except that blood plasma is replaced by a salt solution.

Use information from the figure above to suggest **two** purposes of the control well.

1. _____

_____

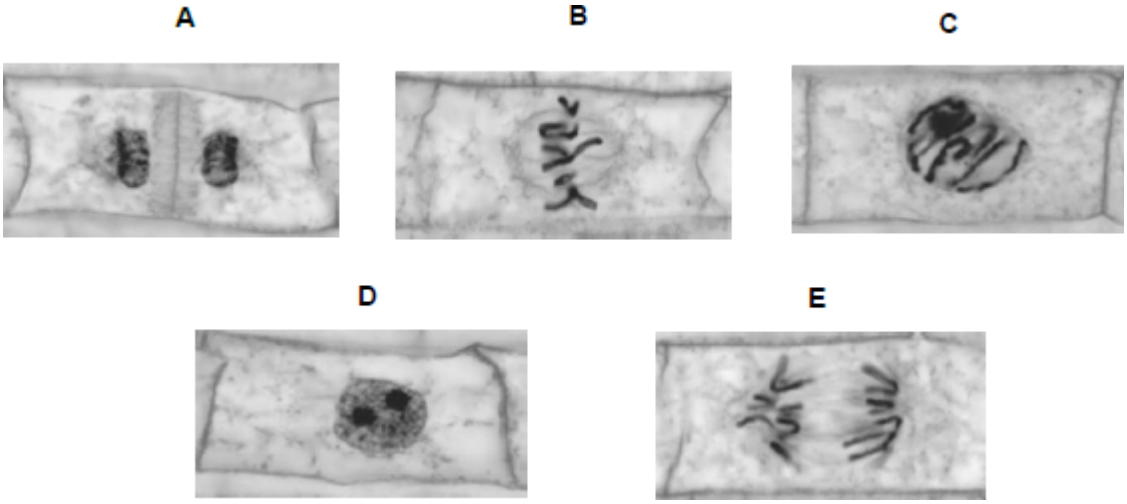
2. _____

_____

(2)

(Total 8 marks)

5 The figure below shows some cells from an onion root tip at different stages of the cell cycle.



(a) Place stages **A** to **E** in the correct order. Start with stage **D**.

D _____

(1)

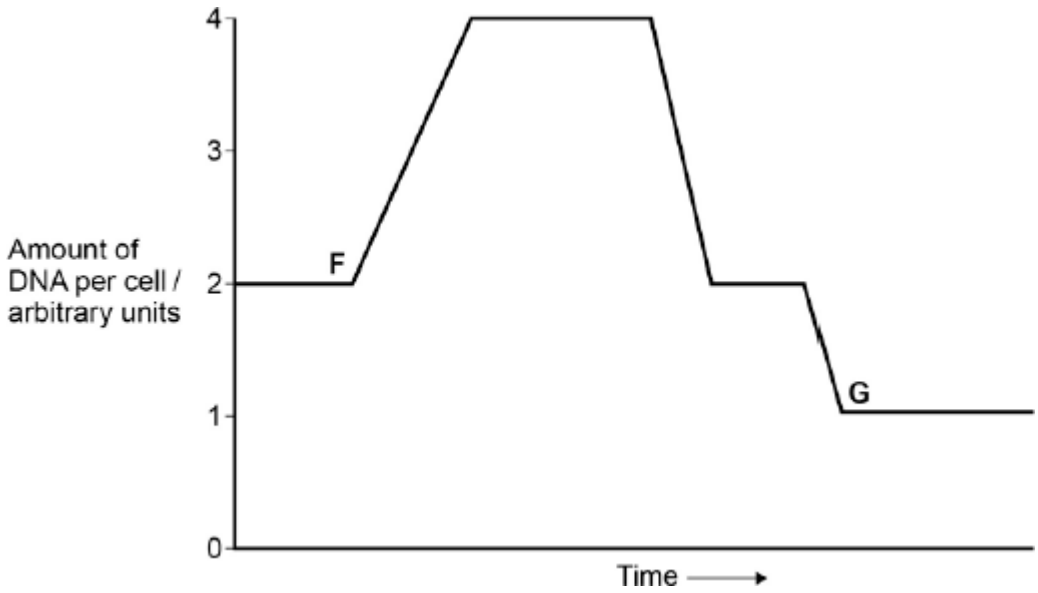
To obtain these images, the onion root tip was cut off, stained and put on a microscope slide. A cover slip was placed on top. The root tip was then firmly squashed and viewed under an optical microscope.

(b) Complete the table below to give **one** reason why each of these steps was necessary.

Step	Reason
Taking cells from the root tip	
Firmly squashing the root tip	

(2)

The figure below shows how the amount of DNA per cell changed during interphase and meiosis in an animal.



(c) Explain how the behaviour of chromosomes causes these changes in the amount of DNA per cell between **F** and **G**.

(Extra space) _____

(3)

(d) What would happen to the amount of DNA per cell at fertilisation of cell **G?**

(1)

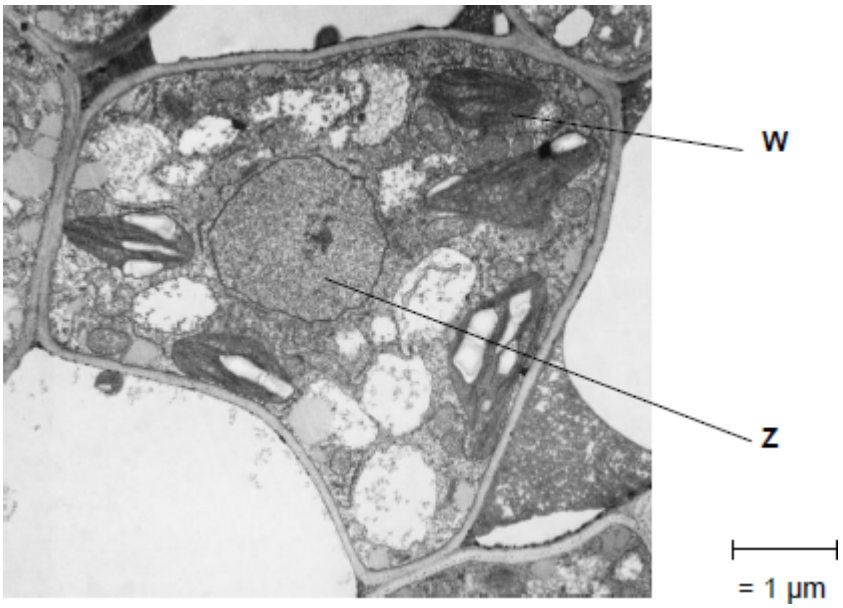
(Total 7 marks)

6 (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.

(Extra space) _____

(4)

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



(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)

7 A student investigated the distribution of stomata on leaves from two species of plant. She removed small pieces from the lower surface of the leaves of each plant species. She mounted these pieces on separate microscope slides. She then counted the number of stomata in several parts of the epidermis on each piece of leaf tissue using an optical microscope.

(a) Suggest appropriate units the student should use to compare the distribution of stomata on leaves.

_____

(1)

(b) The pieces of leaf tissue examined were very thin.

Explain why this was important.

_____

_____

_____

_____

_____

(2)

(c) Give **two** reasons why it was important that the student counted the number of stomata in several parts of each piece of leaf tissue.

1. _____

_____

2. _____

_____

(2)

(d) One of the two plant species used by the student in this investigation was a xerophyte.

Other than the distribution of stomata, suggest and explain **two** xerophytic features the leaves of this plant might have.

1. _____

_____

2. _____

_____

(2)

(e) The student then compared the rate of transpiration (evaporation of water) from the two species of plant. She did this by measuring the rate of water uptake by each plant species.

Suggest **two** reasons why the rate of water uptake by a plant might not be the same as the rate of transpiration.

1. _____

_____

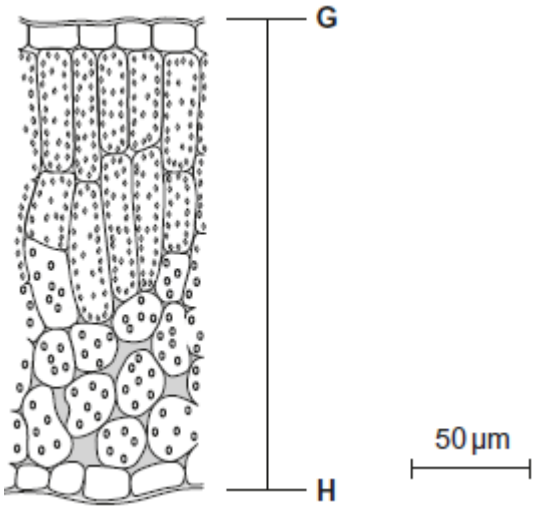
2. _____

_____

(2)

(Total 9 marks)

8 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)

9 Multiple sclerosis (MS) is a condition caused when the body's own immune system attacks the myelin sheath around axons. The cell bodies of the neurones themselves can also be damaged or destroyed. People with MS usually have periods of time when their MS gets no worse, followed by relapses when it gets worse.

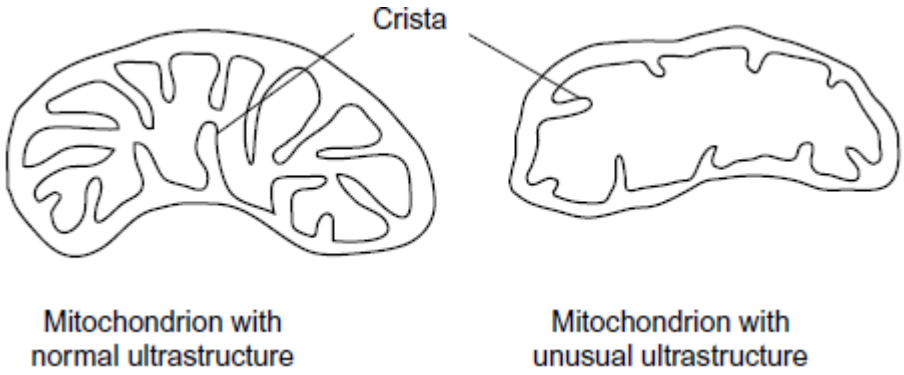
Scientists investigated the effects on neurones of damage to myelin. The scientists obtained a modified antigen from the myelin sheath of humans and injected it into mice. After a number of days, this injection of antigen resulted in the myelin sheaths in the mice being damaged. Some cell bodies of neurones were also damaged.

(a) Suggest how the injection of the antigen resulted in the myelin sheaths being damaged.

(3)

(b) The scientists compared the ultrastructure of normal and damaged neurones. They found that damaged neurones contained many mitochondria with an unusual ultrastructure.

The diagram shows a mitochondrion with normal ultrastructure and one with the unusual ultrastructure.



Suggest why having a large number of mitochondria with this unusual ultrastructure could lead to neurones dying.

(3)

(c) The scientists took a large number of photographs of thin sections through neurones. Using these photographs, they found that 40% of mitochondria had the unusual ultrastructure in damaged neurones.

(i) What sort of microscope would the scientists use to take the photographs? Give **one** reason for your answer.

Type of microscope _____

Reason _____

_____

_____

(1)

(ii) Suggest how the scientists found the percentage of mitochondria with the unusual ultrastructure.

_____

_____

_____

_____

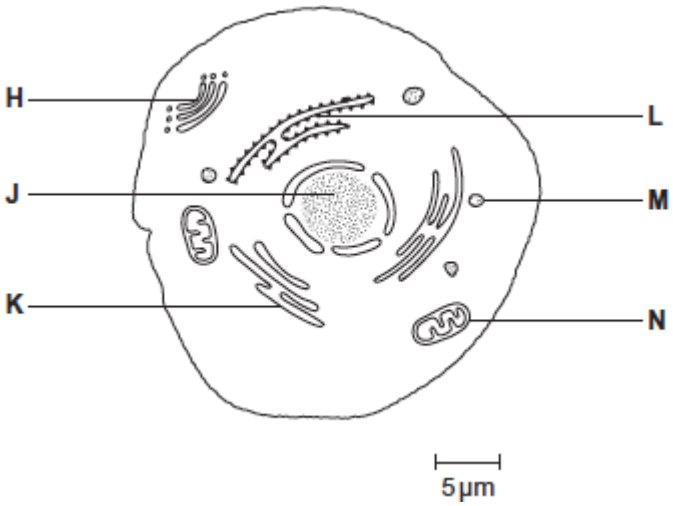
_____

_____

(3)

(Total 10 marks)

10 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)

11 (a) Describe and explain how cell fractionation and ultracentrifugation can be used to isolate mitochondria from a suspension of animal cells.

(5)

(b) Describe the principles and the limitations of using a transmission electron microscope to investigate cell structure.

(5)

(Total 10 marks)

12 (a) The events that take place during interphase and mitosis lead to the production of two genetically identical cells. Explain how.

[Extra space]

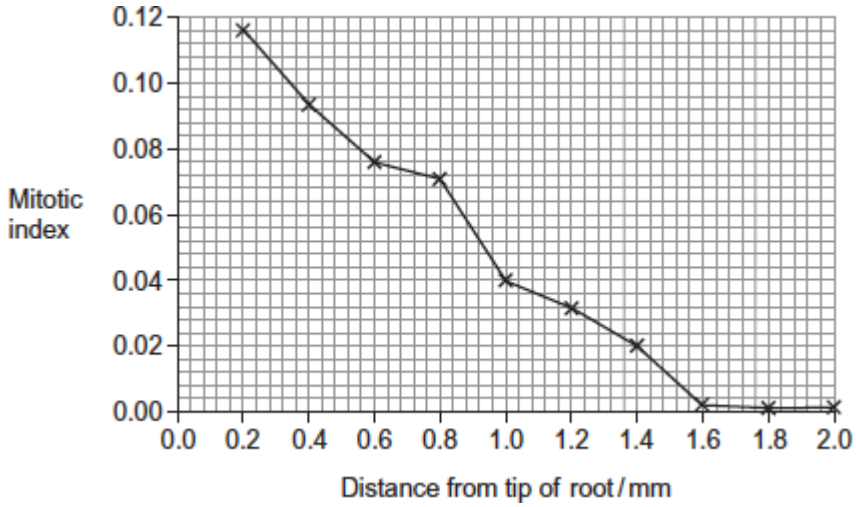
(4)

(b) A student cut thin sections of tissue at different distances from the tip of a root. She stained the sections and viewed them with an optical microscope.

For each section, the student counted the number of cells in mitosis and the total number of cells in each field of view. She then calculated a **mitotic index** for each section using the equation:

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}}$$

The student's results arer shown in the graph.



(i) The student cut thin sections of tissue to view with an optical microscope. Explain why it was important that the sections were thin.

(2)

(ii) What does the graph show about the growth of roots?
Use the data to explain your answer.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

13 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.

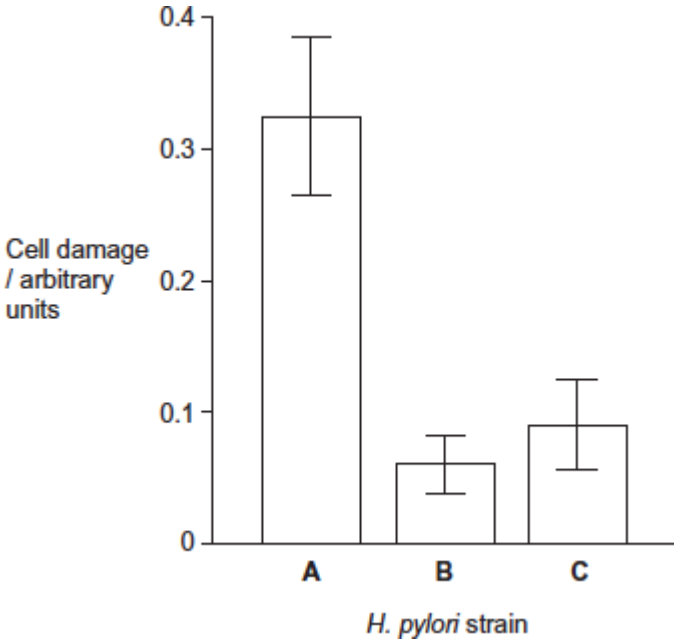
The scientists grew different strains of *H. pylori* in liquid culture.

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.

[Extra space]

(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.

[Extra space]

(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.

[Extra space]

(3)

(Total 12 marks)

14 Researchers investigated whether the blood supply to slow and fast muscle fibres in a muscle changes with age. They used diaphragms taken from hamsters (*Mesocricetus auratus*). The diaphragm is in constant use for breathing. They took diaphragms from groups of young, adult and old hamsters.

They removed the diaphragm from each animal and took a sample of muscle tissue.They examined it under an optical (light) microscope. For each sample they selected several fields of view at random. In each field of view, they then counted the number of capillaries associated with each type of muscle fibre.

This allowed the researchers to calculate the mean number of capillaries for each type of muscle fibre, for each age group.

The table below shows the researchers' results which include standard deviation (SD).

Hamster age group	**Number of hamsters in group**	**Mean number of capillaries associated with each type of muscle fibre**	
		Slow fibres (± SD)	**Fast fibres (± SD)**
Young	9	3.4 (±0.8)	4.0 (±0.8)
Adult	10	4.7 (±0.2)	6.3 (±0.4)
Old	8	4.6 (±0.9)	6.8 (±0.6)

(a) Give **four** precautions that the researchers took to make their calculations of mean number of capillaries per fibre reliable.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

(4)

(b) The researchers examined the muscle of an animal in the **old** age group. They found one field of view containing only slow muscle fibres. They counted 69 capillaries in this field of view.

(i) Use a calculation to estimate how many slow muscle fibres were visible in this field of view. Show your working.

Number of slow muscle fibres = _____

(2)

(ii) The actual number of slow muscle fibres in the field of view was **not** the same as the number you calculated in question (i).

Give **one** reason why.

_____

_____

_____

(1)

(c) A student read the report of the researchers' investigation. She thought that the investigation was unethical but that a conclusion could still be made.

(i) Suggest why she thought the investigation was unethical.

_____

_____

_____

(1)

(ii) She concluded that age had a significant effect on the mean number of capillaries per fibre.

Evaluate this conclusion.

(4)

(Total 12 marks)

15 (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 _____

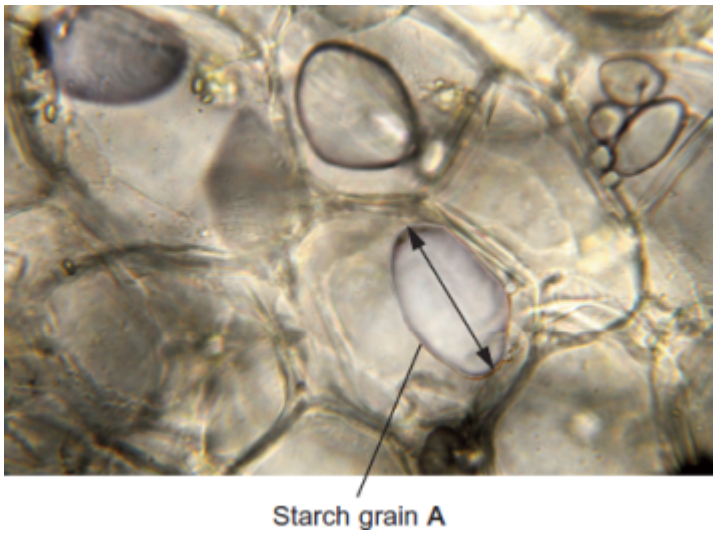
Explanation _____

_____

_____

(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.

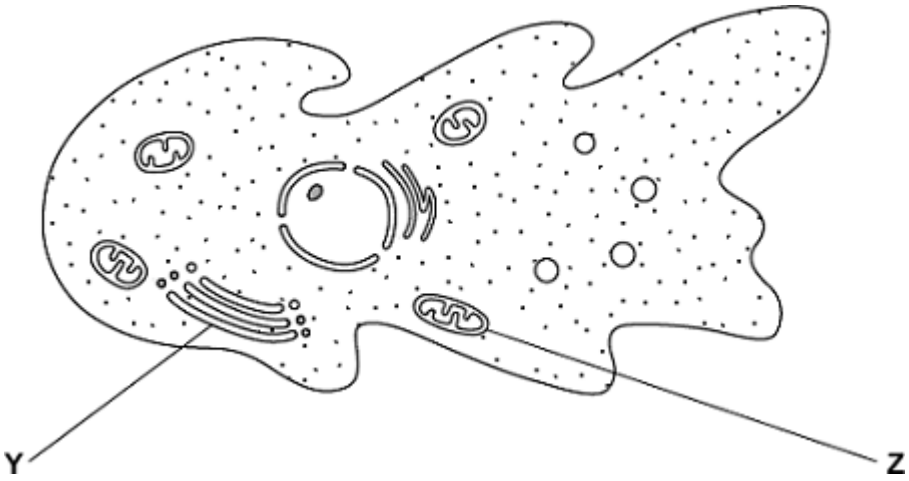


Magnification _____ times

(2)

(Total 8 marks)

16 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**?

_____

_____

_____

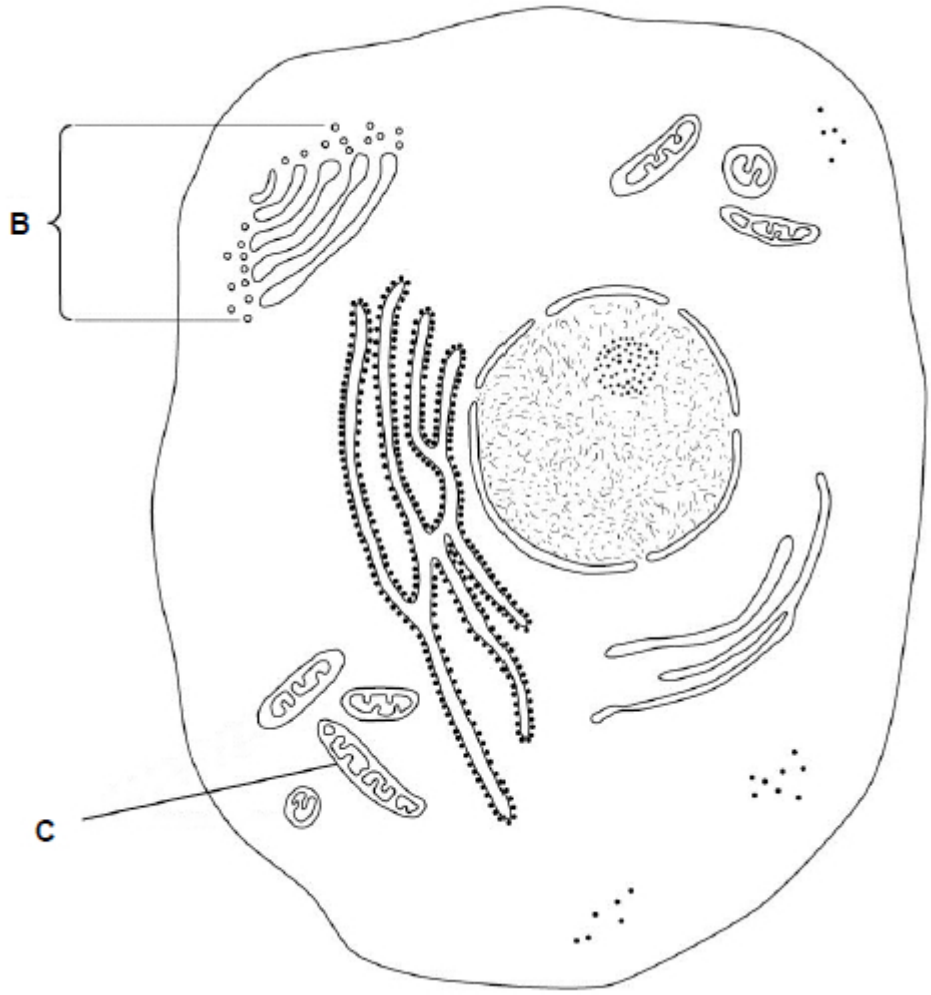
(1)

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

(2)

(Total 6 marks)

17 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)

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

_____

_____

_____

_____

_____

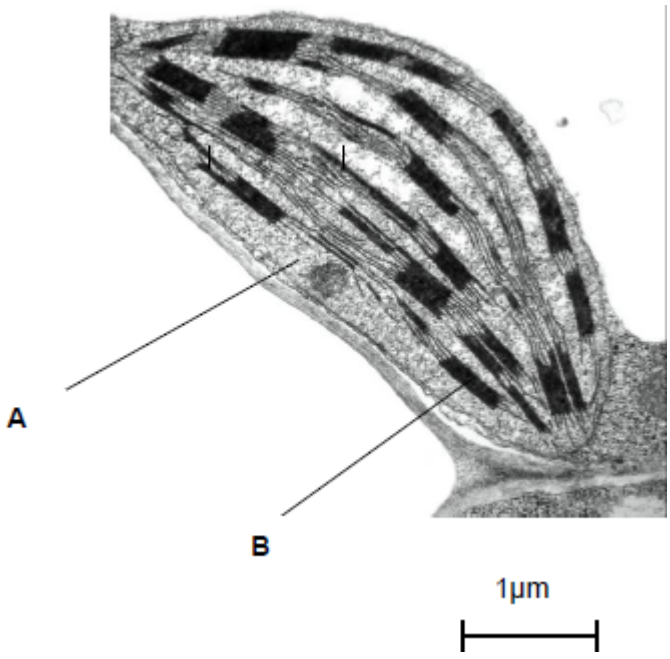
_____

(Extra space) _____

_____

(3)

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



(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)