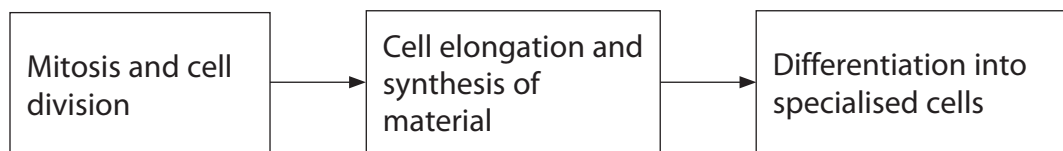


1 Plant growth involves mitosis, cell division and cell differentiation and is influenced by environmental factors such as temperature.

(a) The diagram below shows the stages in the growth of a root in a plant seedling.



(i) Place a cross in the box next to the correct sequence of stages in mitosis.

(1)

- A Metaphase, anaphase, prophase, telophase
- B Prophase, anaphase, metaphase, telophase
- C Prophase, metaphase, anaphase, telophase
- D Telophase, metaphase, anaphase, prophase

(ii) Place a cross in the box next to the material that would be synthesised to form the cell wall of the seedlings.

(1)

- A Cellulose
- B Cholesterol
- C Glycogen
- D Thrombin

(iii) Place a cross in the box next to the tissue that would form the vessels in a root, following differentiation.

(1)

- A Chorion
- B Endothelium
- C Sclerenchyma
- D Xylem

- (b) A student carried out an investigation into the effect of temperature on the growth of plant seedlings. The two species that she chose for the study were sea plantain, *Plantago maritima* and bog sedge, *Kobresia simpliciuscula*.

Sets of seeds from each of these species of plant were germinated at 18 °C. As soon as they germinated, the seedlings were placed in three temperature-controlled rooms at 10 °C, 14 °C and 18 °C. They were allowed to grow for 50 days. Samples of seedlings were taken at 5-day intervals and their mean dry masses were recorded.

The results of this investigation are shown in the tables below.

Table 1 – Sea plantain

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
5	2		
10	3	4	
15	4	6	12
20	7	2	20
25	10	19	34
30	13	25	47
35	17	31	85
40	20	40	109
45	24	55	164
50	28	80	210

Table 2 – Bog sedge

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
5	1		
10	1	1	
15	1	2	
20	1	2	
25	2	2	
30	2	3	
35	2	4	
40	3	5	12
45	4	6	16
50	5	7	22

(i) Suggest how these results could be displayed in order to compare the effect of temperature on the growth of seedlings of these two species.

(3)

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(ii) Suggest why all of the seeds were germinated at 18 °C before being placed in the temperature-controlled rooms.

(2)

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- (iii) Use the data in the tables to suggest which of the two species is better adapted for growth at a wide range of latitudes (distance from the equator). Give reasons for your choice.

(4)

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(Total for Question 1 = 12 marks)

2 Mitosis is part of the cell cycle.

(a) Give **two** roles of the cell cycle.

(2)

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(b) For each of the statements about mitosis below, place a cross ☒ in the box that identifies the correct word or words.

(i) The following disappear during prophase in an animal cell

(1)

- A** nucleus and centrioles
- B** nucleus and nucleolus
- C** nucleolus and mitochondria
- D** nucleus and ribosomes

(ii) The following are formed during prophase in an animal cell

(1)

- A** DNA
- B** Golgi apparatus
- C** mitochondria
- D** spindle fibres

(c) A student prepared a root tip squash to observe the stages in mitosis.
Describe how the student could distinguish between a cell in metaphase and a cell in anaphase.

(3)

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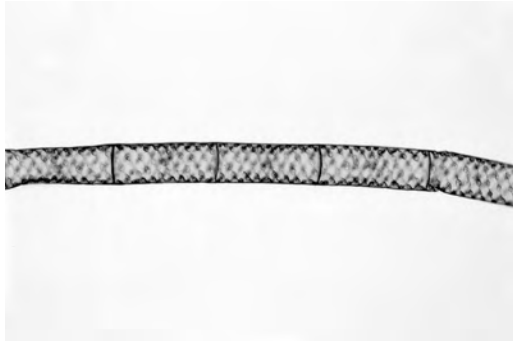
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(Total for Question 2 = 7 marks)

- 3 Filamentous algae are simple photosynthetic organisms that consist of long strands of very similar eukaryotic cells. Each of the cells in the strand is enclosed within a cellulose cell wall. The strand increases in length as the cells divide and elongate.

The photographs below show some cells in strands of a filamentous alga, as seen using a light microscope.



Magnification $\times 200$



Magnification $\times 200$

- (a) (i) Put a cross in the box next to the term that describes the process involved in the cell divisions in a filamentous alga. (1)

- A exocytosis
- B meiosis
- C mitosis
- D osmosis

- (ii) Put a cross in the box next to the structure that would **not** be found in a cell from the strand of a filamentous alga. (1)

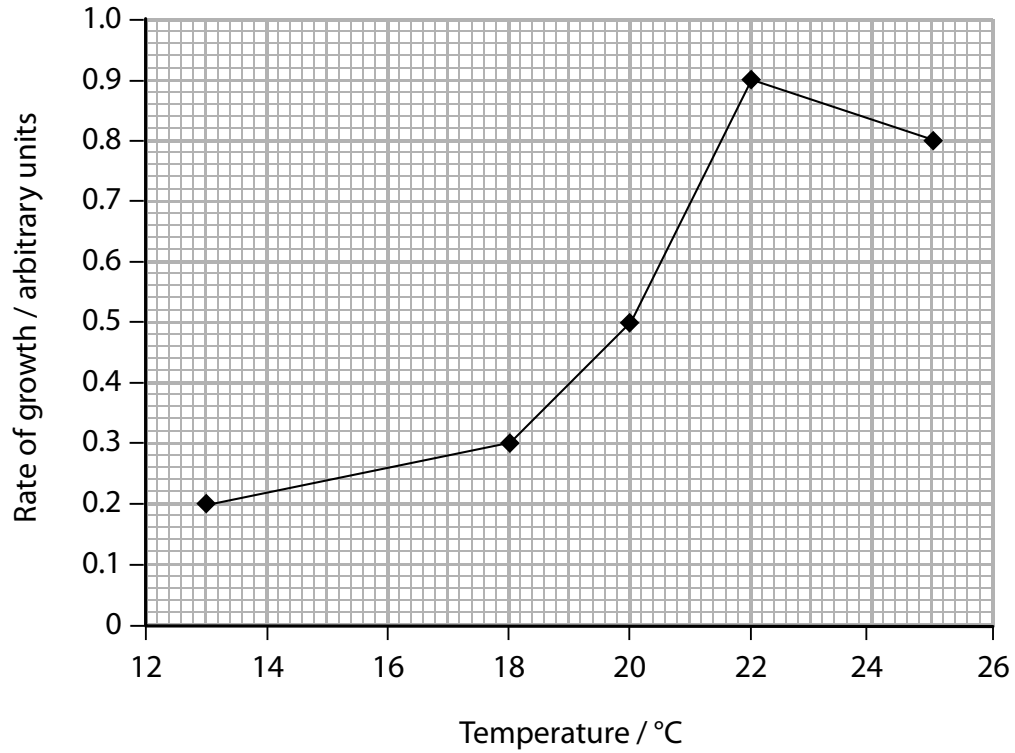
- A lysosome
- B mitochondrion
- C plasmid
- D ribosome

- (b) An investigation was carried out into the effect of temperature on the rate of growth of a filamentous alga. Several short strands of the alga were placed into culture solutions which were kept at five different temperatures and at a high light intensity.

The number of cells in the strands, in each culture solution, was counted at the beginning of the time period and again after 18 days.

The rate of growth was then calculated.

The results of this investigation are shown in the graph below.



(i) Name the **independent** variable in this investigation.

(1)

(ii) Using the information in the graph, describe and suggest explanations for the effect of temperature on the rate of growth of the filamentous alga.

(4)

(iii) Suggest why it was important that this investigation was carried out at a high light intensity.

(3)

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(iv) Suggest **two** abiotic factors, other than light intensity, that would need to be controlled in this investigation.

(2)

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(Total for Question 3 = 12 marks)

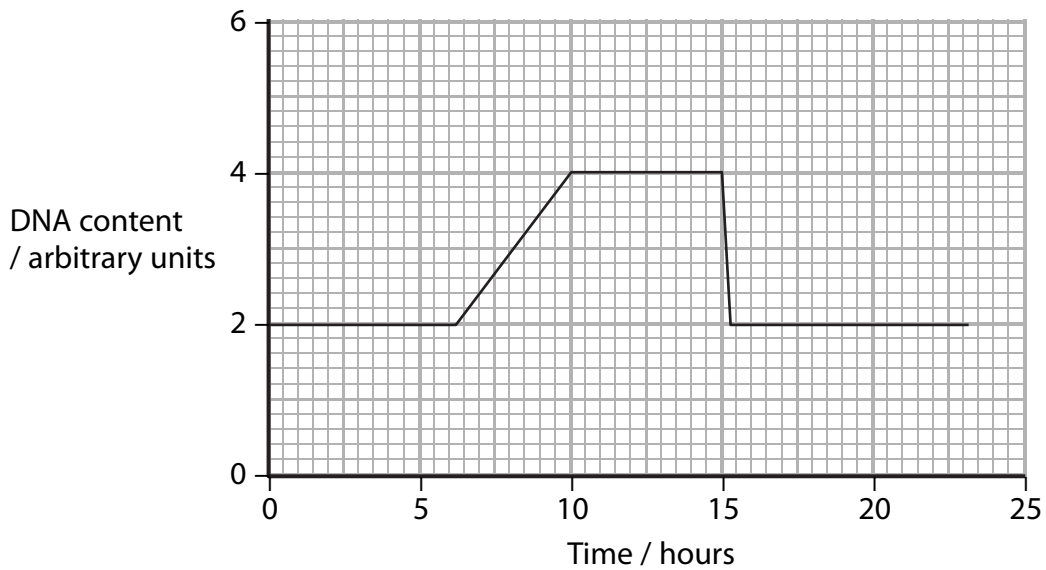
4 Cell division produces more cells. Groups of cells become organised into tissues and further organisation results in the formation of a multicellular organism.

(a) Complete the diagram below by writing in the boxes the missing levels of organisation in the correct order.

(2)



(b) The graph below shows the changes in the DNA content of an onion cell, during one cell cycle.



(i) Explain why the DNA content of the cell doubles.

(2)

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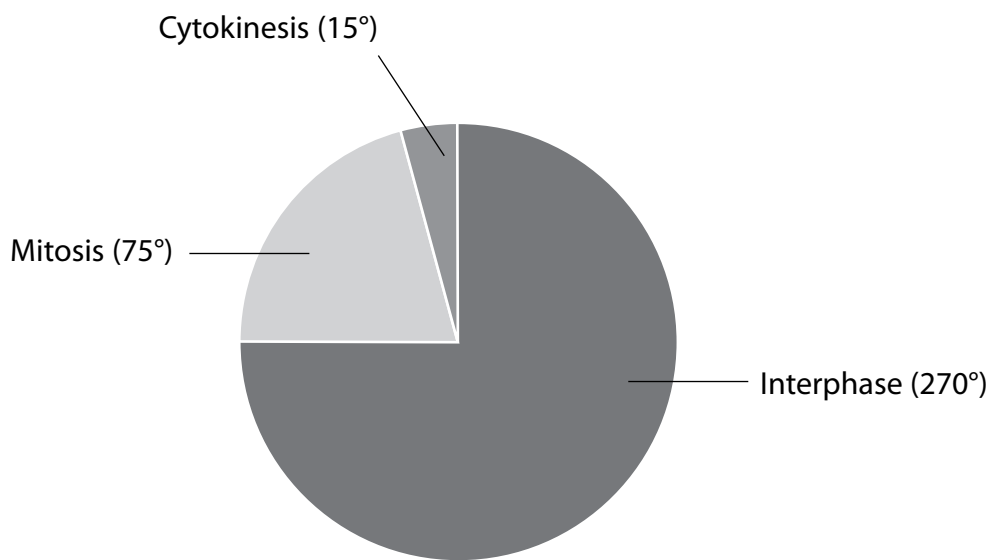
(ii) Using the graph, state how long the S phase (DNA synthesis) takes.

(1)

..... hours

(iii) In onion cells, interphase lasts an average of 18 hours. Using this information and the diagram below, calculate how long mitosis takes. The figures in brackets show the number of degrees for each sector of the circle. Show your working.

(2)



Answer hours

*(c) Prophase is a stage in mitosis. Describe the events that occur during prophase.

(3)

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(Total for Question 4 = 10 marks)

5 Meiosis and mitosis are involved in cell division.

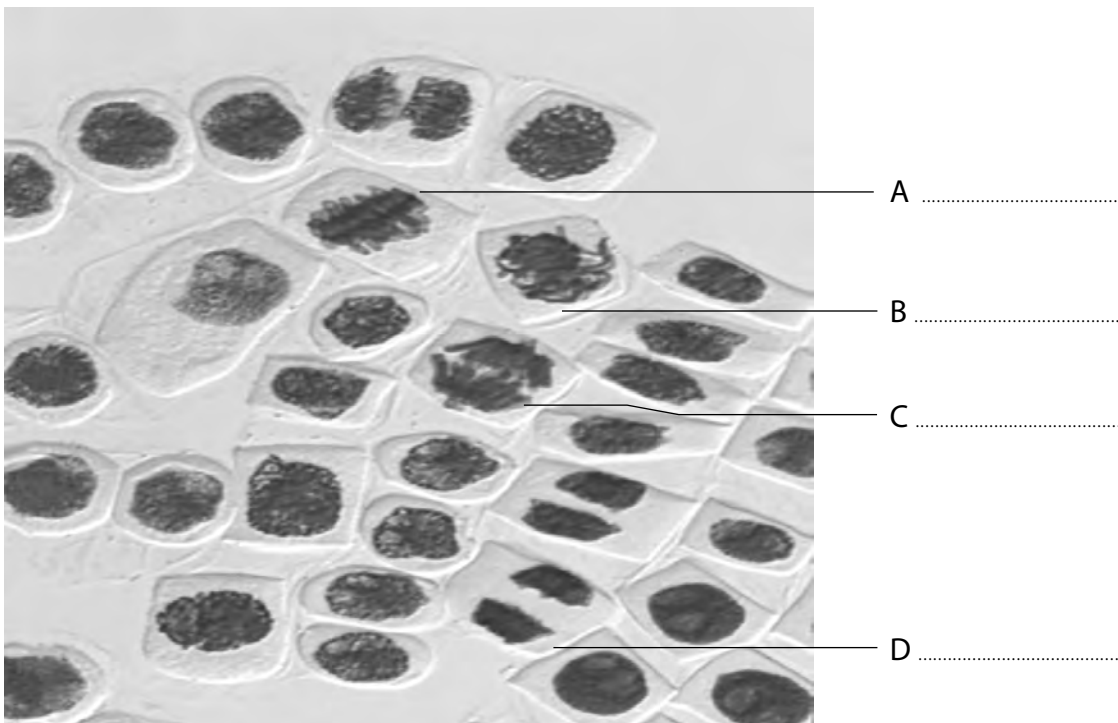
(a) The table below gives some statements about cell division. Place a tick (✓) in the box if **meiosis** is involved.

(2)

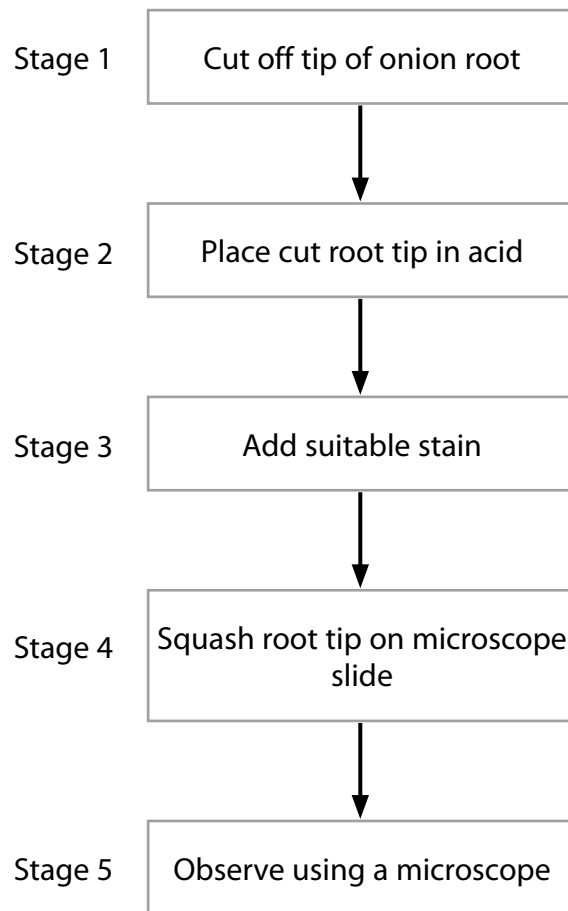
Statements about cell division	Meiosis is involved
Required for both sexual and asexual reproduction	
Produces gametes	
Crossing over can occur	
Occurs in mammals but not flowering plants	

(b) The photograph below shows some cells undergoing **mitosis**. Each of the cells A, B, C and D is in a different stage of mitosis. Write the name of the stage next to the appropriate letter.

(4)



(c) The diagram below shows some stages in the production of a root tip squash to observe mitosis.



(i) Suggest why the **tip** of the onion root is used.

(1)

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(ii) Suggest why acid is used in stage 2.

(1)

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(iii) Name a suitable stain for the root tip squash.

(1)

(iv) There are various risks associated with the production of a root tip squash.
Suggest **two** risks and the precautions you would take to minimise each risk.

(2)

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(Total for Question 5 = 11 marks)
