Do not write outside the box

Answer **all** questions in the spaces provided.

Question 1: N/A

2 (a) Describe the part played by each of the following in myofibril contraction.

2 (a) (i) Tropomyosin

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(2 marks)

2 (a) (ii) Myosin

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(2 marks)

2 (b) The table shows features of fast and slow muscle fibres.

Feature	Fast muscle fibre	Slow muscle fibre
Type of respiration	Mainly anaerobic	Mainly aerobic
Glycogen	High concentration	Low concentration
Capillaries	Few	Many

Use information from the table to suggest and explain **one** advantage of:

2 (b) (i) the high glycogen content of fast muscle fibres

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(2 marks)

2 (b) (ii) the number of capillaries supplying slow muscle fibres.

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(2 marks)

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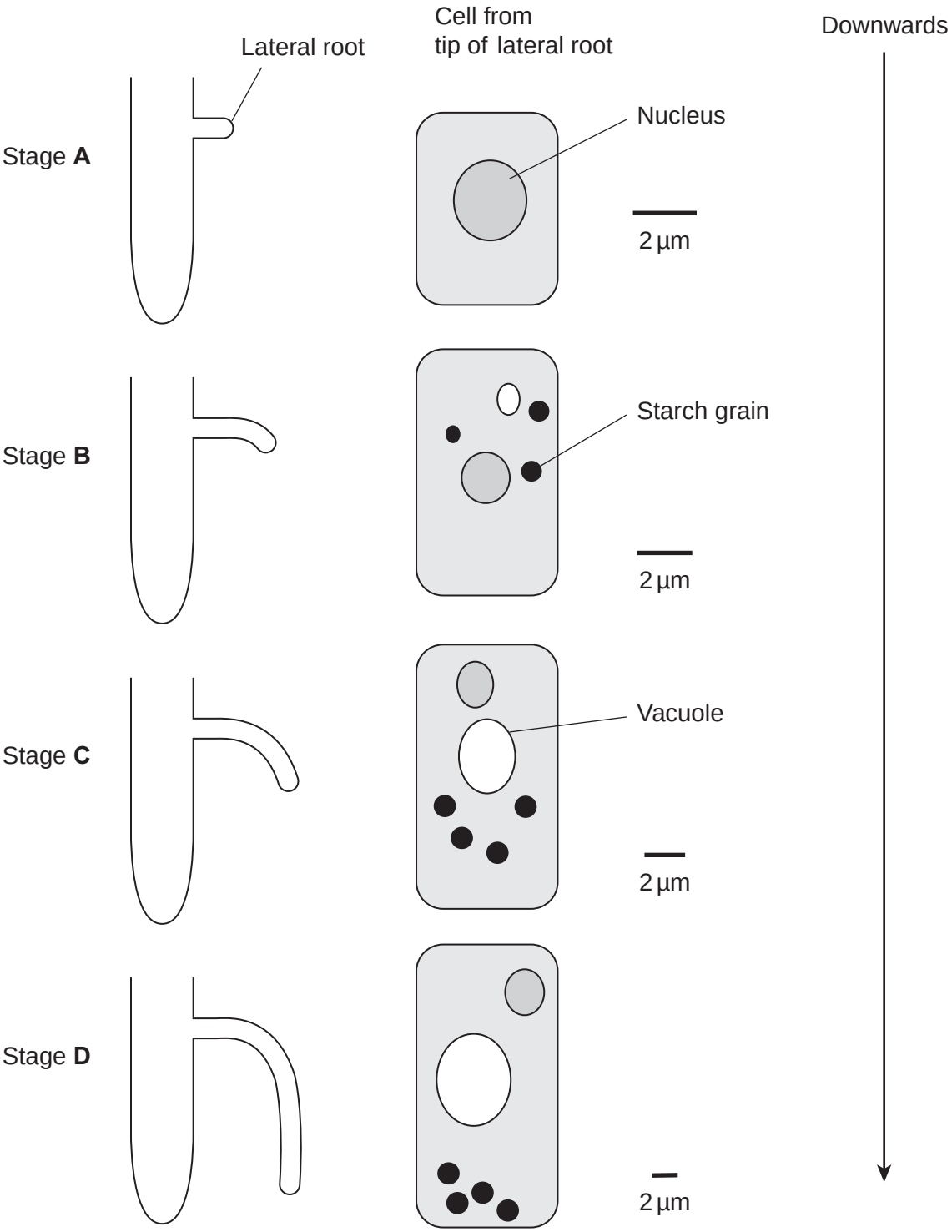
3 Scientists investigated the response of lateral roots to gravity. Lateral roots grow from the side of main roots.

The diagrams show four stages, **A** to **D**, in the growth of a lateral root and typical cells from the tip of the lateral root in each stage. All of the cells are drawn with the bottom of the cell towards the bottom of the page.



3 (a) Describe **three** changes in the root tip cells between stages **A** and **D**.

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(3 marks)

3 (b) The scientists' hypothesis was that there was a relationship between the starch grains in the root tip cells and the bending and direction of growth of lateral roots.

Does the information in the diagram support this hypothesis? Give reasons for your answer.

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(3 marks)

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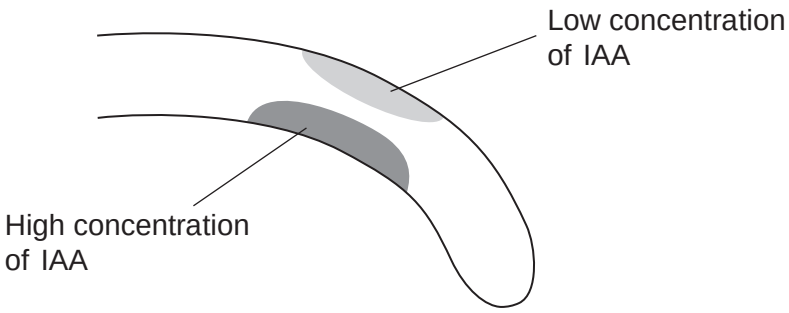
Question 3 continues on the next page

3 (c) The diagram shows the distribution of indoleacetic acid (IAA) in the lateral root at Stage **B**.



Explain how this distribution of IAA causes the root to bend.

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(2 marks)

8

Turn over for the next question

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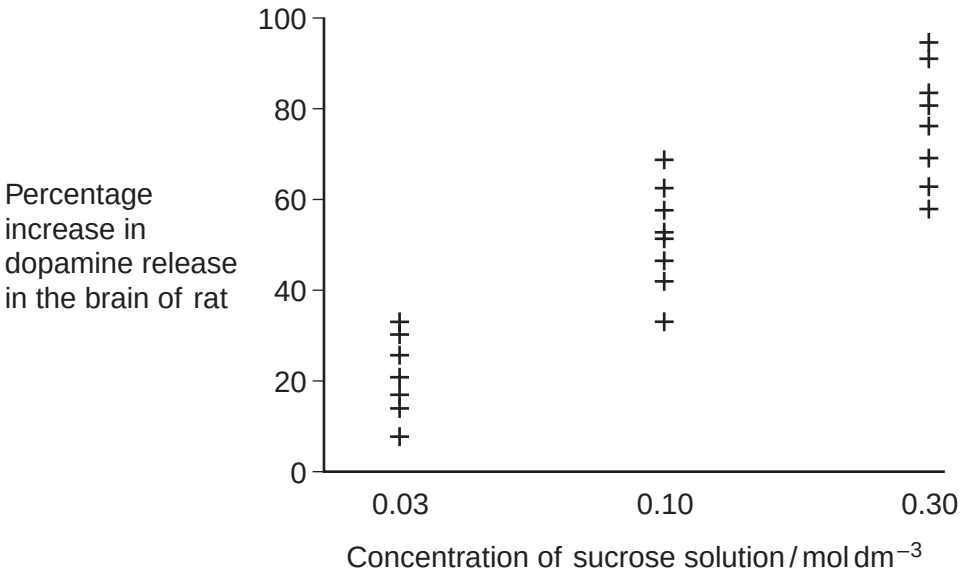
ANSWER IN THE SPACES PROVIDED

4 The release of a substance called dopamine in some areas of the brain increases the desire to eat.

Scientists measured increases in the release of dopamine in the brains of rats given different concentrations of sucrose solution to drink.

Sucrose stimulates taste receptors on the tongue.

The graph shows their results. Each point is the result for one rat.



4 (a) The scientists concluded that drinking a sucrose solution had a positive feedback effect on the rats' desire to eat.

How do these data support this conclusion?

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(3 marks)

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4 (b) In this investigation, the higher the concentration of sucrose in a rat's mouth, the higher the frequency of nerve impulses from each taste receptor to the brain.

If rats are given very high concentrations of sucrose solution to drink, the refractory period makes it impossible for information about the differences in concentration to reach the brain.
Explain why.

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(2 marks)

4 (c) In humans, when the stomach starts to become full of food, receptors in the wall of the stomach are stimulated. This leads to negative feedback on the desire to eat.
Suggest why this negative feedback is important.

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(3 marks)

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5 Hyperthermia is a condition in which a person's body temperature is above 37.5 ºC. This happens when a person's body produces or absorbs more heat than it loses to the environment.

Doctors recruited healthy volunteers. At a room temperature of 20 ºC, the doctors measured each volunteer's:

- body temperature
- rate of oxygen consumption
- rate of carbon dioxide production.

Each volunteer then put on a suit that covered the whole body. Water at 38 ºC was circulated through pipes in the suit. This caused the volunteer to develop hyperthermia.

The doctors' results are shown in the table.

	At 20 ºC	**In suit at 38 ºC**	**P value**
Mean body temperature / ºC	36.82	38.62	< 0.001
Mean rate of oxygen consumption / $cm^3\ kg^{-1}\ minute^{-1}$	3.31	4.16	< 0.05
Mean rate of carbon dioxide production / $cm^3\ kg^{-1}\ minute^{-1}$	2.68	3.03	> 0.05

The doctors carried out statistical tests to see whether or not the differences in the results were significant. The P values from these tests are shown in the table.

5 (a) Calculate the percentage increase in mean body temperature.
Show your working.

Percentage increase .....

(2 marks)

5 (b) Explain **one** way in which a suit with water circulating in it at 38 ºC causes hyperthermia.

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(2 marks)

5 (c) Were the changes produced by hyperthermia significant? Give reasons for your answer. You should use the P values in your answer.

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(2 marks)

5 (d) Using information from the table, explain the increase in mean rate of oxygen consumption.

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(2 marks)

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Question 6: N/A

7 Serotonin is a neurotransmitter released in some synapses in the brain. It is transported back out of the synaptic gap by a transport protein in the pre-synaptic membrane.

7 (a) Serotonin diffuses across the synaptic gap and binds to a receptor on the post-synaptic membrane.

Describe how this causes depolarisation of the post-synaptic membrane.

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(2 marks)

7 (b) It is important that a neurotransmitter such as serotonin is transported back out of synapses. Explain why.

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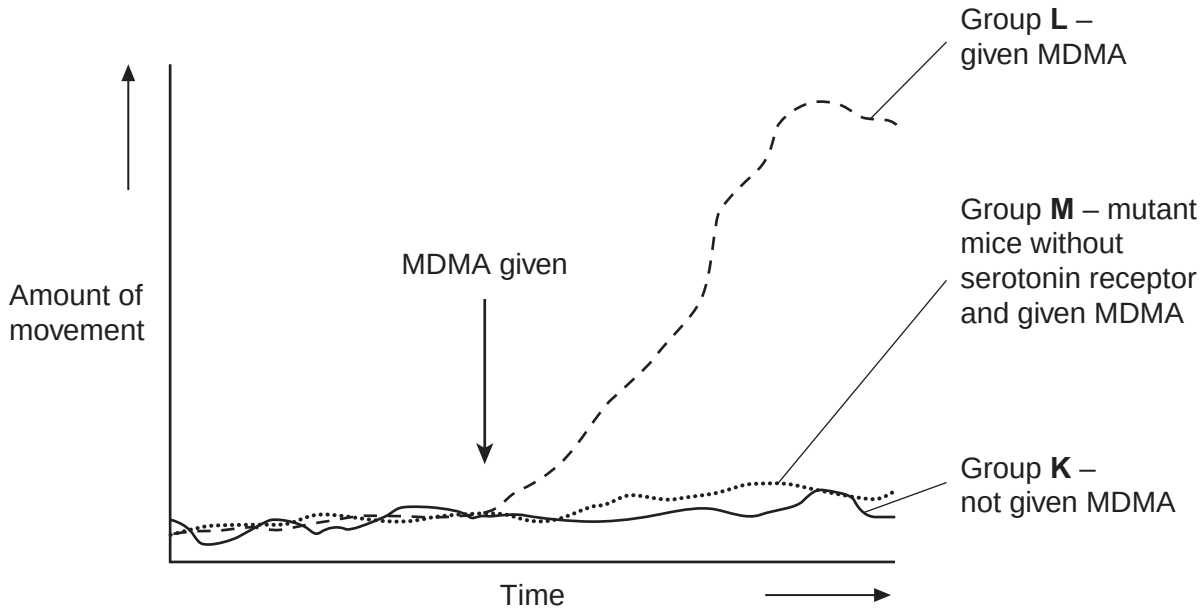
(2 marks)

7 (c) Scientists investigated the effect of a drug called MDMA on movement of mice. They measured the amount of movement of three groups of mice, **K**, **L** and **M**.

- Group **K**, mice not given MDMA.
- Group **L**, mice given MDMA.
- Group **M**, mutant mice that did not produce a serotonin receptor on their post-synaptic membranes and were given MDMA.

The graph shows their results.



The scientists concluded that MDMA affects movement by binding to serotonin receptors.

How do these results support this conclusion?

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8 A scientist investigated the uptake of radioactively labelled carbon dioxide in chloroplasts. She used three tubes, each containing different components of chloroplasts. She measured the uptake of carbon dioxide in each of these tubes. Her results are shown in the table.

Tube	Contents of tube	Uptake of radioactively labelled CO_2 / counts per minute
A	Stroma and grana	96 000
B	Stroma, ATP and reduced NADP	97 000
C	Stroma	4 000

(a) Name the substance which combines with carbon dioxide in a chloroplast.

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(1 mark)

(b) Explain why the results in tube **B** are similar to those in tube **A**.

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(1 mark)

(c) Use the information in the table to predict the uptake of radioactively labelled carbon dioxide if tube **A** was placed in the dark. Explain your answer.

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(2 marks)

(d) Use your knowledge of the light-independent reaction to explain why the uptake of carbon dioxide in tube **C** was less than the uptake in tube **B**.

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(2 marks)

(e) DCMU is used as a weed killer. It inhibits electron transfer during photosynthesis. The addition of DCMU to tube **A** decreased the uptake of carbon dioxide. Explain why.

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(2 marks)

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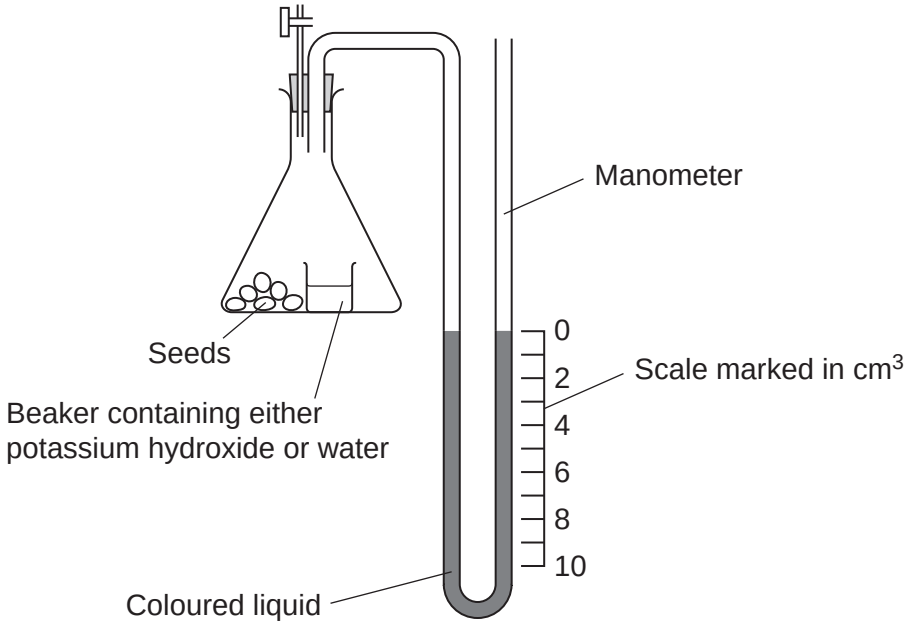
Turn over for the next question

9 A student investigated the rate of gas exchange in aerobically respiring seeds using the apparatus shown in the diagram. She carried out two experiments.

- In Experiment **1**, she put potassium hydroxide solution in the beaker. Potassium hydroxide solution absorbs carbon dioxide.
- In Experiment **2**, she put water in the beaker.



(a) Both experiments were carried out at the same temperature. Explain why.

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(2 marks)

(b) (i) The level of coloured liquid in the right-hand side of the manometer tube went down during Experiment **1**. Explain why.

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(3 marks)

(Extra space) .....

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The results from both experiments are shown in the table.

Experiment	Solution in beaker	Fall in volume of coloured liquid in right-hand side of manometer / cm^3
1	Potassium hydroxide	5
2	Water	1

(b) (ii) Use these results to calculate the volume of carbon dioxide produced during Experiment **1**.

Answer = ... cm^3

(1 mark)

(c) The student repeated Experiment **1** using seeds which were respiring anaerobically. What would happen to the level of coloured liquid in the right-hand side of the manometer tube? Explain your answer.

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(2 marks)

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10 (a) Explain how farming practices increase the productivity of agricultural crops.

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(b) Describe how the action of microorganisms in the soil produces a source of nitrates for crop plants.

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(5 marks)

(Extra space) .....

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(c) Explain how the use of pesticides can result in resistant strains of insect pests.

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(Extra space) .....

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END OF QUESTIONS