A-Level Biology

Stimuli and Response

Question Paper

Time available: 66 minutes
Marks available: 48 marks

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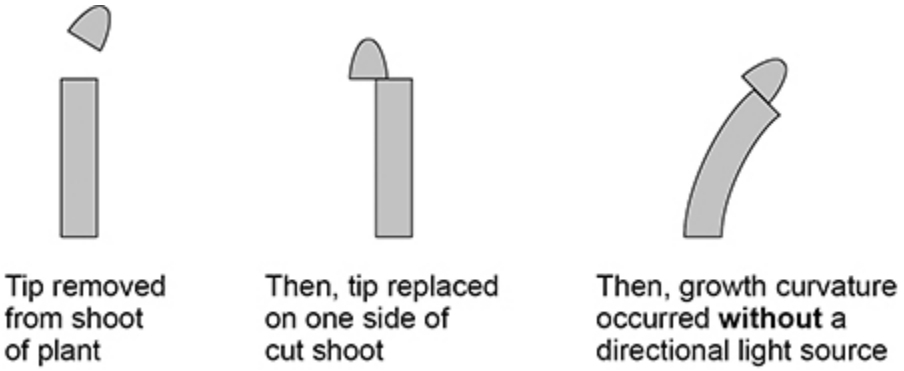
1. **Figure 1** shows an investigation into growth factors in plants.

Figure 1



(a) Use your knowledge of indoleacetic acid (IAA) to explain the growth curvature shown in **Figure 1**.

(3)

A bioassay is a method to determine the concentration of a substance by its effect on living tissues.

Figure 2 shows the practical procedure used in a growth curvature bioassay to determine the concentration of IAA in shoot tips.

Figure 2

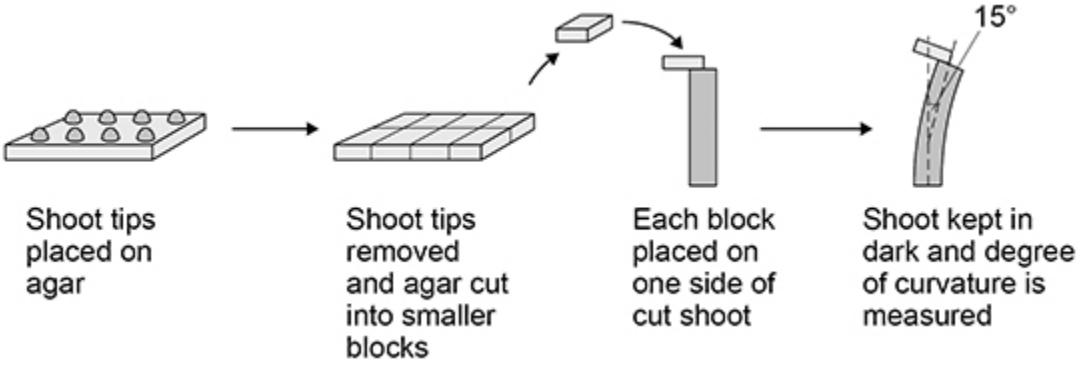
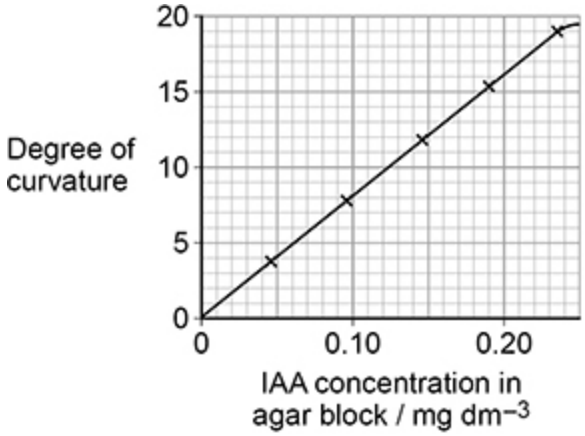


Figure 3 shows the calibration curve for this growth curvature bioassay.

Figure 3


Degree of curvature
20
15
10
5
0
0
0.10
0.20
IAA concentration in agar block / mg dm−3

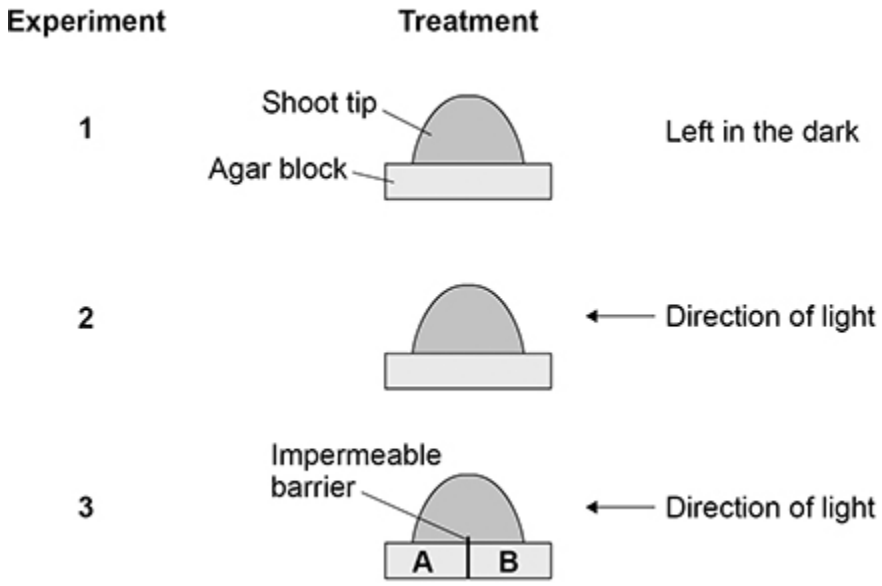
(b) Using the procedure in **Figure 2** and the calibration curve in **Figure 3**, describe how you could compare the IAA concentration in shoot tips from two different plant species.

In your answer you should refer to all the variables that should be controlled to produce a valid comparison.

(5)

A scientist investigated the effect of a directional light stimulus on the distribution of IAA in shoot tips. The scientist set up three experiments as shown in **Figure 4**. All variables were controlled apart from exposure to light.

Figure 4



She then used the growth curvature bioassay to compare the IAA concentrations in the agar

blocks from:

- experiment **1**
- experiment **2**
- experiment **3** section **A**
- experiment **3** section **B**.

The table below shows the scientist's results.

Experiment	Degree of curvature in Bioassay / degrees
1	17.69
2	17.61
3A	11.22
3B	6.50

(c) State **two** conclusions about IAA that you can make from the results shown in the table above.

1 _____

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2 _____

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(2)

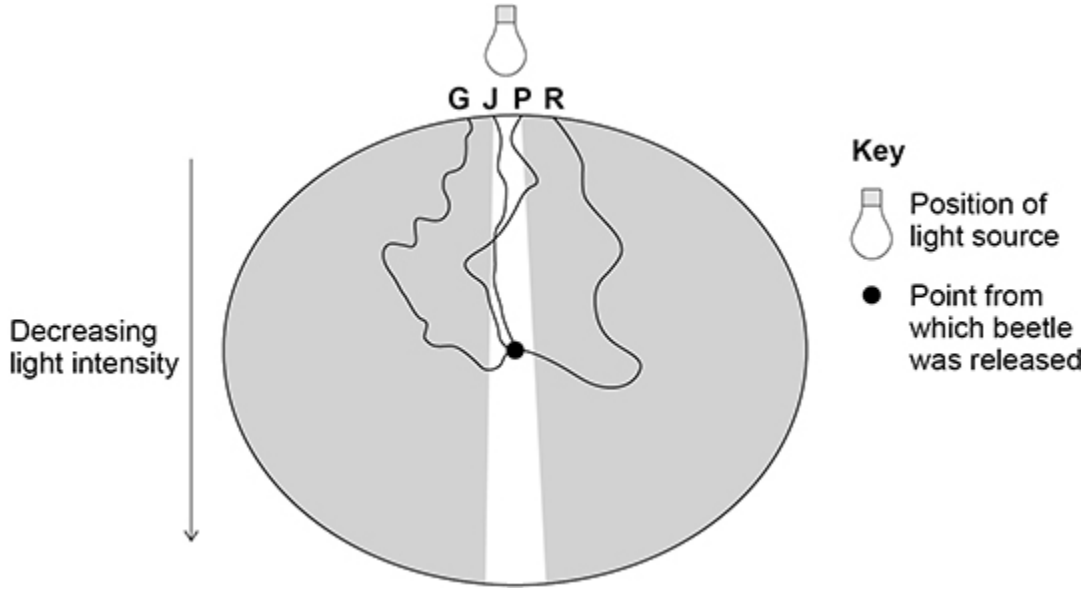
(Total 10 marks)

2. Scientists investigated movement in adult pine beetles. Adult beetles emerge from cracks in tree bark.

The scientists released a newly emerged adult beetle, **G**, from the centre of a sample area that had a single light source coming from one direction. They made a drawing of the beetle's path of walking. They repeated this with three more beetles, **J**, **P** and **R**.

Figure 1 shows the scientists' results.

Figure 1



(a) Name the type of behaviour shown by beetles **G**, **J**, **P** and **R**, and suggest **one** advantage to adult beetles of the type of behaviour shown.

Behaviour _____

Advantage _____

_____

_____

(2)

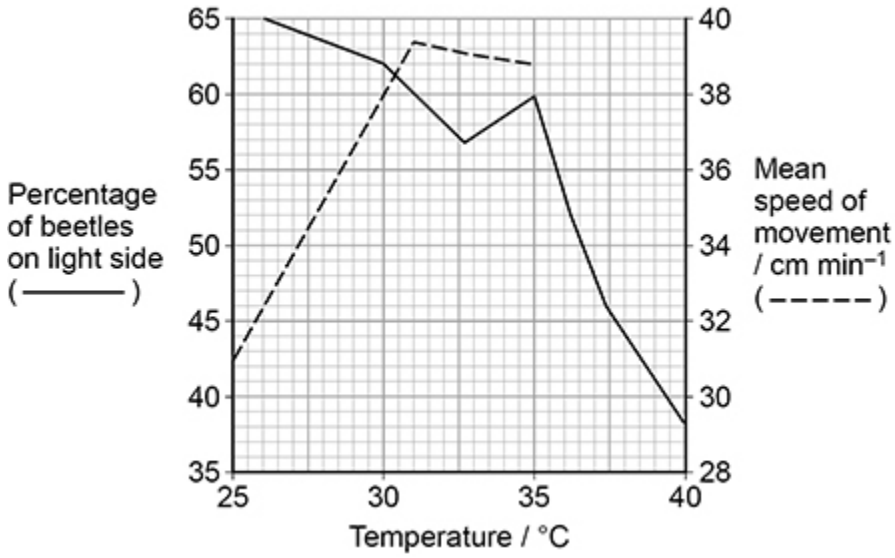
At higher temperatures and higher light intensities, adult pine beetles normally

- move more
- fly rather than walk.

When preparing to fly, these adult beetles walk slowly. The scientists investigated the movement of adult beetles at different temperatures, and in the light and the dark. They created a box that was half in the light and half in the dark. They released an adult beetle at the midpoint of the central dividing line between light and dark areas. They recorded the path of the beetle's movement and its location after 5 minutes. From this, they calculated the mean speed of movement. They repeated the experiment with many beetles and at several temperatures.

Figure 2 shows the scientists' results.

Figure 2



(b) After studying these experiments, a student concluded:

- there is a significant change in movement between 35 °C and 37.5 °C
- between 35 °C and 37.5 °C, more beetles move away from the light
- between 35 °C and 37.5 °C, more beetles have a slower walking speed.

Suggest reasons why these conclusions might **not** be valid.

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(3)

(Total 5 marks)

3. A student investigated the effects of indoleacetic acid (IAA) on the growth of oat seedlings (young plants).

The student:

- removed the shoot tip from each seedling and cut out a 10 mm length of shoot
- placed 10 lengths of shoot into each of 5 Petri dishes
- added to each Petri dish an identical volume of 5% glucose solution
- added to each Petri dish 40 cm^3 of a different concentration of IAA solution
- left the Petri dishes at 20 °C in the dark with their lids on for 5 days
- removed the shoots after 5 days and measured them
- determined the mean change in length of shoot at each concentration of IAA.

Table 1 shows her results.

Table 1

IAA concentration added to Petri dish / parts per million	10^{-5}	10^{-3}	10^{-1}	1	10
Mean change in length of shoot / mm	0.0	0.1	1.3	2.4	3.1

(a) Explain why the student removed the shoot tip from each seedling.

(2)

(b) Explain why the student added glucose solution to each Petri dish.

(2)

(c) Explain why the lids were kept on the Petri dishes.

(2)

(d) Describe and explain the results shown in **Table 1** above and suggest how the results might have differed if lengths of **root** had been used.

(3)

(e) The student produced the different concentrations of IAA using a stock 1 g dm^{-3} solution of IAA (1 g dm^{-3} = 1 part per thousand) and distilled water.

Complete **Table 2** with the volumes of stock IAA solution and distilled water required to produce 40 cm^3 of 10 ppm (parts per million) IAA solution.

Table 2

Concentration of IAA solution / parts per million	Volume of stock IAA solution / cm^3	Volume of distilled water / cm^3
10		

(1)

(Total 10 marks)

4. (a) Give **one** similarity and **one** difference between a taxis and a tropism.

Similarity _____

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_____

Difference _____

_____

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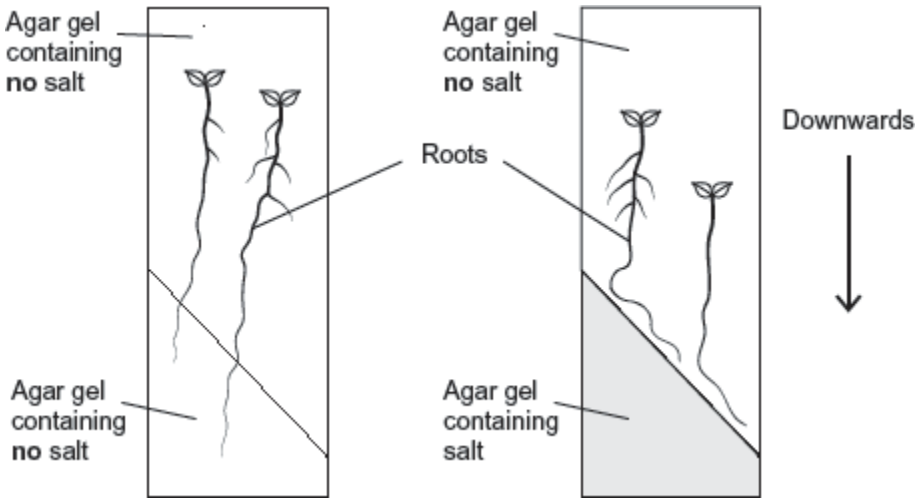
(2)

Scientists investigated tropisms in the roots of tomato plants. They grew tomato plants from seeds on vertical agar plates, as shown in **Figure 1**. The top of each plate was made of agar gel containing **no** salt. The bottom of each plate was made of one of the following:

- agar gel containing **no** salt
- agar gel containing salt.

Typical results for growth of the roots are shown in **Figure 1**.

Figure 1



(b) What do these results show about the responses of the roots of tomato plants to gravity and salt?

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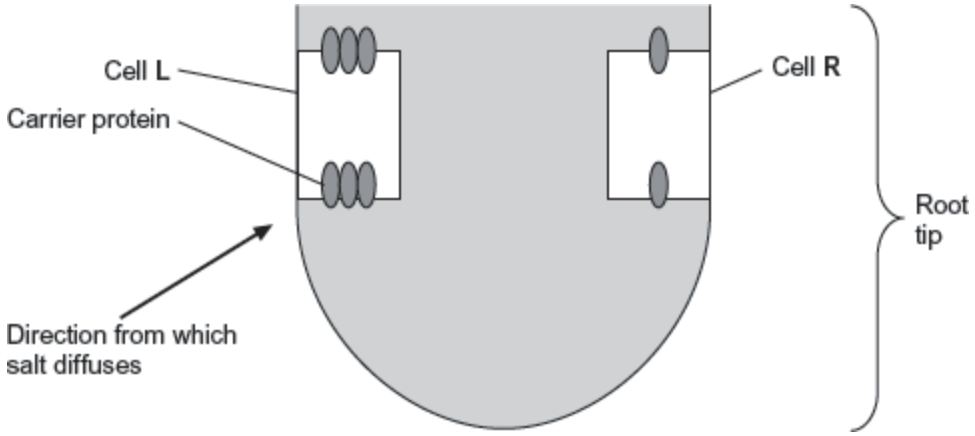
(3)

(c) In root tips of tomatoes, IAA is transported **out** of the cells by a carrier protein. In roots of tomatoes, high concentrations of IAA inhibit cell elongation.

The scientists' hypothesis was that salt causes a change in the number of IAA carrier proteins in cells in different parts of the root tip.

Figure 2 shows two cells, **L** and **R**, in the root tip of a tomato plant.

Figure 2



Explain why this root tip would grow away from salt.

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(3)

(Total 8 marks)

5. A biologist investigated the behaviour of a species of worm that lives in soil.

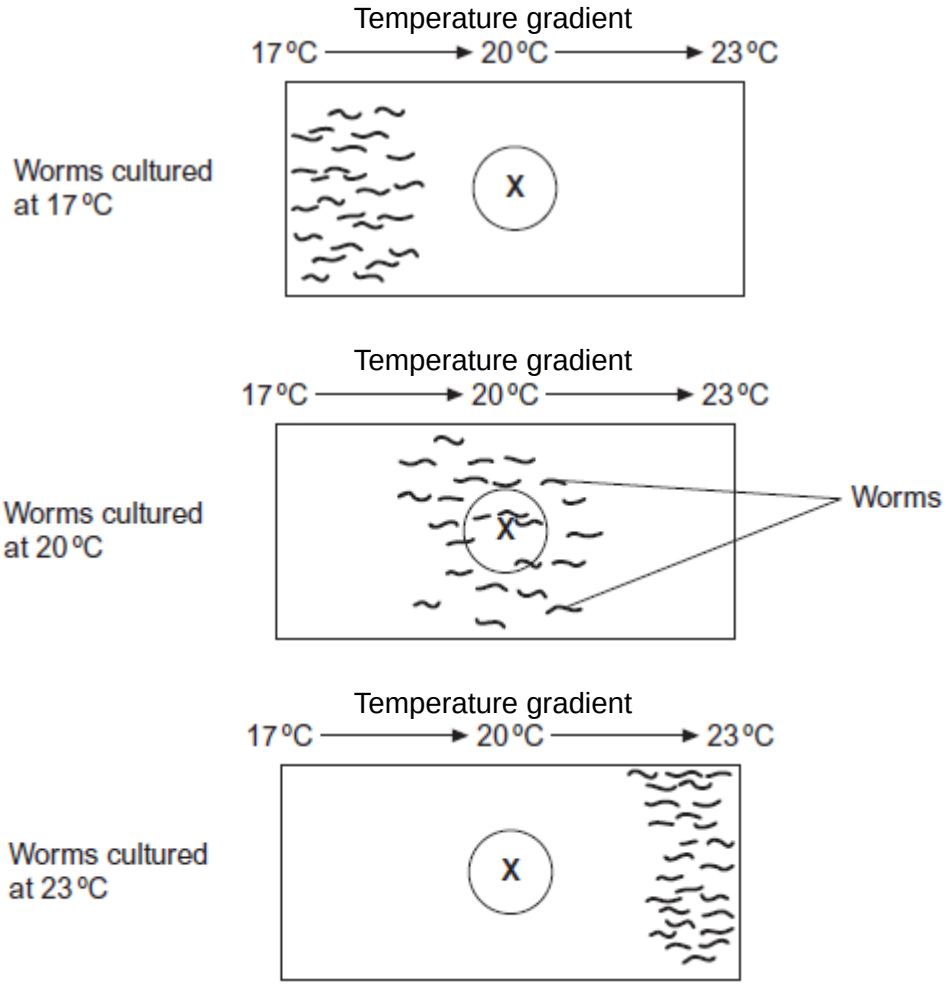
He cultured three samples of worms in three separate trays of soil for many days.
Each culture:

- contained a food supply
- was kept at a different temperature.

The temperatures of the cultures were 17 °C, 20 °C and 23 °C.

The biologist then removed food from the trays for several hours. Then he transferred each sample of worms onto a glass surface where there was **no food**. Each surface had a temperature gradient across it. After 1 hour, the biologist recorded the position of each worm.

The figure below shows his results. On each diagram, (X) marks where he released the worms onto the glass surface.



(a) The biologist concluded that the worms' behaviour demonstrated taxis.
How do these results support this conclusion?

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(2)

(b) Using the information provided, suggest an explanation for the worms' behaviour on the glass surfaces in the absence of food.

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(3)

(c) In each experiment, the biologist exposed the surfaces to light that was dim and even, so he could see where the worms went.

Apart from seeing where the worms went, suggest **two** reasons why it was important that the light was dim and even.

1. _____

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2. _____

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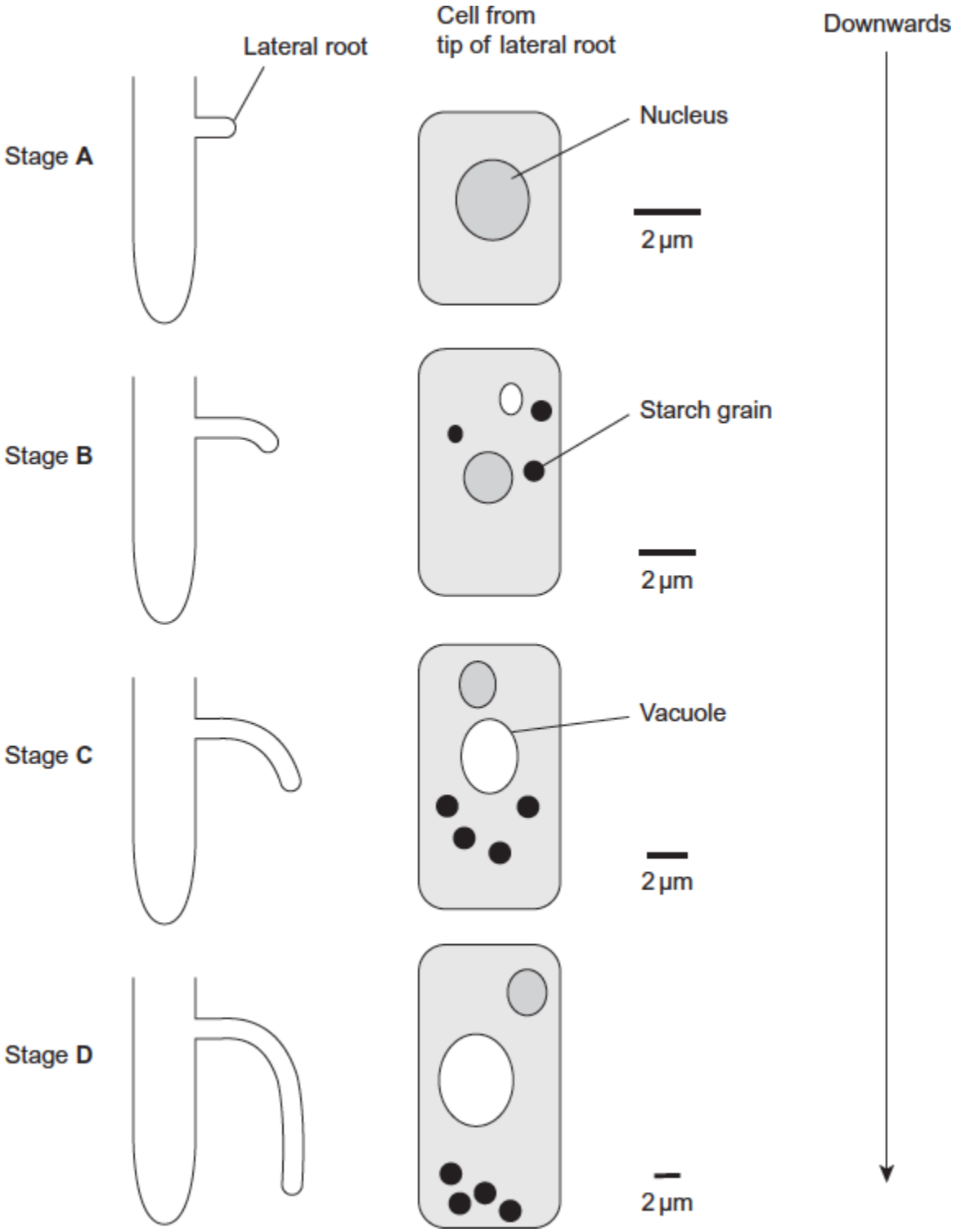
(2)

(Total 7 marks)

6. 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.



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

1. _____

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2. _____

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3. _____

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(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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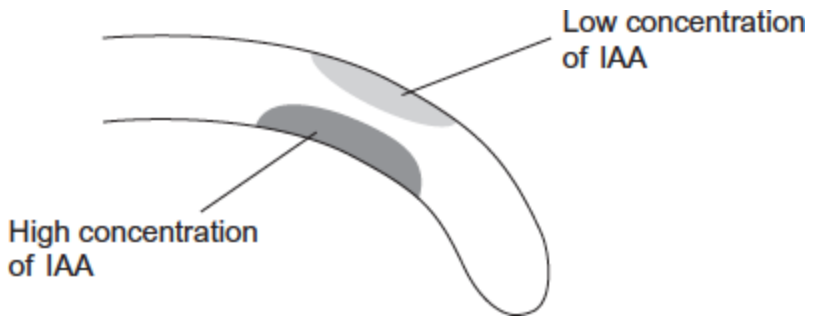
(3)

(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)

(Total 8 marks)