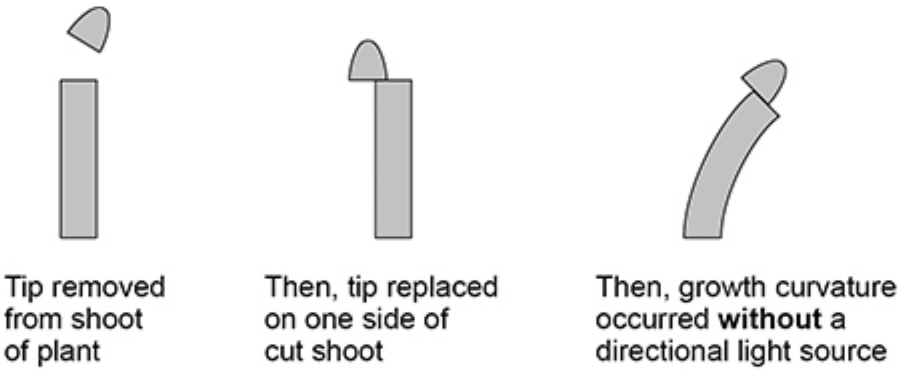
Q1.

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**.

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(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

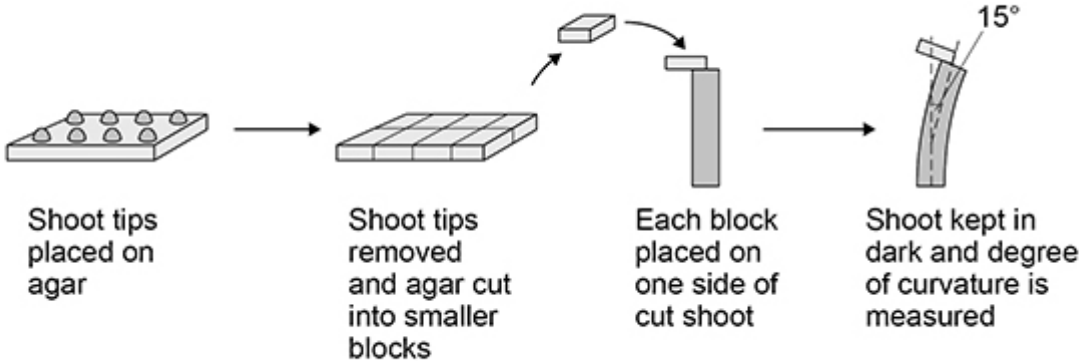
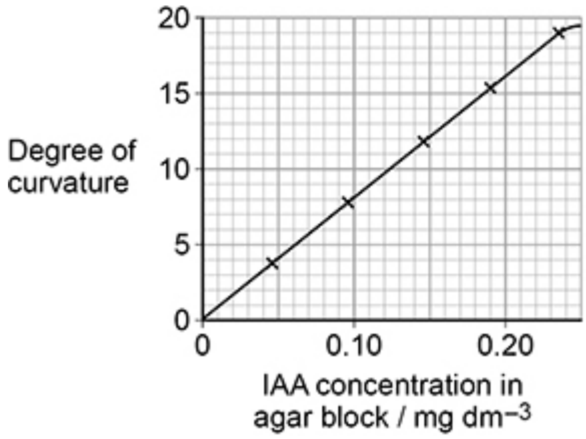


Figure 3 shows the calibration curve for this growth curvature bioassay.

Figure 3



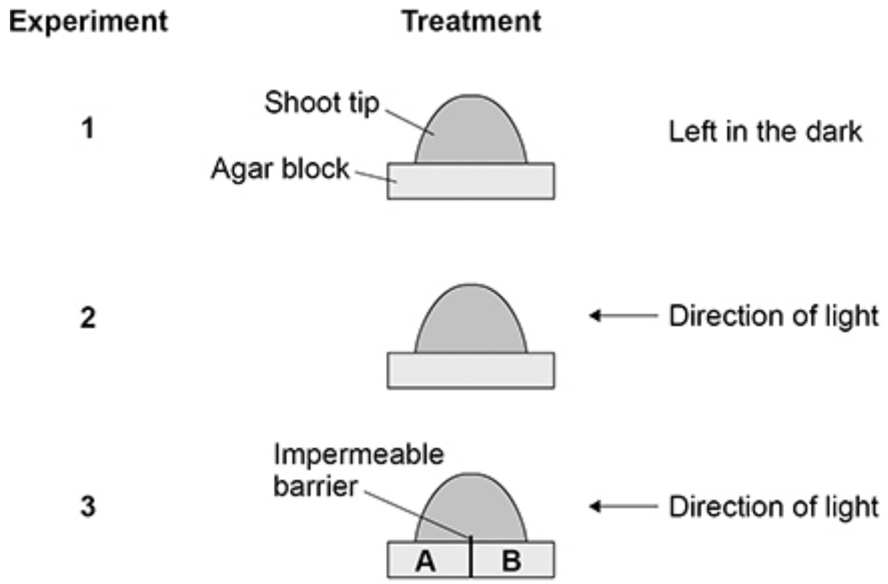
(b) Using the procedure in **Figure 2** and the calibration curve in **Figure 3**, describe how you could compare the IAA concentration in shoot tips from two different plant species.

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)

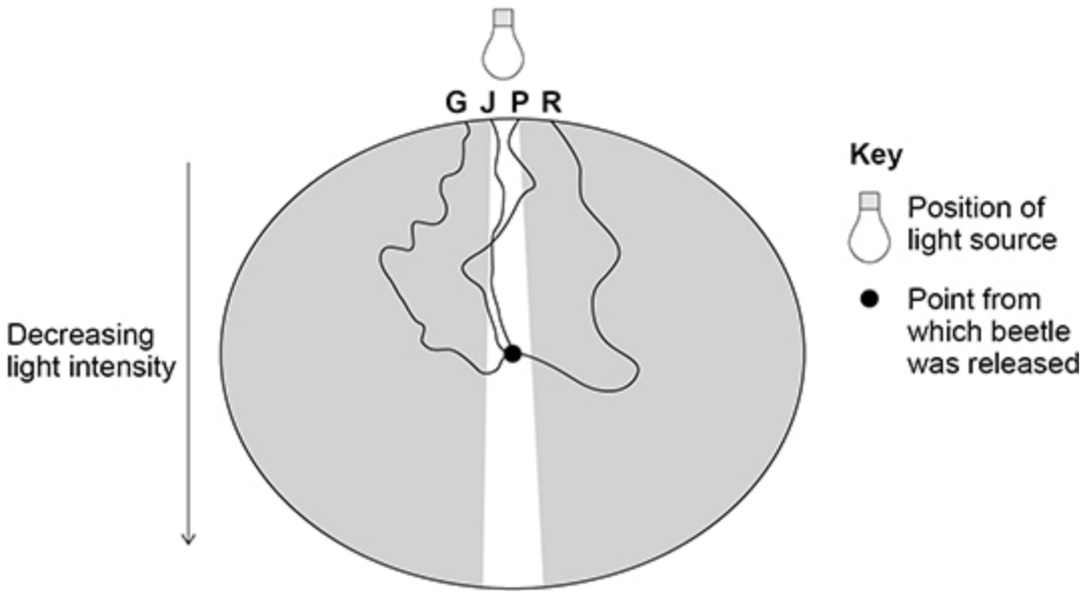
Q2.

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 ____

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(2)

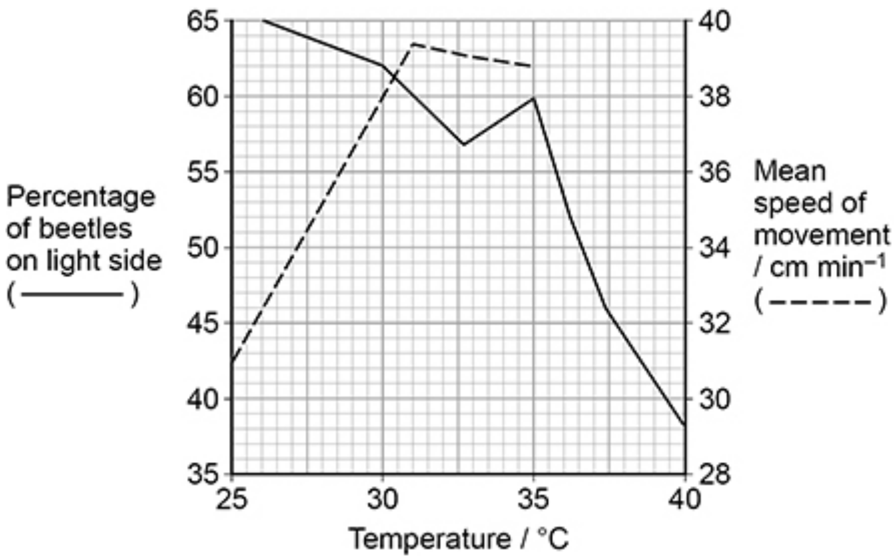
At higher temperatures and higher light intensities, adult pine beetles normally

- 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)

Q3.

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.

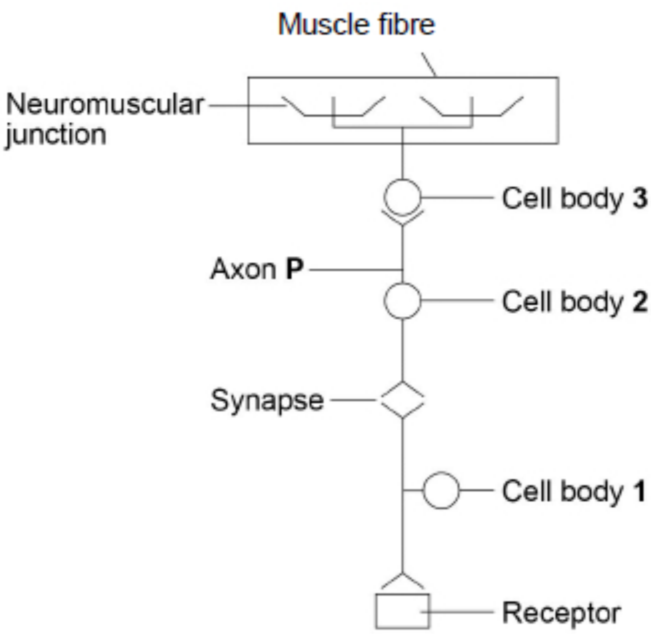
Table 2

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)

Q4.

The diagram below shows a nerve pathway in an animal.



(a) The nerve pathway shown in the diagram may be regarded as a simple reflex arc.

Use the diagram to explain why.

(1)

(b) Suggest **two** advantages of simple reflexes.

1.

2.

(2)

Q5.

The crown-of-thorns starfish (COTS) is one of the main causes of the decline of the world's coral reefs.

Marine biologists used a choice chamber to investigate the effects of flashing and constant light on the behaviour of COTS.

Table 1 shows their results as they presented them. The P values show results from a statistical test.

Table 1

Behaviour of COTS	**Type of light used in choice chamber**	
	Flashing	**Constant**
COTS moving towards the stimulus	22	12
COTS moving away from the stimulus	28	38
P value	0.69	0.02

(a) State a null hypothesis the marine biologists tested in this investigation.

(1)

(b) The natural habitat of COTS is coral reefs of tropical oceans.

Suggest **two** factors that should be kept constant in the choice chambers so that COTS display normal behaviour.

1

2

(1)

(c) A journalist studying **Table 1** suggested that either type of light could be used to cause COTS to move away from coral reefs.

Evaluate the journalist's suggestion.

(3)

(d) One of the reasons COTS can destroy coral reefs in a short time is because COTS move quickly, allowing them to move from one reef to another.

Table 2 shows the maximum speeds recorded of COTS in constant light.

Table 2

Response to light	**Maximum speed / mm min^{-1}**
COTS moving towards constant light	259
COTS moving away from constant light	264

Calculate the shortest time one COTS would take to move up a coral reef from 66 m under water to 18 m under water in hours of daylight.

Give your answer to the nearest hour.

Answer = ________________________ hours

(2)