Helicate

HELICATE · A-LEVEL BIOLOGY · TOPIC BANK

3.6.1 Stimuli, both internal and external, are detected and lead to a response

Topic question bank

Version 1 · 14 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
9	74	No time limit	/ 74

Contents

Subtopic	Questions	Marks
Tropisms in flowering plants Specification 3.6.1.1	01	11
Taxes, kineses and simple reflexes Specification 3.6.1.1	02–03	18
Receptors Specification 3.6.1.2	04–06	21
Control of heart rate Specification 3.6.1.3	07–09	24
Total		**74**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA A-level Biology (7402), specification section 3.6.1. Not affiliated with or endorsed by AQA.

Do not write outside the box

Tropisms in flowering plants 3.6.1.1

0 1 . 1 A shoot that is lit from one side grows towards the light.
Explain how indoleacetic acid (IAA) causes this response.

[2 marks]

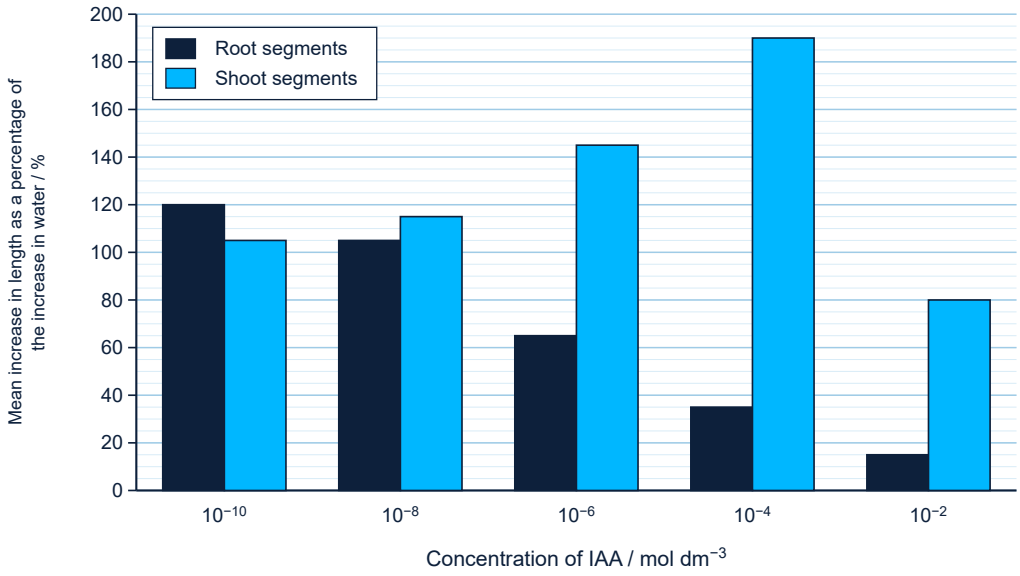
Question 1 continues on the next page

Do not write outside the box

Scientists cut segments from the roots and shoots of seedlings, after first removing the tip of each root and shoot. They placed batches of segments in IAA solutions of different concentrations, and other batches in water. After 24 hours, they measured the increase in length of each segment.

For each IAA concentration, they expressed the mean increase in length of the segments as a percentage of the mean increase in length of the segments in water. A value of 100% means that the segments grew by the same amount as the segments in water. Figure 1 shows their results.

Figure 1



0 1 . 2 Which conclusion is supported by Figure 1?
Tick (✓) one box.

[1 mark]

Elongation of root cells is inhibited by lower concentrations of IAA than elongation of shoot cells. ☐

The optimum concentration of IAA for elongation of shoot cells is 10^{-6} mol dm^{-3}. ☐

IAA increases elongation of root cells at every concentration below 10^{-4} mol dm^{-3}. ☐

At 10^{-2} mol dm^{-3}, IAA inhibits elongation of root cells less than it inhibits elongation of shoot cells. ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 Explain why the scientists:

[2 marks]

removed the tip of each root and shoot .....

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compared each result with segments in water .....

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0 1 . 4 The mean increase in length of the shoot segments in water was 1.6 mm.
Use Figure 1 to calculate the mean increase in length of the shoot segments in 10^{-4} mol dm^{-3} IAA solution.

[2 marks]

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Answer ..... **mm**

Question 1 continues on the next page

Do not write outside the box

0 1 . 5 A seedling was placed horizontally in the dark. After 5 hours, the concentration of IAA in both the root and the shoot was about 10^{-6} mol dm^{-3} on the lower side and about 10^{-8} mol dm^{-3} on the upper side.
The root then grew downwards and the shoot grew upwards.
Use Figure 1 to explain these responses.

[4 marks]

11

Turn over for the next question

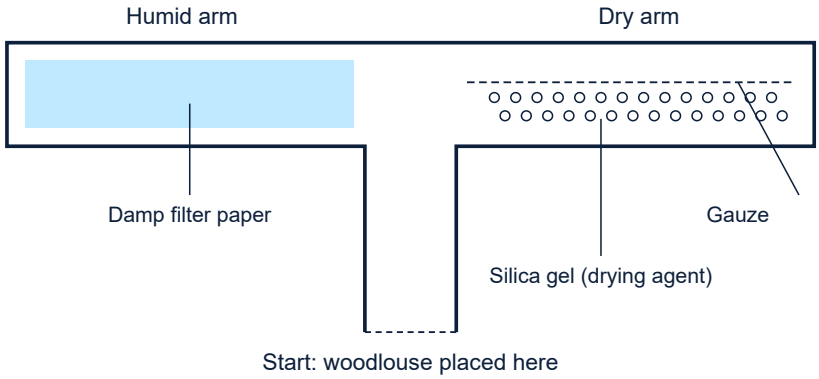
Do not write outside the box

Taxes, kineses and simple reflexes 3.6.1.1

A student used the maze in Figure 2 to investigate the effect of humidity on the movement of woodlice. The whole maze was covered with black card. The student:

- collected 40 woodlice from under logs
- placed one woodlouse at the start of the maze and recorded which arm it entered
- used each woodlouse only once
- swapped the positions of the humid arm and the dry arm after every 10 woodlice.

Figure 2



0 2 . 1 Explain how each of these features of the method helps to make the conclusions of the investigation valid:

[2 marks]

using each woodlouse only once .....

.....

.....

swapping the positions of the two arms .....

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Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Give **one** way the student should make sure the woodlice are treated ethically.

[1 mark]

Of the 40 woodlice, 29 entered the humid arm and 11 entered the dry arm. The student used the chi-squared (χ^2) test to analyse the results. The null hypothesis was that the woodlice were equally likely to enter either arm.

$$\chi^2 = \Sigma (O - E)^2 \div E$$

O is the observed number and E is the expected number.

0 2 . 3 Calculate the value of χ^2 for these results.

[2 marks]

Answer

0 2 . 4 The critical value of χ^2 for 1 degree of freedom at a probability of 0.05 is 3.84. Use your answer to the previous part to give a conclusion for this investigation. Explain your answer.

[2 marks]

Question 2 continues on the next page

Do not write outside the box

Woodlice lose water rapidly through their body surface. In a separate investigation, the student placed woodlice one at a time in a dish of dry air or a dish of humid air, and recorded their movement. Table 1 shows the results.

Table 1

	Dry air (20% relative humidity)	Humid air (95% relative humidity)
Mean speed of movement / mm s^{-1}	7.6	1.9
Mean percentage of time spent moving	88	34

0 2 . 5 Name the type of response shown in Table 1. Use Table 1 to explain how this response helps to keep woodlice in a favourable environment.

[3 marks]

Type of response .....

.....

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.....

10

0 3 . 1 Which response is a taxis?
Tick (✓) one box.

[1 mark]

A woodlouse moves more slowly when the air around it becomes more humid. ☐

A single-celled alga swims towards a light source. ☐

A plant root grows downwards, in the direction of gravity. ☐

A person's leg kicks forward when the tendon below the knee is tapped. ☐

Question 3 continues on the next page

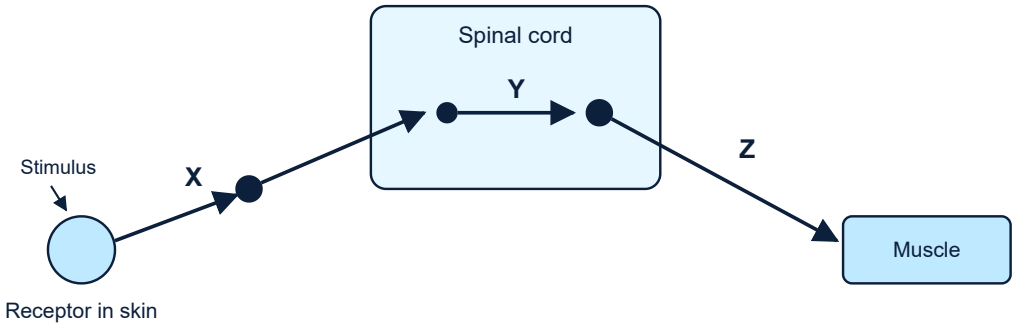
Do not write outside the box

0 3 . 2 Flatworms live under stones in streams. A student placed flatworms in the centre of a dish that was lit from one side. Each flatworm moved in a straight line, directly away from the light, until it reached the edge of the dish.
Explain why this behaviour is a taxis and not a kinesis, and suggest how it increases the flatworms' chance of survival.

[3 marks]

When a person touches a very hot object, the hand is pulled away within a fraction of a second, before the person feels any pain. Figure 3 shows the three neurones involved in this simple reflex.

Figure 3



0 3 . 3 Name the neurones labelled X, Y and Z.

[2 marks]

X .....

Y .....

Z .....

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 Explain how a simple reflex such as this one protects the body.

[2 marks]

8

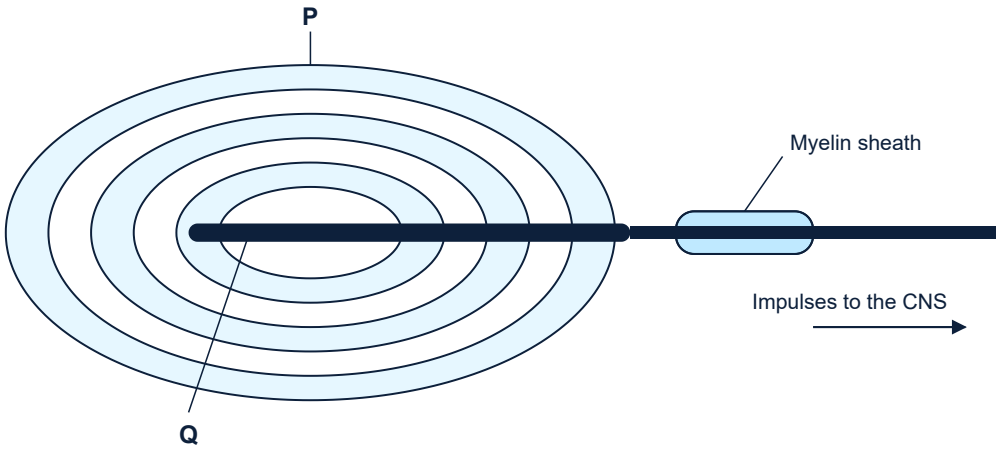
Turn over for the next question

Do not write outside the box

Receptors 3.6.1.2

Figure 4 shows the structure of a Pacinian corpuscle. It is not drawn to scale.

Figure 4



0 4 . 1 Name the structures labelled P and Q.

[1 mark]

P .....

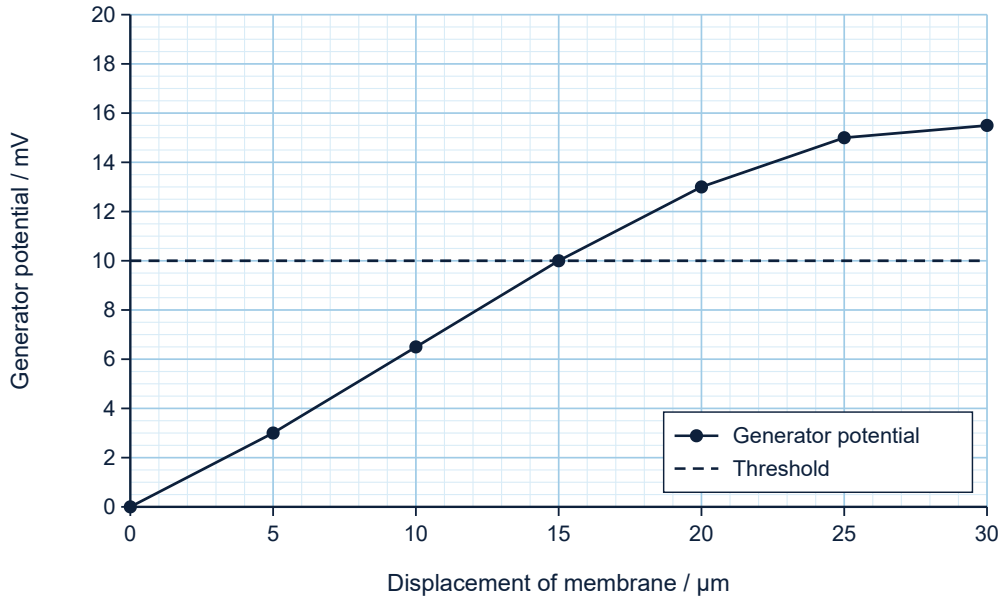
Q .....

Question 4 continues on the next page

Do not write outside the box

Researchers pressed on a single Pacinian corpuscle with a probe, using different pressures. They measured how far the membrane of the neurone ending was displaced and the size of the generator potential produced. Figure 5 shows their results, and the threshold of the sensory neurone.

Figure 5



0 4 . 2 Explain how pressing on the corpuscle produced the generator potentials shown in Figure 5.

[3 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 3 A pressure that displaced the membrane by 10 μm did not produce an action potential in the sensory neurone.
Use Figure 5 to explain why.

[1 mark]

0 4 . 4 Suggest why the generator potential increases only a little at displacements above 25 μm.

[1 mark]

0 4 . 5 In another experiment, the researchers warmed a Pacinian corpuscle by 5 °C without pressing on it. No generator potential was produced.
What does this result show about Pacinian corpuscles? Explain your answer.

[2 marks]

8

Turn over for the next question

Do not write outside the box

A student investigated the resolution of touch receptors in human skin. A volunteer was blindfolded. The student touched the volunteer's skin with either one point or two points of a pair of dividers, in a random order, and asked the volunteer whether one or two points were felt. The two points were moved closer together until they were felt as one. Table 2 shows the results.

Table 2

Region of skin	Mean minimum distance between points felt as two separate points / mm
Fingertip	2.5
Palm of hand	11
Forearm	38

0 5 . 1 Explain why the student:

[2 marks]

blindfolded the volunteer .....

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sometimes touched the skin with only one point .....

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0 5 . 2 Suggest an explanation for the difference between the results for the fingertip and the forearm.

[2 marks]

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4

Turn over for the next question

Do not write outside the box

0 6 . 1 Which statement explains why rods do **not** give colour vision?
Tick (✓) one box.

[1 mark]

All rods contain the same type of optical pigment. ☐

Rods are found only in the centre of the retina. ☐

The pigment in rods is not broken down by light. ☐

Each rod sends separate impulses to the brain. ☐

Scientists compared the retina of a nocturnal mammal, which is active at night, with the retina of a diurnal mammal, which is active during the day. Table 3 shows their results.

Table 3

	Nocturnal mammal	**Diurnal mammal**
Number of rods per mm^2 of retina	340 000	120 000
Number of cones per mm^2 of retina	6 800	40 000
Mean number of rods connected to each neurone in the optic nerve	80	15
Mean number of cones connected to each neurone in the optic nerve	4	1

0 6 . 2 Calculate the ratio of rods to cones in the retina of the nocturnal mammal.

[1 mark]

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Answer ..... **: 1**

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Use Table 3 to explain why the nocturnal mammal can see in dim light, but the diurnal mammal sees more detail in bright light.

[5 marks]

0 6 . 4 Light of the wavelengths that most people see as red or green is absorbed mainly by red-sensitive and green-sensitive cones. Some people do not have red-sensitive cones. These people cannot tell red light from green light. Suggest why.

[2 marks]

9

Turn over for the next question

Do not write outside the box

Control of heart rate 3.6.1.3

0 7 . 1 After a heart transplant, the nerves that connected the heart to the brain are not reconnected. The transplanted heart still beats.
Which statement explains why?
Tick (✓) one box.

[1 mark]

Cardiac muscle is myogenic, so the sinoatrial node (SAN) starts each heartbeat without nervous stimulation. ☐

Chemoreceptors in the wall of the heart send impulses directly to the ventricles. ☐

The atrioventricular node (AVN) sends waves of electrical activity to the SAN. ☐

Impulses from the cardiac centre reach the heart through the blood. ☐

Question 7 continues on the next page

Do not write outside the box

Table 4 shows the time after the SAN starts a wave of electrical activity when the wave reaches different regions of a human heart.

Table 4

Region of the heart	Time after the SAN starts the wave of electrical activity / ms
Sinoatrial node (SAN)	0
Atrioventricular node (AVN): wave arrives	40
Atrial muscle furthest from the SAN	85
Bundle of His: wave leaves the AVN	140
Purkyne tissue at the apex (bottom) of the ventricles	175
Ventricle muscle at the top of the ventricles, next to the atria	225

0 7 . 2 Use Table 4 to give the time for which the wave of electrical activity is delayed at the AVN. Explain why this delay is important.

[2 marks]

Delay (ms) .....

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Question 7 continues on the next page

Do not write outside the box

0 7 . 3 The distance along the bundle of His and the Purkyne tissue, from the AVN to the apex of the ventricles, is 98 mm.
Use Table 4 to calculate the mean speed at which the wave of electrical activity travels along this pathway. Give your answer in m s^{-1}.

[2 marks]

Answer ..... **m s^{-1}**

0 7 . 4 Use Table 4 to explain why the ventricles contract from the apex upwards.
Suggest why this is an advantage.

[2 marks]

7

Turn over for the next question

Do not write outside the box

A volunteer exercised on a bicycle for 8 minutes. Table 5 shows the volunteer's heart rate and the pH of the volunteer's blood at different times.

Table 5

	At rest	After 8 minutes of exercise	3 minutes after exercise ended	15 minutes after exercise ended
Heart rate / beats min^{-1}	68	156	104	72
pH of blood	7.41	7.33	7.37	7.40

0 8 . 1 Use Table 5 and your knowledge of the control of heart rate to explain the changes in heart rate during and after the exercise.

[6 marks]

Question 8 continues on the next page

Do not write outside the box

0 8 . 2 Cardiac output (CO) can be calculated using the formula CO = R × V, where R is the heart rate and V is the stroke volume.
After 8 minutes of exercise, the volunteer's cardiac output was 18.72 dm^3 min^{-1}.
Calculate the volunteer's stroke volume at this time, in cm^3.

[2 marks]

Answer ..... **cm^3**

0 8 . 3 A student concluded that the fall in blood pH was the only cause of the increase in the volunteer's heart rate.
Evaluate this conclusion.

[3 marks]

11

Turn over for the next question

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A group of 12 students investigated the effect of body position on pulse rate. Each student lay on a bench for 5 minutes, and then their pulse rate was measured. Each student then stood up, and their pulse rate was measured again 15 seconds later.

The mean pulse rate was 64 beats min^{-1} when lying down and 82 beats min^{-1} after standing up.

0 9 . 1 Suggest **two** variables, other than the time spent lying down, that the students should have controlled.

[2 marks]

1 .....

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2 .....

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0 9 . 2 When a person stands up, the blood pressure in the carotid arteries falls. Explain how this leads to an increase in pulse rate.

[3 marks]

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Question 9 continues on the next page

Do not write outside the box

0 9 . 3 Suggest why the pulse rate was measured 15 seconds after standing up rather than several minutes later.

[1 mark]

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6

END OF QUESTIONS

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