Senses, Plant Responses, the Brain and Learning (Topic 8): Edexcel SNAB A Level Biology Exam Questions by Topi

20 questions · 60 marks · about 72 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2019 · Q9(c) · 3 marks

(c) When the child was shown the cheeseburger, information would have been sent from the eye to the brain.

Describe the role of sodium ions in the functioning of a mammalian rod cell.

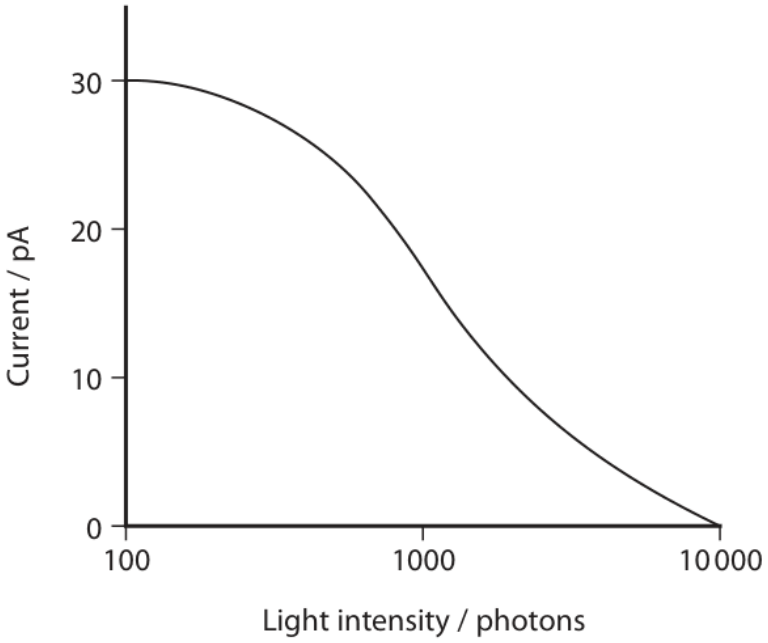
(3)

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10 The retina of the human eye contains rod cells.
These cells detect light energy as photons.
The light energy is converted to a nerve impulse that is interpreted by the brain.

(a) A current is produced by a rod cell when ions move through the cell surface membrane of a rod cell.

The graph shows the effect of increasing light intensity on the current produced by a rod cell.



Explain the effect of increasing light intensity on the current produced by a rod cell.

(5)

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Question 3 · A level Paper 2 · June 2023 · Q9(b) · 4 marks

(b) Rod cells form synapses with bipolar neurones.

Describe how movement of sodium ions in a rod cell affects depolarisation in a bipolar neurone.

(4)

Question 4 · A level Paper 2 · June 2024 · Q7(b)(i) · 2 marks

(b) One recessive genetic condition affecting the eye is fundus albipunctatus.

In this condition the speed of rhodopsin formation in rod cells is reduced after exposure to bright light.

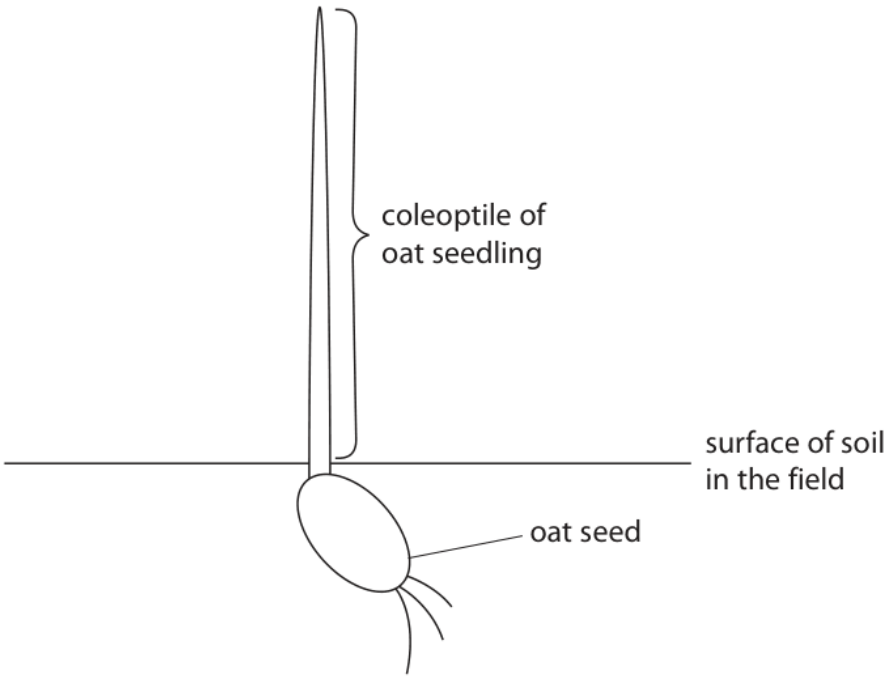
(i) Describe the process of rhodopsin formation in rod cells after exposure to bright light.

(2)

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3 Phytochromes and IAA (indole acetic acid) are important substances that bring about growth responses in plants.

(a) The diagram shows an oat seedling in part of a field.



Cells in the tip of the oat coleoptile release IAA.

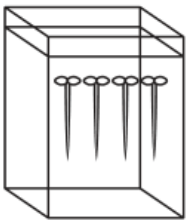
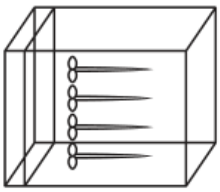
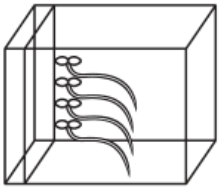
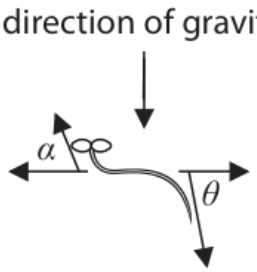
Explain how the IAA affects the growth of the coleoptile.

(4)

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(b) The effect of gravity on the growth of lettuce plants with either upright or weary phenotype was investigated.

The diagram shows the stages in this investigation.

Stage A 	Lettuce plants were grown until their stems were 15 cm long.
Stage B 	The lettuce plants were then placed in complete darkness and rotated so that they were at 90° to the direction of gravity.
Stage C  	The curvatures of the stems (α) and roots (θ) were measured for the next 23 days.

(i) Explain why the plants were placed in a box in complete darkness.

(3)

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Question 7 · A level Paper 3 · November 2021 · Q1(b) · 4 marks

(b) Describe the role of IAA (auxin) in the phototropic response of plants.

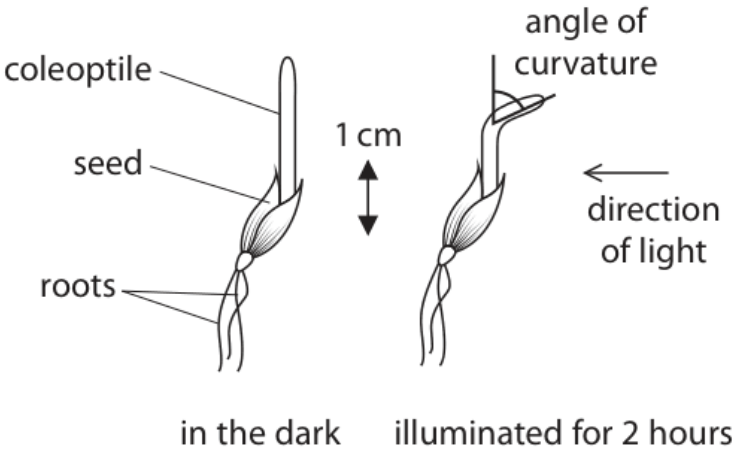
(4)

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1 When oat seeds germinate, they produce roots and a coleoptile.

(a) The effect of shading the tip of the coleoptile was investigated.

The diagram shows how the coleoptile of an oat seedling can bend towards light.



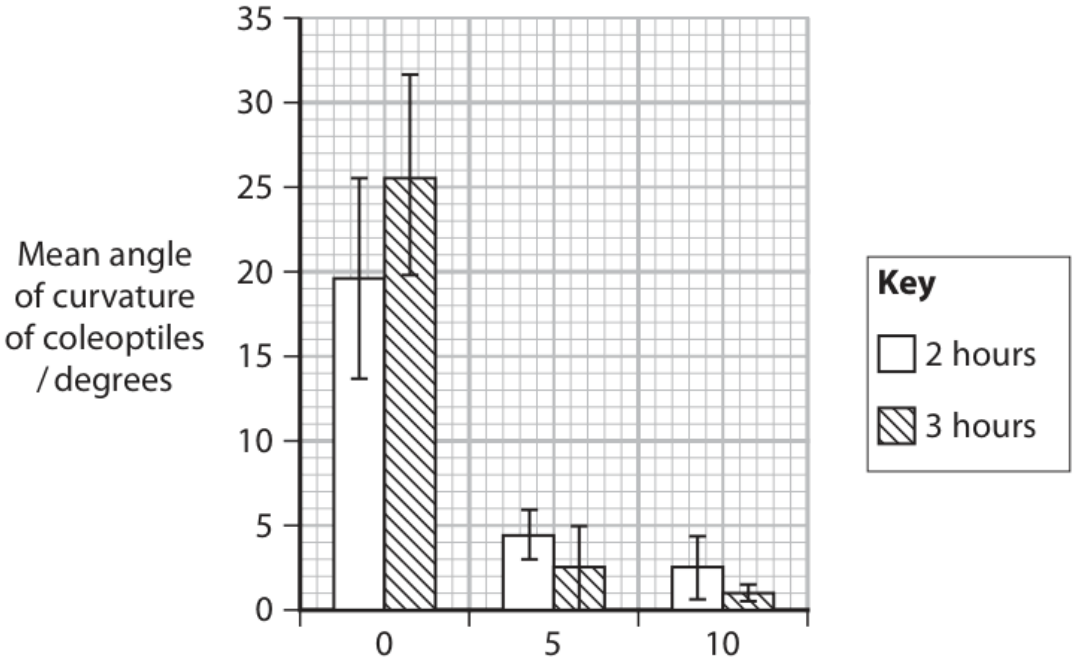
Oat seeds were germinated. When the coleoptiles were 2 cm long the seedlings were split into three groups.

- Group 1 none of the tip of the coleoptile was shaded
- Group 2 5 mm at the tip of the coleoptile was shaded
- Group 3 10 mm at the tip of the coleoptile was shaded

All the coleoptiles were then exposed to light from one side.

The curvature of the coleoptiles was measured after intervals of 2 hours and 3 hours.

The results of this investigation are shown in the graph.



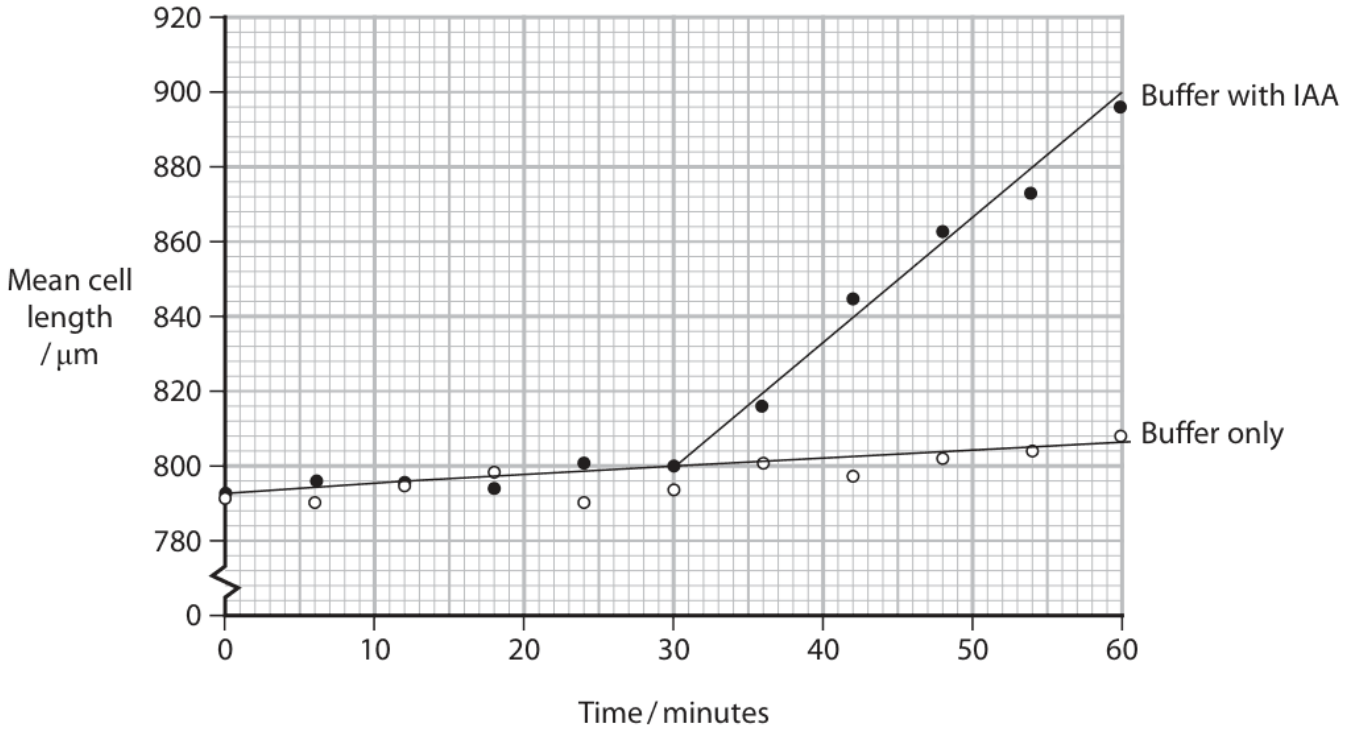
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(b) In a second investigation, cells were taken from below the tip of the coleoptile.

These cells were soaked in buffer alone or buffer containing IAA (auxin), for a period of 60 minutes.

The lengths of the cells were measured every six minutes.

The results of this investigation are shown in the graph.



Question 8 · A level Paper 3 · June 2022 · Q1(c) · 3 marks

(c) Explain how the evidence from these investigations indicates that plant hormones are involved in the phototropic response of oat coleoptiles.

(3)

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Question 9 · A level Paper 2 · June 2024 · Q8(b)(ii) · 3 marks

(ii) Explain how the response of phytochrome to a light stimulus can cause an increase in plant growth.

(3)

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Question 10 · A level Paper 2 · June 2025 · Q8(a)(ii) · 3 marks

(ii) *Arabidopsis* is known as a long-day plant.

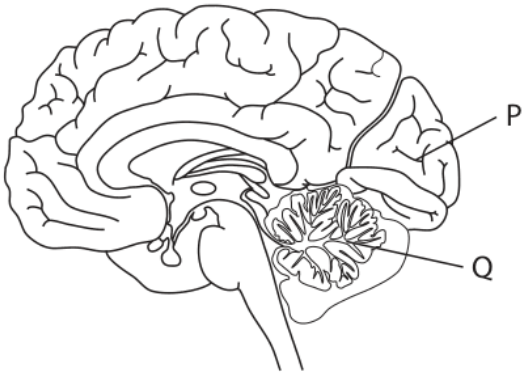
Explain why *Arabidopsis* will flower when each day has 16 hours of light.

(3)

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Question 11 · A level Paper 2 · June 2024 · Q1(c) · 2 marks

(c) The diagram shows a human brain.



Brain tumours can change brain function.
Describe the possible effects of brain tumours in parts P and Q.

(2)

P .....

.....

Q .....

.....

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Question 12 · A level Paper 2 · June 2018 · Q4(a)(iii) · 3 marks

(iii) Explain how fMRI can be used to identify the part of the brain involved in interpreting information from the visual cortex.

(3)

Question 13 · A level Paper 2 · June 2022 · Q2(b)(i) · 3 marks

(b) There are various types of scan that can be used to study the brain.

(i) Describe why a region of the brain might appear lighter in an image obtained by a functional magnetic resonance image (fMRI) scan.

(3)

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Question 14 · A level Paper 2 · June 2024 · Q1(b)(i) · 2 marks

(b) PET, MRI and fMRI are methods for scanning the brain.

PET uses labelled glucose. This glucose can be detected so that PET can be used to identify brain tumours.

(i) Describe the advantages of using PET and fMRI rather than MRI scans to investigate a possible tumour in the brain.

(2)

Question 15 · A level Paper 2 · June 2018 · Q4(b) · 3 marks

(b) Describe the role of visual stimulation on the development of the visual cortex during the critical period.

(3)

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Question 16 · A level Paper 2 · November 2021 · Q10(c) · 2 marks

(c) In one experiment, Hubel and Wiesel kept the right eye of a kitten closed during the critical period.

They then studied the effect of this on the visual region of the brain of this kitten.

Describe the differences in the visual region of this kitten compared with the visual region of a kitten that had both eyes open during the critical period.

(2)

Question 17 · information from earlier in the question

9 Many organisms that live in the sea produce poisonous chemicals called neurotoxins.

(a) Pufferfish produce a neurotoxin called tetrodotoxin (TTX). This is believed to be a defence against predators.

An investigation studied TTX from five individuals of the same species of pufferfish.

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(ii) The investigation also tested the toxicity of the different tissues from each of the five pufferfish.

The level of toxicity was tested in mice, and the results are shown in the table.

	Level of toxicity per gram of pufferfish tissue / arbitrary units			
Sex of fish	**Liver**	**Muscle**	**Gonad**	**Skin**
Female	126	4	398	18
Female	239	6	485	17
Female	112	4	350	16
Male	4	3	3	15
Male	4	3	4	17

Some humans eat pufferfish.

Describe why mice were used to determine the level of toxicity.

(3)

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Question 18 · A level Paper 3 · June 2022 · Q5(a) · 2 marks

5 Habituation is a learning response observed in many types of animal.

(a) Explain the importance of the habituation response in an animal.

(2)

Question 19 · A level Paper 3 · June 2017 · Q2(d) · 4 marks

(d) This investigation used only one 30-minute session of TENS pulses. This was done to reduce the risk of habituation.

Describe the process that occurs at a synapse that leads to habituation.

(4)

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Question 20 · information from earlier in the question

(b) *Stentors* are found in fresh water attached to pebbles.

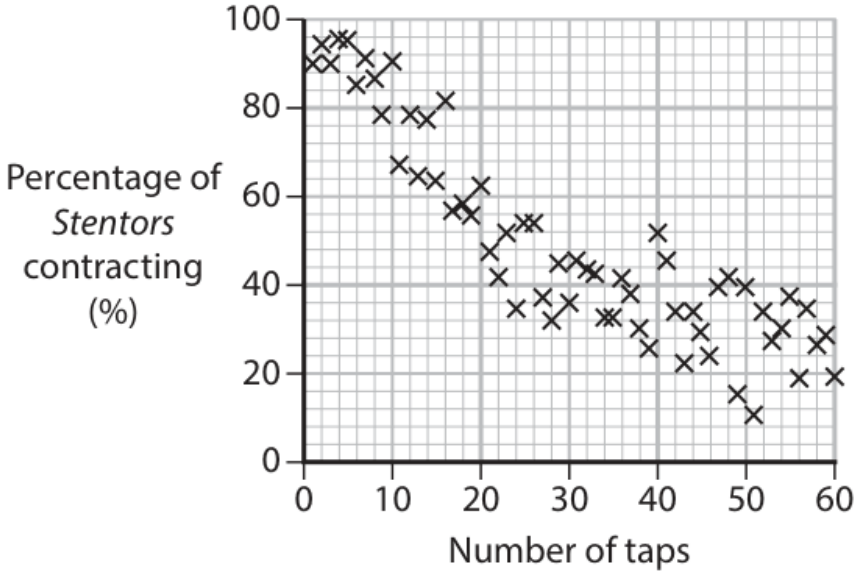
The response of *Stentors* to a stimulus was investigated.

A sample of 150 *Stentors* was allowed to attach to the bottom of a Petri dish filled with stream water. The *Stentors* were then given two hours to acclimatise.

The Petri dish was then tapped with a ruler once every minute.

After each tap, the percentage of *Stentors* that contracted was recorded.

The results are shown in the graph.



Question 20 · A level Paper 3 · June 2025 · Q2(b)(iv) · 2 marks

(iv) Explain the results of this investigation.

(2)

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Mark schemes

Question 1 · A level Paper 2 · June 2019 · Q9(c) · 3 marks

Question Number	Answer
9(c)	A description that makes reference to three of the following: • sodium ions are pumped out of the { rod cell / inner segment } (1) • (in the light / when stimulated) sodium ions do not move back into rod cell (1) • (in the dark / when not stimulated) sodium ions can move back into the { rod cell / outer segment } (1) • (in the light / when sodium ions do not move back in) the rod cell is hyperpolarised / (in the dark / when sodium ions can move back in) the rod cell is depolarised (1)

Additional Guidance	Mark
	(3)

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Question 2 · A level Paper 2 · November 2021 · Q10(a) · 5 marks

Question Number	Answer
10(a)	An explanation that makes reference to the following: • increasing light intensity decreases the current (1) • because {rhodopsin is broken down / opsin is released} (1) • therefore, more opsin binds to the channel proteins in the outer segment (1) • sodium-gated voltage channels close (1) • {reducing / stopping} the influx of sodium ions / making membrane impermeable to sodium ions (1)

Additional Guidance	Mark
ALLOW opsin binds to the cell surface membrane / sodium-gated voltage channels ALLOW Na^+ channels / (non-specific) cation channels for sodium-gated voltage channels	**(5)**

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Question Number	Answer
9(b)	A description that makes reference to four of the following: • (in the dark) sodium ions moving {in through sodium ion channels / into the outer segment} (1) • sodium ions {removed / pumped out} at inner segment (1) • so rod cell depolarises (1) • causing { neurotransmitter / glutamate } to be released (1) • inhibits depolarisation in (adjacent) bipolar neurone (1)

Additional Guidance	Mark
CONVERSE for depolarisation of bipolar neurone (in the light): CONVERSE- sodium ions do not enter / are inhibited from entering the rod cell CONVERSE- rod cell hyperpolarises CONVERSE- inhibition of release of {neurotransmitter / glutamate } CONVERSE- bipolar neurone depolarised.	[4]

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Question 4 · A level Paper 2 · June 2024 · Q7(b)(i) · 2 marks

Question Number	Answer	Additional Guidance	Mark
7(b) (i)	A description that makes reference to two of the following: • (rhodopsin reformation) occurs in the dark (1) • retinal joins to opsin (1) • trans retinal is converted to cis retinal (in the dark) (1)		2

Question 5 · A level Paper 2 · October 2020 · Q3(a) · 4 marks

Question Number	Answer
3(a)	An explanation that makes reference to four of the following: • IAA diffuses from the tip of the coleoptile (1) • (therefore) can be taken up by cells in zone of elongation (1) • which causes cells to elongate (1) • details of action in zone of elongation (1) • (therefore) causes the coleoptile to { grow towards the light / increase in height } (1)

Additional Guidance	Mark
e.g. leads to lowering of the pH in the cellulose cell wall ALLOW: positive phototropism IGNORE: bend for growth	(4)

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Question 6 · A level Paper 3 · June 2019 · Q5(b)(i) · 3 marks

Question Number	Answer
5(b)(i)	An explanation that makes reference to the following: • plants respond to light / plants show phototropic responses (1) • (therefore) light must be excluded in order to study the effects of gravity (1) • (putting plants in the dark) therefore prevents light having an effect (1)

Additional guidance	Mark
ALLOW plant shoots grow towards light ALLOW 'geotropism' for 'effects of gravity' ALLOW to control light	**(3)**

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Question 7 · A level Paper 3 · November 2021 · Q1(b) · 4 marks

Question number	Answer
1(b)	An answer that makes reference to the following: • (IAA) produced in the tip of the shoot (1) • (IAA) accumulates on the dark side of the shoot (1) • (IAA) stimulates cell elongation (1) • causing the shoot to grow towards the light source (1)

Additional guidance	Mark
ALLOW a diffusion gradient is established / IAA diffuses to the opposite side of the shoot ALLOW low concentrations of IAA inhibit cell elongation on the light side ALLOW plant ALLOW bend	Choose an item (4)

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Question 8 · A level Paper 3 · June 2022 · Q1(c) · 3 marks

Question number	Answer
1(c)	An explanation that makes reference to the following: • {IAA/auxin} is a (plant) hormone (1) • (investigation showed) cells grew longer with IAA / IAA stimulates cell elongation (1) • {light sensing / IAA producing} cells are in the tip (of the coleoptile) (1) • (results show) cell elongation happened in cells below the (shoot) tip (1) • the response to IAA is (relatively) {slow / prolonged} (1)

Additional guidance	Mark
ALLOW IAA caused cell growth / increases cell length ALLOW cells that respond to IAA are in a different part of the coleoptile to the light sensing structures for MP 3 and 4	(3)

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Question 9 · A level Paper 2 · June 2024 · Q8(b)(ii) · 3 marks

Question Number	Answer
8(b)(ii)	An explanation that makes reference to three of the following: • phytochrome far red formed (in light) (1) • (phytochrome far red) is the active form (1) • (so phytochrome far red) stimulates {mitosis / cell division / cell elongation } (1) • phytochrome far red {is a transcription factor / activates transcription factors / stimulates protein synthesis} (1)

Additional Guidance	Mark
ALLOW P_{fr} for phytochrome far red	3

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Question 10 · A level Paper 2 · June 2025 · Q8(a)(ii) · 3 marks

Question Number	Answer
8 (a)(ii)	An explanation that makes reference to three of the following: • long days allow { P_{FR} to be made / P_{FR} to P_R ratio increases / P_R to be converted to P_{FR} } (1) • short nights mean less time for {conversion of P_{FR} to P_R / loss of P_{FR}} (1) • P_{FR} stimulates flowering (1) • P_{FR} activates transcription factors for genes associated with flowering (1)

Additional Guidance	Mark
ALLOW active phytochrome for P_{FR}, and inactive phytochrome for P_R ALLOW 16 hours is long enough to accumulate enough P_{FR} ALLOW gene activation or protein synthesis if linked to flowering	**(3)**

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Question 11 · A level Paper 2 · June 2024 · Q1(c) · 2 marks

Question Number	Answer
1(c)	A description that makes reference to the following: • P- inability to see / reduce visual perception (1) • Q - (change in ability to) balance / posture / (fine) motor skills / coordination (1)

Additional Guidance	Mark
ALLOW damage to vision ALLOW suitable descriptions	**2**

Question 12 · A level Paper 2 · June 2018 · Q4(a)(iii) · 3 marks

Question Number	Answer
4(a)(iii)	An explanation that makes reference to the following: • (fMRI) detects { blood flow / oxygen use } in the brain (1) • increased brain activity results in increased { blood flow / demand for oxygen / aerobic respiration } in the area of activity (1) • oxyhaemoglobin absorbs fewer radio waves / fMRI detects areas where less signal absorbed (1)

Additional Guidance	Mark
ALLOW signal reflected by oxyhaemoglobin	**(3)**

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Question 13 · A level Paper 2 · June 2022 · Q2(b)(i) · 3 marks

Question Number	Answer
2(b)(i)	A description that makes reference to the following: • due to more activity (1) • an increase in { oxygenated blood / blood flow } to this region (1) • fMRI signals { reflected / not absorbed } by oxygenated blood (1)

Additional Guidance	Mark
ALLOW increased aerobic respiration ALLOW oxyhaemoglobin or oxygen-rich blood for oxygenated blood ALLOW oxyhaemoglobin or oxygen-rich blood for oxygenated blood	(3)

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Question 14 · A level Paper 2 · June 2024 · Q1(b)(i) · 2 marks

Question Number	Answer
1(b) (i)	A description that makes reference to the following: • (both) can assess brain activity (1) • image formed in real time (1)

Additional Guidance	Mark
ALLOW show areas of brain that are more active ALLOW brain function for brain activity ALLOW live imaging for real time	2

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Question 15 · A level Paper 2 · June 2018 · Q4(b) · 3 marks

Question Number	Answer
4(b)	A description that makes reference to three of the following: • ocular dominance columns (develop in visual cortex) (1) • neurones form synapses with these { cells / columns } (1) • { stimuli / action potentials / impulses } along neurones required to strengthen connections (with cells of ocular dominance columns) (1) • stimulation during the critical period is needed to form (effective) connections in the visual cortex (1)

Additional Guidance	Mark
ALLOW columns of (target) cells ALLOW more synapses for stronger connections OR connections become weaker if stimuli not received	**(3)**

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Question 16 · A level Paper 2 · November 2021 · Q10(c) · 2 marks

Question Number	Answer
10(c)	A description that makes reference to two the following: • fewer synaptic connections (1) • by neurones {associated with right eye / to right ocular dominance columns} (1) • left ocular dominance columns {expanded / contain more synapses} (to compensate) (1)

Additional guidance	Mark
ALLOW fewer synapses ALLOW converse for right ocular dominance columns	**(2**

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Question 17 · A level Paper 2 · June 2024 · Q9(a)(ii) · 3 marks

Question Number	Answer
9(a)(ii)	A description that makes reference to three of the following: • (like humans) they are mammals / (may be a) good model for humans (1) • (therefore) will react in a similar way / metabolise the toxin in the same way (1) • no risk to humans / unethical to test in humans (1) • can control variables (1)

Additional Guidance	Mark
ALLOW similar anatomy ALLOW to find out if safe to eat, only male fish safe to eat, liver edible e.g. genetically identical	3

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Question 18 · A level Paper 3 · June 2022 · Q5(a) · 2 marks

Question number	Answer
5(a)	An explanation that makes reference to the following: • allows an animal (to learn) to ignore (repetitive) non-threatening stimuli (1) • therefore allowing it to focus on (potentially) more relevant stimuli (1)

Additional guidance	Mark
ALLOW therefore allowing it to conserve {energy / resources} ALLOW converse – such as if animals did not habituate they would waste energy on unimportant stimuli	(2)

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Question 19 · A level Paper 3 · June 2017 · Q2(d) · 4 marks

Question Number	Answer
2(d)	A description that makes reference to four of the following: • (repeated stimulus) decreases {sensitivity / permeability} of pre-synaptic membrane / calcium channels not opening **(1)** • so {fewer / no} Ca^{2+} ions move into pre-synaptic neurone **(1)** • so {fewer / no} vesicles {move towards / fuse with} (pre-synaptic) membrane **(1)** • so {less / no} neurotransmitter {released / can diffuse across gap} **(1)** • {action potential / depolarisation} less likely to occur in post-synaptic neurone **(1)**

Additional Guidance	Mark
ALLOW calcium channels less or not responsive	**(4)**

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Question 20 · A level Paper 3 · June 2025 · Q2(b)(iv) · 2 marks

Question number	Answer
2(b)(iv)	An explanation that makes reference to two of the following: • Stentors become habituated to the {tapping / stimulus} (1) • so less energy wasted on {an unnecessary response / responding to non-threatening stimulus} (1)

Additional guidance	Mark
ALLOW with increased number of taps the Stentor ignore the {tapping / stimulus} / Stentor become less responsive to the {tapping / stimulus} ALLOW less energy wated on unimportant stimulus	(2)

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