PAG 11 Plant and Animal Responses: OCR A Level Biology Exam Questi

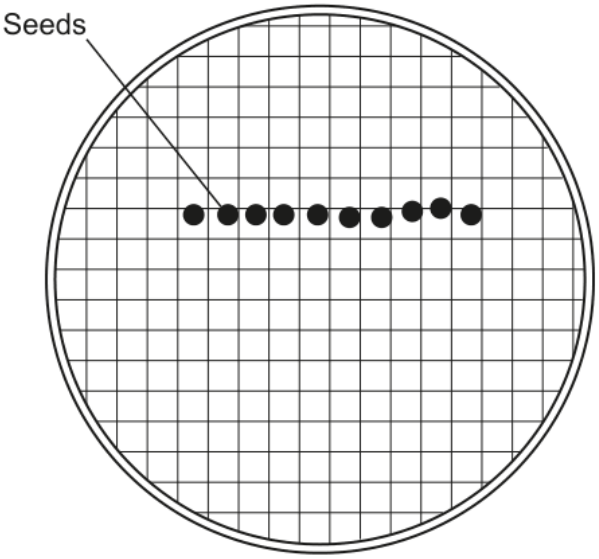
8 questions · 35 marks · about 42 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 1 · June 2023 · Q17(a)(i) · 2 marks

17 Some students investigate the effect of IAA (auxin) concentration on the growth of roots and shoots in mustard seedlings.

This is the method that they use with 8 different concentrations of IAA:

- Place a filter paper on a bed of cotton wool in the Petri dish and soak it with IAA solution.
- Place 10 seeds in a horizontal line on the damp filter paper.
- Cover with a lid that has a grid marked on it, as shown in the diagram.
- Repeat this process with each different concentration of IAA.
- Add distilled water to one Petri dish in place of IAA solution.
- Place the Petri dishes vertically in a warm dark place for 2 to 3 days until the seeds have germinated and the roots and shoots have started to grow.
- Measure the length of the shoots and roots by counting the number of grid squares the shoot or root covers.



(a) (i) Explain why the Petri dishes were placed vertically and in the dark.

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..... **[2]**

Turn over

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Question 2 · A level Paper 1 · June 2023 · Q17(a)(ii) · 2 marks

(ii) Explain the purpose of the Petri dish containing distilled water instead of IAA solution.

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..... **[2]**

Question 3 · information from earlier in the question

(c) The students also investigated the effect of plant hormone concentration on root growth.

(i) State the name of a plant hormone that would be expected to affect root growth.

..... **[1]**

Question 3 · A level Paper 3 · November 2020 · Q3(c)(ii) · 1 mark

(ii) In the investigation, the students controlled light, temperature and mineral concentration.

State one **other** factor that the students should have controlled in this investigation.

..... **[1]**

Turn over

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3 Students investigated the effect of light on the growth of garden cress seedlings.

- A total of 120 seedlings were divided into 2 groups of 60.
- Group A was grown in darkness for 2 days.
- Group B was grown for 1 day in darkness and then for 1 day in white light using the set-up shown in Fig. 3.1.

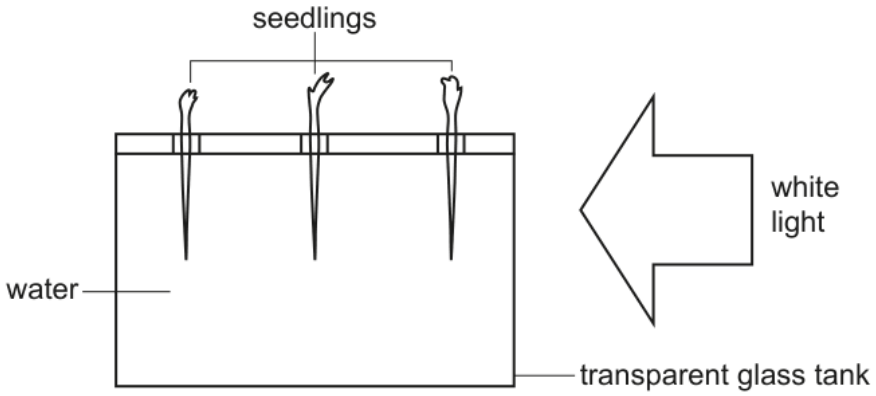


Fig. 3.1

The results of the students' experiment are shown in Tables 3.1 and 3.2.

Group	Mean length (mm)		Mean mass (μg)	
	stem	root	stem	root
A	13	18	102	60
B	25	23	160	120

Table 3.1

	Number of seedlings	
Direction of growth in Group B	**stem**	**root**
Away from light	2	29
Neither away from nor towards light	3	20
Towards light	55	11

Table 3.2

(a) (i)* Describe and explain the results shown in Tables 3.1 and 3.2.

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Question 5 · A level Paper 1 · June 2017 · Q21(b) · 6 marks

(b) Another response affected by plant hormones is phototropism.

A student completed an investigation into phototropism in cress seeds.

This was the method used:

- Place 50 cress seeds (*Lepidium sativum*) on a sterile paper towel in a petri dish.
- Water with 10 cm^3 of distilled water.
- Repeat for 3 different sets of seeds:
  - Set 1 is placed in a box to prevent light shining on the seeds.
  - Set 2 is placed in a box with light from above only.
  - Set 3 is placed in a box with light from the right hand side only.
- Keep all 3 sets at 25 °C.
- After 72 hours, remove 20 of the seedlings from each set and count how many have bent.

Identify **two** limitations of the student's method.

For each limitation, explain how it limits the validity of conclusions that can be drawn **and** suggest an improvement that would improve the validity of conclusions made.

limitation 1:

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explanation:

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improvement:

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limitation 2:

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explanation:

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improvement:

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[6]

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Question 6 · information from earlier in the question

(c) Another student plans to investigate the effect of gibberellin concentration on the rate of stem elongation in the pea plant, *Pisum sativum*.

(i) Suggest appropriate units for the dependent variable in this investigation.

..... **[1]**

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Question 6 · A level Paper 3 · June 2022 · Q3(c)(ii) · 6 marks

(ii)* The student has access to standard laboratory equipment and planting materials.

Outline a method that the student could use to investigate the effect of gibberellin concentration on stem elongation in *P. sativum*.

In your answer, you should include details of an appropriate statistical test for this investigation.

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Additional answer space if required.

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Question 7 · A level Paper 1 · June 2025 · Q18(b) · 6 marks

(b)* Scientists investigate the effect of gibberellin on stem length in young soybean plants.

This is the method they use:

- Select young plants with 4 pairs of leaves.
- Apply gibberellin solution to the leaves of 8 young plants.
- Select 8 more young plants as a control group.
- Allow young plants to grow until they develop 7 pairs of leaves.
- Measure the distance between the fifth and sixth pairs of leaves in each young plant. This is called the internode distance.
- Calculate the mean and standard deviation of the internode distance for each group.

Their results are shown in the table.

Group	Mean internode distance (cm)	Standard deviation
Gibberellin treated	6.33	1.44
Control	3.58	1.27

Here are the critical values for *t*.

Degrees of freedom (df)	Probability (%)	
	5.0	1.0
6	2.45	3.71
7	2.36	3.50
8	2.31	3.36
10	2.23	3.17
12	2.18	3.05
14	2.15	2.98
16	2.12	2.92

The scientists used Student's *t*-test to compare the mean internode distances in the treated and control groups.

Their calculated value for *t* was 4.05.

The scientists concluded that gibberellin caused a significant increase in stem length in young soybean plants.

Suggest a null hypothesis for the investigation **and** evaluate this conclusion.

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Question 8 · A level Paper 3 · June 2017 · Q6 · 6 marks

6* A student investigated the heart rates of smokers and non-smokers.

- Each test subject had their resting heart rate measured using an electronic heart rate monitor.
- They ran 1 km on a running track and their heart rate after running 500 m was recorded.
- Their heart rate was recorded for a third time 3 minutes after the completion of the exercise.

All test subjects were 18 years old. Subjects were tested between 9 am and 4 pm on one day, one at a time. Each test lasted approximately 20 minutes in total. The tests were repeated one week later using the same method. Mean heart rates were calculated for each subject.

The student's plan was to compare the heart rates of smokers and non-smokers using Student's *t*-test.

The student's results are shown in Table 6.

Student	Smoker?	Gender	Resting heart rate (bpm)	Heart rate during exercise	Heart rate after exercise
1	Y	Male	60.5	130.0	66.5
2	N	Female	67.0	145.5	73
3	Y	Male	70.0	120	77.0
4	Y	Male	65.5	100	69
5	Y	Male	66.0	128.5	75.5
6	Y	Female	65.5	115.5	74.5
7	Y	Female	73.5	120.5	81
8	N	Female	63.0	118	66
9	N	Female	71.0	95.5	80.5
10	N	Female	65.5	110	71
11	N	Male	64.0	145.5	68
12	N	Male	52.5	140.0	58.5
13	N	Male	54.0	137.5	63
14	N	Female	73.0	130.5	81
15	N	Female	61.5	124	67
16	N	Female	71.0	130	81.5
17	N	Male	60.0	122.5	63
18	N	Female	64.5	118	69
19	N	Female	67.5	130.5	73.5
20	Y	Male	72.0	135	82
21	Y	Female	69.5	110	75.5

Table 6

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Suggest and explain improvements that the student could make to his experimental method and his presentation of data.

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Mark schemes

Question 1 · A level Paper 1 · June 2023 · Q17(a)(i) · 2 marks

17	**(a)**	**(i)**	placed vertically so that , roots grow downwards / shoots grow upwards ✓ in dark so that light does not affect , results / growth **OR** in dark to prevent phototropism ✓	

2	2.7	**DO NOT ALLOW** trop**h**ism / trop**h**ic **ALLOW** roots are positively geotropic / shoots are negatively geotropic **ALLOW** gravitropic for geotropic **ALLOW** roots grow towards gravity / shoots grow away from gravity **ALLOW** absence of light / darkness , is a control variable

Question 2 · A level Paper 1 · June 2023 · Q17(a)(ii) · 2 marks

17	**(a)**	**(ii)**	act as a control ✓ determine , results / growth , without , auxin / IAA ✓ compare , results / growth , with and without, auxin / IAA ✓ allow calculation of percentage , change / stimulation / inhibition ✓	**max 2**	3.4

DO NOT ALLOW control variable **ALLOW** e.g. shows growth without auxin **ALLOW** percentage , increase / decrease for % change

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Question 3 · A level Paper 3 · November 2020 · Q3(c)(ii) · 1 mark

ii	(soil/water) pH / species of plant / age of plant / size of plant / soil type / water availability ✓	1	3.3

IGNORE carbon dioxide concentration / wind movement / humidity
ALLOW pre-treatment of seeds

Question 4 · A level Paper 3 · November 2020 · Q3(a)(i) · 6 marks

3	a	i				
			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
			Level 3 (5-6 marks) Detailed description **and** linked explanation of results for **both** tables. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** Describes results for **both** tables with some explanation of at least **one** table. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.*	**6**	2.3 2.4 3.1	**Indicative scientific points may include (but are not limited to):** *AO2.3 and 2.4 Apply knowledge and understanding of scientific ideas and techniques in a practical context when handling qualitative and quantitative data.* *Descriptions*: <u>Table 3.1</u>: • light increases length and mass of both roots and stems • group A has less growth than group B <u>Table 3.2:</u> • stems grow towards the light (with a few exceptions) • (almost) half the roots grow away from light • some appear unaffected by light or grow towards light
			Level 1 (1-2 marks) Offers some description for both tables **or** describes and explains one table. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.			*AO3.1 Analyse scientific information to make judgements and reach conclusions* *Explanations*: <u>Table 3.1:</u> • more carbohydrates produced during photosynthesis • light may trigger growth and germination (through phytochromes) <u>Table 3.2:</u> • details of phototropism (e.g. auxins produced in shoot tip moves to side away from light / auxins cause more cell elongation on side away from light) • light allows photosynthesis • positive phototropism in stems • geotropism more important than phototropism in roots • (some) negative phototropism in roots • other reasons for varied data, e.g. conditions not natural / measurement error / shading of stems / stems heavier than roots so tips

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21	(b)	***related to light (L)*** **L1** light intensity / brightness , is not , controlled / specified **OR** size of hole in box not specified ✓ **L2** different , light intensities / brightness , could lead to variation in , phototropism / bending ✓ **L3** *idea that* light intensity / brightness , stays the same ✓ ***related to selection of seedlings (S)*** **S1** no method for , selecting / AW , (20) seedlings ✓ **S2** could lead to biased results ✓ **S3** *idea of* random selection ✓ ***related to measuring bend of seedlings (B)***
		B1 degree of bending (of seedlings) not considered ✓ **B2** *idea of* a (reproducible) comparison is not possible **OR** could lead to biased results ✓ **B3** measure angle of bend ✓ ***related to replicates (R)*** **R1** experiment / trial , was not repeated ✓ **R2** cannot , calculate mean / identify anomalies / carry out statistical analysis ✓ **R3** repeat (experiment at least) twice **OR** carry out (at least) three trials ✓ ***related to size of dish (D)*** **D1** size of petri dish not , controlled / specified ✓ **D2** different sized dishes could affect , spacing of seeds / access to light ✓ **D3** specify , size / volume / diameter , of petri dish ✓
		Total

6 max	*Mark limitation, explanation and improvement as continuous prose within each numbered prompt.*

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Question 6 · A level Paper 3 · June 2022 · Q3(c)(ii) · 6 marks

3	**(c) (ii)**	***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
		Level 3 (5-6 marks) Comprehensive outline of a valid experimental method, including details of all three types of variable, **and** statistical analysis for the investigation. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** The answer contains detailed reference to variables **and** statistical analysis for the investigation. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** The answer contains brief reference to a variable **or** statistical analysis for the investigation. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.	**6**	3.3 3.4	**Indicative scientific points may include (but are not limited to):** *AO3: To develop and refine practical design and procedures* *Experimental method* Validity • Details of sample sizes and repeats • Details of group design (e.g. two groups: one without additional gibberellin, or several groups receiving different gibberellin concentrations, plus a control group) • Details of gibberellin application Variables • Details of control variables (e.g. plant/seedling size, water availability, light, temperature) • Details of the independent variable (varying gibberellin concentrations) • Details of the measurement of the dependent variable (measurement of stem length)
					Statistical analysis • Idea of identifying anomalies • Mean calculations • Standard deviation • Statistical testing (e.g. t-test if two groups are used, or Spearman's rank/Pearson correlation test if a range of concentrations are used)

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18 (b)"	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** An appropriate null hypothesis **AND** interpretation of the *t*-test **AND** a detailed discussion of points not supporting the conclusion. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** An appropriate null hypothesis **AND** some interpretation of the *t*-test **OR** An appropriate null hypothesis **AND** a discussion of points not supporting the conclusion **OR** Some interpretation of the t-test **AND** a discussion of points not supporting the conclusion. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*
Question	**Answer**

	Level 1 (1–2 marks) An appropriate null hypothesis **OR** some interpretation of the *t*-test **OR** some points not supporting the conclusion. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*
Question	**Answer**

6	2.4	**Comms**: line of reasoning based on • **stated** critical values that are **correct** • differences between means not in context of correlation/relationship. **Indicative scientific points could include:** *Null / H_0 hypothesis*
	3.2	• there is no (significant) difference between (mean, internode / stem) lengths
		• there is no (significant) increase in stem

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Question 8 · A level Paper 3 · June 2017 · Q6 · 6 marks

6	***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** ***A level annotation should be used where all marks for a level have been achieved eg for 6 marks*** **L3** ***If a candidate has achieved 5 marks then they have reached level 3 but with one mark omitted*** **e.g L3** ^ ***The same principal should be applied to level 2 and level1*** ***No marks (0) should have a cross***			
	Level 3 (5-6 marks) Describes **and** explains some improvements to the method **and** the presentation. *There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.* **Level 2 (3-4 marks)** Describes some improvements to the method **and** the presentation, **and** explains improvements to **either** method **or** presentation *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.* **Level 1 (1-2 marks)**	**6**		**Indicative scientific points may include** *Method:* • sample sizes should be increased to improve the accuracy and repeatability of the results • same number of subjects for, smokers/non-smokers/gender, to make comparisons more valid • gender should be controlled/tested separately because heart rate may show an overall difference between genders • other subject factors (e.g. diet, exercise history, other health issues) should be controlled/taken into account because these can influence heart rate
	Describes some improvements to either method **and** / **or** presentation. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*			• the level of smoking (e.g. casual vs 20 per day) should be controlled because this is likely to be a continuous variable rather than the discrete variable the student has implied • time of day should have been standardised because this may influence heart rate • subjects should have been given an exercise that required a particular intensity (e.g. treadmill running) because effort will have varied • more repeats before calculating mean to identify anomalies *Presentation:* • smokers and non-smokers should have been presented as separate columns to make comparisons easier • units should be include for the final two columns to show that the three heart rate measurements were made using the same method • the number of significant figures/decimal places should be the same for each measurement to standardise the level of precision • present data graphically to spot trends more easily • label heart rates as mean heart rates for clarity

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