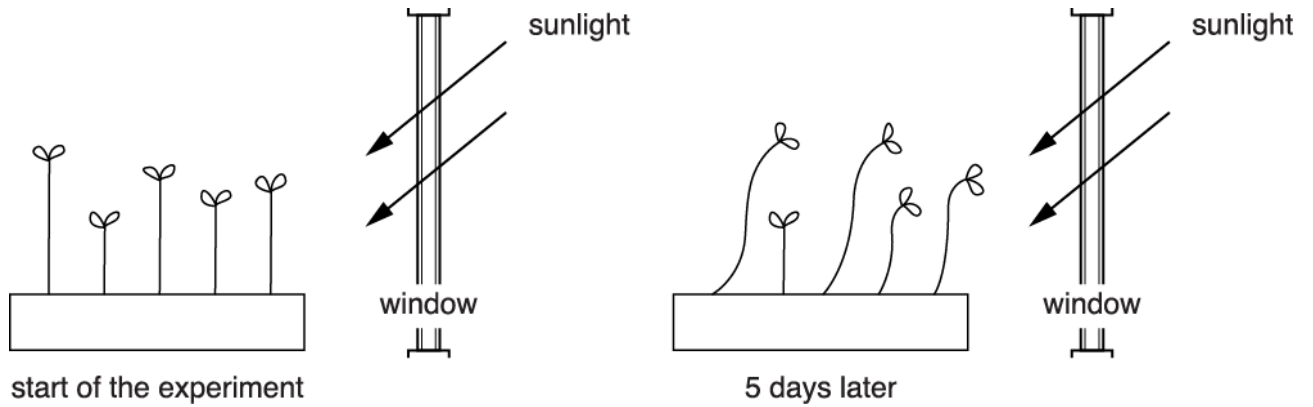


1. James investigates the effect of light on shoot growth.

He places a tray of 5 cress seedlings on a windowsill and leaves them for 5 days.

He notes the appearance of the seedlings at the start of the experiment and again 5 days later.



all cress seedlings grow upright

only 1 cress seedling is growing upright

James concludes that the seedlings have grown towards the sunlight. James thinks that there are problems with his experimental design.

Evaluate the experimental design. In your answer you should:

- identify some of the problems
- suggest how the experiment could be improved.



The quality of written communication will be assessed in your answer.

[6]

2. If a plant only receives light from one direction, then it will grow towards the light.

This is called phototropism.

Phototropism increases the plant's chance of survival.

Explain why.

[2]

3. Phototropism is one way in which plants respond to light.

Brian wants to investigate phototropism.

He has two pots of cress seedlings, two cardboard boxes and two lamps.

Explain how he would set up his experiment and the results he would get.



The quality of written communication will be assessed in your answer.

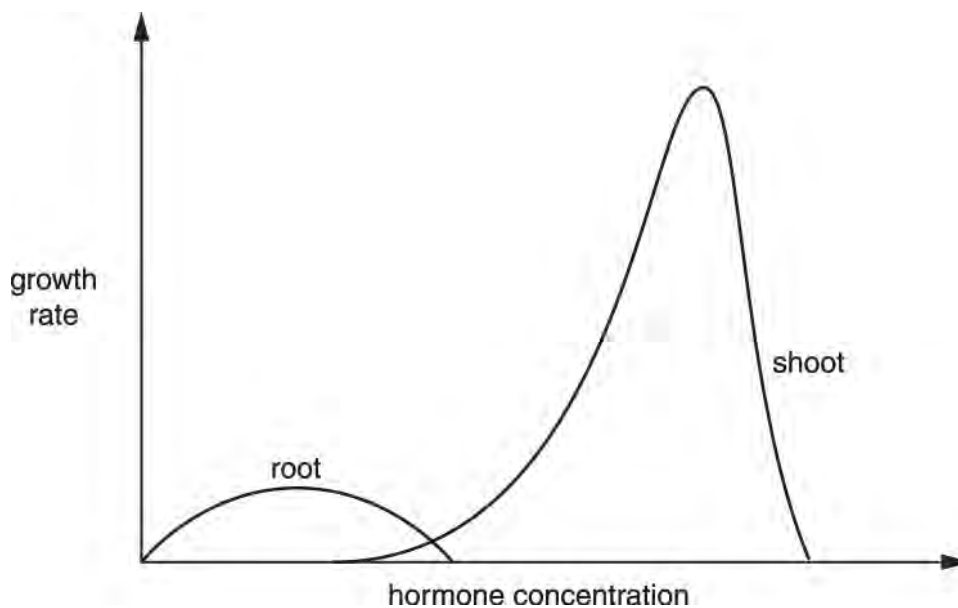
You may use the space to draw a diagram to support your answer.

[6]

4(a). A plant hormone affects the growth of shoots and roots.

Look at the graph.

It shows the effect of different concentrations of this hormone on shoot growth and root growth.



Two of these are correct conclusions from the data.

Put ticks (?) in the boxes next to the **two** correct conclusions.

Root growth requires lower concentration of hormone than shoot growth.

Increasing the hormone concentration has no effect on shoot growth.

Roots and shoots both grow at very high hormone concentrations.

All hormone concentrations increase the growth rate of shoots.

The hormone causes a greater rate of shoot growth than root growth.

[2]

(b). Shoot growth is also affected by light.

Write down the name of a shoot's growth response to light.

----- [1]

(c). This growth response increases the plant's chance of survival.

Explain why.

----- [2]

END OF QUESTION PAPER

Question	Answer/Indicative content	Marks	Guidance																		
1	<p>Level 3 (5-6 marks) Identifies some problems with experimental design AND suggests improvements directly linked to the problem.</p> <p>Quality of written communication does not impede communication of the science at this level</p> <p>Level 2 (3-4 marks) Identifies some problems with experimental design and suggests improvements, unlinked.</p> <p>Quality of written communication partly impedes communication of the science at this level</p> <p>Level 1 (1-2 marks) Identifies either a problem OR an improvement.</p> <p>Quality of written communication impedes communication of the science at this level</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit</p>	6	<p>This question is targeted at grades up to C</p> <p>Indicative scientific points may include</p> <table border="0" data-bbox="975 376 1517 1668"> <tr> <td><u>Problem</u></td> <td><u>Improvement</u></td> </tr> <tr> <td>Only 5 cress seedlings used</td> <td>Increase the number of cress seedlings</td> </tr> <tr> <td>Light is from other sources</td> <td>Eliminate light from other areas / grow in a box with light from one direction only</td> </tr> <tr> <td>Could be due to another factor</td> <td>Try light source from other angles to see if results are similar</td> </tr> <tr> <td>5 days may not be long enough</td> <td>Extend experiment beyond 5 days</td> </tr> <tr> <td>No repeats carried out</td> <td>Repeat experiment</td> </tr> <tr> <td>One seedling did not grow towards the light</td> <td>Repeat experiment</td> </tr> <tr> <td>Some blocked from light because seedlings not all the same size</td> <td>Use seedlings all the same size / put smaller plants near front / ensure evenly lit</td> </tr> <tr> <td>Idea that sunlight can be variable</td> <td>Use fixed light source / lamp (from side)</td> </tr> </table> <p>Examiner's Comments</p> <p>Candidates were given a description of an experiment on the effect of light on shoot growth and were asked to suggest</p>	<u>Problem</u>	<u>Improvement</u>	Only 5 cress seedlings used	Increase the number of cress seedlings	Light is from other sources	Eliminate light from other areas / grow in a box with light from one direction only	Could be due to another factor	Try light source from other angles to see if results are similar	5 days may not be long enough	Extend experiment beyond 5 days	No repeats carried out	Repeat experiment	One seedling did not grow towards the light	Repeat experiment	Some blocked from light because seedlings not all the same size	Use seedlings all the same size / put smaller plants near front / ensure evenly lit	Idea that sunlight can be variable	Use fixed light source / lamp (from side)
<u>Problem</u>	<u>Improvement</u>																				
Only 5 cress seedlings used	Increase the number of cress seedlings																				
Light is from other sources	Eliminate light from other areas / grow in a box with light from one direction only																				
Could be due to another factor	Try light source from other angles to see if results are similar																				
5 days may not be long enough	Extend experiment beyond 5 days																				
No repeats carried out	Repeat experiment																				
One seedling did not grow towards the light	Repeat experiment																				
Some blocked from light because seedlings not all the same size	Use seedlings all the same size / put smaller plants near front / ensure evenly lit																				
Idea that sunlight can be variable	Use fixed light source / lamp (from side)																				

Question			Answer/Indicative content	Marks	Guidance
					problems and solutions in the experimental design. Many candidates did not realise the purpose of the experiment, so suggested measures to get the cress seedlings to grow upright. Others suggested problems which were not visible in the diagram, such as lack of water. Higher scoring candidates related the improvements to the problems identified.
			Total	6	
2			Plants are able to get more light (1) so they can photosynthesise / make glucose / make sugar (1)	2	<p>ignore nearer the sun / get more sun / attracts sunlight accept make starch / make food accept reverse arguments</p> <p>Examiner's Comments</p> <p>Candidates who did not state that the phototropic response enables the plant to get MORE sunlight failed to score the first mark – the second was available for correct reference to photosynthesis or making food.</p>
			Total	2	

Question	Answer/Indicative content	Marks	Guidance
3	<p>Level 3 (5–6 marks) Response gives a full and detailed account of the method, and compares expected results. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) Response includes both an account of a workable method and some basic indication of expected results. Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Response includes a basic explanation of either a workable method or expected results. Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.</p>	6	<p>This question is targeted at grades up to E Indicative scientific points may include:</p> <p>For method</p> <ul style="list-style-type: none"> • put a hole in the side of one of the boxes • remove the lid from the other box / put a large hole in the top of the other box • record the appearance of the cress seedlings before • check to make sure that they are growing with straight stems • put one pot of cress seedlings in one of the boxes and the other pot in the second box • turn on the two lamps • shine light in the side of one of the boxes • shine light from the top of the second box • controlling other factors • monitor room temperature in and outside the boxes • make sure that the pots of cress seedlings are kept moist <p>For results</p> <ul style="list-style-type: none"> • after a suitable time • record the appearance of the cress seedlings after • check to see if they have continued to grow with straight stems or have curved • count the numbers of straight / curved seedlings in each pot • check to see if the curved seedlings are growing towards the side source of light • check to see if the straight seedlings are in the box with the overhead light source • plot or tabulate the results to show a comparison. <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p> <p>Examiner's Comments</p>

Question			Answer/Indicative content	Marks	Guidance										
					A six-mark extended-writing question. Examiners were pleased to see the inventiveness and variety of uses candidates came up with for the given equipment, and some of the best answers were a real pleasure to read. On the other hand, there were too many candidates who gave only a bare response about the expected outcome, e.g. "The cress will grow towards the light" without giving any of the required detail of how the equipment might be used in a controlled experiment.										
			Total	6											
4	a		<table border="1"> <tr> <td>Root growth requires lower concentration of hormone than shoot growth</td> <td style="text-align: center;">✓</td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td>The hormone causes a greater rate of shoot growth than root growth.</td> <td style="text-align: center;">✓</td> </tr> </table>	Root growth requires lower concentration of hormone than shoot growth	✓							The hormone causes a greater rate of shoot growth than root growth.	✓	2	Examiner's Comments This part was very well answered.
Root growth requires lower concentration of hormone than shoot growth	✓														
The hormone causes a greater rate of shoot growth than root growth.	✓														
	b		Phototropism;	1	Examiner's Comments Candidates were required to recall of the term phototropism as opposed to photosynthesis.										
	c		Light needed for photosynthesis; Makes food;	2	Examiner's Comments This question showed that it was challenging to link the idea that light energy is needed for photosynthesis to the idea that this would lead to the plant producing more food or glucose.										
			Total	5											