

**Questions****Q1.**

The effect of applying weed killer containing plant hormones to fields of wheat was investigated.

In field A, the weed killer was applied each year for five years.

In field B, no weed killer was applied for the five years.

Each field was 1000 m<sup>2</sup> and all other conditions remained the same.

The results are shown in Figure 14.

field	wheat yield in kg per 100 m <sup>2</sup>				
	2015	2016	2017	2018	2019
A	54	52	48	49	50
B	32	28	34	33	34

**Figure 14**

Comment on the effect of using weed killer containing plant hormones in this investigation.

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**(Total for question = 3 marks)**

Q2.

Figure 5 shows young tomato plants growing in a glasshouse.



(Source: © adastr/Shutterstock)

**Figure 5**

The young tomato plants are growing towards the light.

Explain how a plant hormone causes these shoots to grow towards the light.

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**(Total for question = 2 marks)**

Q3.

\* Figure 15 shows a pot plant before it fell over and the same pot plant two weeks after it fell over.

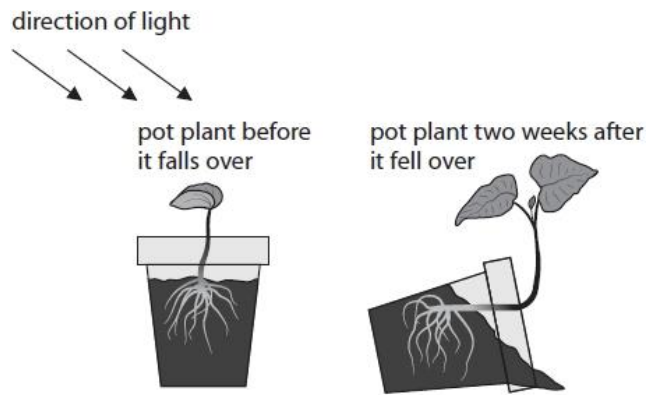


Figure 15

Explain how hormones in the roots and shoots of plants caused this directional growth.

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(Total for question = 6 marks)

**Q4.**

Explain how phototropism is controlled in plant shoots.

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**(Total for question = 3 marks)**

**Q5.**

Some weed killers contain plant hormones.

Explain how plant hormones work as weed killers.

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**(Total for question = 3 marks)**

Q6.

\* Figure 15a shows a plant that has been placed on its side.

Figure 15b shows the same plant after 5 days.

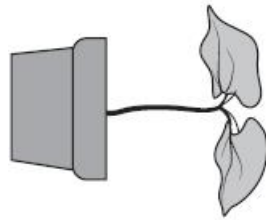


Figure 15a

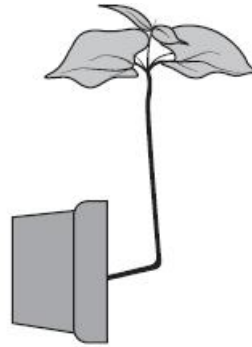


Figure 15b

Explain why the growth of the plant has changed.

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(Total for question = 6 marks)

**Q7.**

A gardener decided to kill the dandelion plants growing in his lawn.

The gardener set up a trial to see which concentration of weed killer would kill the most dandelions and be most economical.

He counted the number of dandelion plants in six 1 m<sup>2</sup> areas of the lawn.

He made six different concentrations of weed killer solution.

He applied the solutions to each of the six different areas.

After two weeks, he counted the number of dandelion plants in each area.

The results are shown in Figure 12.

concentration of weed killer solution (%)	number of dandelion plants in 1 m <sup>2</sup>	
	before applying weed killer	two weeks after applying weed killer
0	9	9
20	9	9
40	7	5
60	8	2
80	8	0

**Figure 12**

(i) Give **one** variable the gardener should control when completing this trial.

(1)

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(ii) State and explain the conclusions the gardener can make based on his trial.

(3)

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**(Total for question = 4 marks)**

**Q8.**

A student wanted to investigate the effect of light on the growth of cress seedlings.

The student had three pots of seedlings grown in different conditions.

Pot A was placed in a window with light from one direction only.

Pot B was placed in a cupboard with no light.

Pot C was placed with light from above.

Figure 18 shows the seedlings at the end of the investigation.

(a) (i) Label the pots of cress seedlings A, B and C.

(2)



(Source: Nigel Cattlin/Science Photo Library)

**Figure 18**

(ii) What is the response shown by the cress seedlings in Pot A?

(1)

- A** negative gravitropism
- B** negative phototropism
- C** positive gravitropism
- D** positive phototropism

(iii) State the plant hormone that causes the cress seedlings to grow towards the light.

(1)

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(b) The student wanted to find out where the hormone that caused the response to directional light was found.

The student had two growing plant shoots and placed them both in a window with light coming from one direction.

Describe a method the student could use to show that the hormone was found in the tip of the plant shoot.

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(Total for question = 6 marks)

**Q9.**

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Commercial growers can use plant hormones to artificially ripen fruit and produce seedless fruit.

(i) Which is the name of the plant hormone used in fruit ripening?

(1)

- A** auxin
- B** gibberellin
- C** sucrose
- D** ethene

(ii) Which plant hormone can commercial growers spray fruit with to produce seedless fruit?

(1)

- A** auxin
- B** gibberellin
- C** sucrose
- D** ethene

(Total for question = 2 marks)



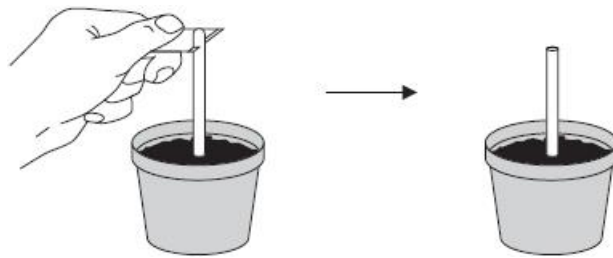
**Q10.**

Figure 18 shows an investigation into the growth of plant shoots.

Experiment 1:

The tip of a shoot was removed from the plant.

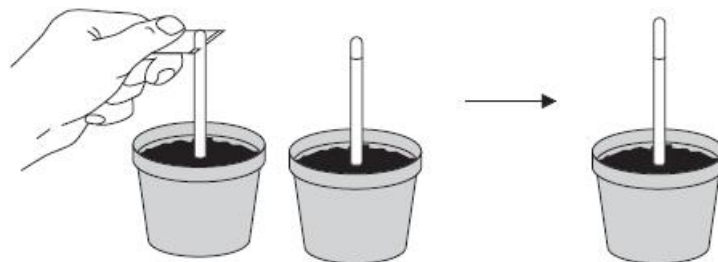
There was no growth in the shoot after 3 days.



Experiment 2:

The tip of a shoot was cut off and then placed back onto the shoot.

The shoot had grown 6 mm after 3 days.



**Figure 18**

(i) Give **one** variable that must have been controlled for the plant shoot to grow vertically, as shown in experiment 2.

(1)

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(ii) State **one** conclusion that could be made based on these two experiments.

(1)

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(iii) Which plant hormone causes growth in the plant shoot?

(1)

- A auxin
- B ethene
- C gibberellin
- D chlorophyll

(iv) Explain **one** way that this investigation could be improved.

(2)

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**(Total for question = 5 marks)**

**Q11.**

\* Explain the uses of auxins, gibberellins and ethene in the commercial production of plants and fruits.

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**(Total for question = 6 marks)**

**Mark Scheme**

Q1.

Question Number	Answer	Additional guidance	Mark
	<p>An answer including <b>three</b> from:</p> <ul style="list-style-type: none"> <li>• fields with the weed killer had a higher crop yield (1)</li> <li>• the difference in crop yield varies (1)</li> <li>• this must be caused by some other external factor / named factor (1)</li> <li>• the weed killer caused the weeds to <b>overgrow</b> and die (1)</li> <li>• reducing <b>competition</b> for resources so more wheat could grow (1)</li> </ul>	<p>accept figures quoted from the table</p> <p>accept disrupts plant growth pattern</p> <p>accept reduced competition for named resources accept reverse argument</p>	<p>(3)</p> <p><b>AO3</b> <b>2ab</b></p>

Q2.

Question number	Answer	Additional guidance	Mark
	<p>An explanation including two from:</p> <ul style="list-style-type: none"> <li>• auxin (1)</li> <li>• {building up on / moving to} the shaded side (1)</li> <li>• causing (cell) elongation (1)</li> </ul>	<p>accept there is more on the shaded side (if MP1 given)</p> <p>accept shaded side elongates / grows quicker</p>	<p>(2)</p> <p>AO2.1</p>

Q3.

Question number	Indicative content	Mark
*	<p style="text-align: center;"><b>AO1 and AO2</b></p> <p><b>shoot growth</b></p> <ul style="list-style-type: none"><li>• auxins</li><li>• moved to the shaded part of the plant shoot</li><li>• causing cells to elongate</li><li>• making the plant bend towards the light</li><li>• this is an example of positive phototropism</li></ul> <p><b>root growth</b></p> <ul style="list-style-type: none"><li>• auxins</li><li>• collect in large amounts on the underside of the root</li><li>• inhibiting cell elongation</li><li>• causing the cells above to elongate faster</li><li>• causing the root to grow downwards in the direction of gravity</li><li>• this is an example of positive gravitropism</li></ul>	<b>(6)</b>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail.  The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections are made between elements in the context of the question
Level 2	3-4	Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed.  The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections are made between elements in the context of the question
Level 3	5-6	Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and developed.  The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	A simple statement of the direction of growth of shoots <b>OR</b> roots.  Linked to some understanding of how or why this occurs.
Level 2	3-4	An explanation of either root <b>OR</b> shoot growth including reference to tropisms or cell elongation <b>OR</b> a simple explanation of both root <b>AND</b> shoot growth including reference to tropisms or cell elongation.  Linked to the role of auxins.
Level 3	5-6	An explanation of root <b>AND</b> shoot growth including the process of cell elongation and direction of growth.  Linked to the role of auxins in tropic responses.

Q4.

Question number	Answer	Additional guidance	Mark
	<p>An explanation linking three of the following:</p> <ul style="list-style-type: none"> <li>• phototropism is controlled by the hormone auxin (1)</li> <li>• auxins move to the shaded side of the shoot (1)</li> <li>• causing <b>cell</b> elongation (1)</li> <li>• causing the shoot to bend towards the light (1)</li> </ul>		<p><b>(3)</b></p> <p><b>A02 1</b></p>

Q5.

Question number	Answer	Additional guidance	Mark
	<p>An explanation linking three of the following:</p> <ul style="list-style-type: none"> <li>• (weed killers contain) auxins (1)</li> <li>• these act on broad leaf plants /only act on the weeds (1)</li> <li>• causing them to overgrow (1)</li> <li>• (selective) weedkillers do not kill grass plants (1)</li> </ul>	accept the weeds grow too fast	<p><b>(3)</b></p> <p><b>A01 1</b></p>

Q6.

Question Number	Indicative content	Mark
*	<p style="text-align: center;"><b>AO1</b></p> <p><b>Observations</b></p> <ul style="list-style-type: none"> <li>• the plant stem bends</li> <li>• the stem is longer/taller</li> <li>• the plant is now growing upwards / towards light</li> <li>• plant has more leaves</li> </ul> <p><b>explanations</b></p> <ul style="list-style-type: none"> <li>• plant hormone / auxin</li> <li>• more hormone / auxin on shaded side</li> <li>• cell elongation (on shaded side)</li> <li>• (positive) phototropism</li> <li>• (negative) gravitropism</li> <li>• more cells / cell division</li> <li>• growing towards light</li> <li>• so (the leaves) are not in shade (e.g. of other plants)</li> <li>• to absorb more light</li> <li>• for photosynthesis</li> </ul>	<p><b>(6)</b></p> <p><b>AO1.1</b></p>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail.</li> <li>• Presents an explanation with some structure and coherence.</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed.</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical.</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed.</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical.</li> </ul>



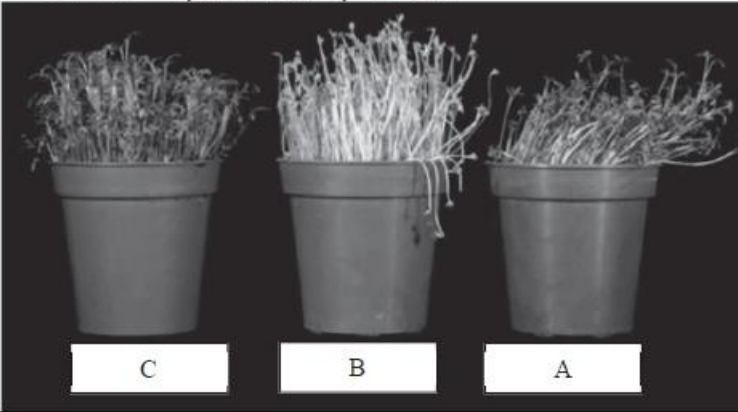
Level	Mark	Additional Guidance
	0	No rewardable material.
Level 1	1-2	<ul style="list-style-type: none"> <li>• makes an observation about how the plant growth has changed</li> <li>• linked to a simple explanation as to why the growth has changed</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• makes observations about how the plant growth has changed</li> <li>• linked to an explanation as to why the growth has changed using some relevant scientific terminology</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• makes observations about more than two ways the plant growth has changed</li> <li>• linked to clear explanations as to why the growth has changed using relevant scientific terminology</li> </ul>

Q7.

Question number	Answer	Additional guidance	Mark
(i)	Any one from: <ul style="list-style-type: none"> <li>• make sure all areas have the same amount of light/water/minerals (1)</li> <li>• use the same volume of solution / weedkiller (1)</li> <li>• temperature (1)</li> <li>• pH of soil (1)</li> </ul>	ignore amount accept mass	(1) <b>AO2 1</b>

Question number	Answer	Additional guidance	Mark
(ii)	<p>An explanation linking the conclusion with two of the explanation marks:</p> <p>Conclusion</p> <ul style="list-style-type: none"> <li>80 (arbitrary units) is the best concentration to use (1)</li> </ul> <p>Explanation</p> <ul style="list-style-type: none"> <li>because it kills the maximum amount of dandelion plants (1)</li> <li>at lower concentrations not all the weeds were killed (1)</li> <li>because the highest concentration contains the most weedkiller (1)</li> </ul>	<p>accept the highest concentration of weedkiller is the best to use</p> <p>accept it kills <b>all</b> the weeds</p>	<p>(3)</p> <p>A03 2ab</p>

Q8.

Question number	Answer	Mark
(a)(i)	<p>1 mark for 1 or 2 correctly labelled pots</p> <p>2 marks for all pots correctly labelled</p>  <p style="text-align: center;">C                      B                      A</p>	(2)
(a)(ii)	D	(1)

Question number	Answer	Mark
(a)(iii)	Auxin	(1)

Question number	Answer	Mark
(b)	An answer that combines the following points to provide a logical description of the method: <ul style="list-style-type: none"> <li>remove the tip from one of the plant shoots and leave the other (1)</li> <li>measure the changes in growth and direction of movement (1)</li> </ul>	(2)

Q9.

Question Number	Answer	Mark
(i)	D ethene  <b>The only correct answer is D</b>  <i>A is incorrect because auxins cause growth responses in plants</i>  <i>B is incorrect because gibberellins cause germination and flower and fruit formation</i>  <i>C is incorrect because sucrose is not a plant hormone</i>	(1)  AO1 1

Question Number	Answer	Mark
(ii)	B gibberellin  <b>The only correct answer is B</b>  <i>A is incorrect because auxins cause growth responses in plants</i>  <i>C is incorrect because sucrose is not a plant hormone</i>  <i>D is incorrect because ethene causes fruit ripening</i>	(1)  AO1 1

Q10.

Question number	Answer	Additional guidance	Mark
(i)	Any <b>one</b> from: <ul style="list-style-type: none"> <li>direction of light (1)</li> <li>ensure equal light intensity around the plant (1)</li> </ul>		(1) AO 2 2

Question number	Answer	Mark
(ii)	Any <b>one</b> from: <ul style="list-style-type: none"> <li>{the substance that causes shoot growth/auxin} is found in the <b>tip</b> of the shoot (1)</li> <li>the <b>tip</b> controls growth (1)</li> <li>the shoot grows from the <b>tip</b>(1)</li> </ul>	(1) AO 3 1b

Question number	Answer	Mark
(iii)	A auxin <b>1. The only correct answer is A</b> <i>B is not correct because ethane is responsible for fruit ripening</i> <i>C is not correct because gibberellins are used for seed germination, fruit formation and seedless fruit</i> <i>D is not correct because chlorophyll is the green pigment found in chloroplasts which is the main site for photosynthesis it does not promote shoot growth</i>	(1) AO 1 1

Question number	Answer	Mark
(iv)	An explanation that links two of the following: <ul style="list-style-type: none"> <li>repeat the experiment with more plant shoots (1)</li> <li>in order to calculate the mean/improve validity / identify anomalies (1)</li> </ul> OR <ul style="list-style-type: none"> <li>control a variable e.g. temperature, water (1)</li> <li>in order to improve validity / make the results comparable (1)</li> </ul> OR <ul style="list-style-type: none"> <li>place something between the tip and the shoot (e.g. agar / mica)/ cover the tip(1)</li> <li>to see if it is a chemical response from the tip. (1)</li> </ul> OR <ul style="list-style-type: none"> <li>set up a control / shoot with no tip cut off (1)</li> <li>to make the results more comparable (1)</li> </ul>	(2) AO 3 3b

Q11.

Question number	Indicative content	Mark
*	<p style="text-align: center;"><b>AO1 / AO2 6 marks</b></p> <p><b>Auxins</b></p> <ul style="list-style-type: none"> <li>• used in selective weed killers</li> <li>• targets broad leaf plants</li> <li>• kills the weeds and not narrow leaf crops</li> <li>• rooting powder</li> <li>• added to the end of cuttings to stimulate the growth of roots</li> </ul> <p><b>Gibberellins</b></p> <ul style="list-style-type: none"> <li>• to stimulate germination in dormant seeds</li> <li>• initiate breakdown of starch</li> <li>• stimulate flower formation</li> <li>• promotes fruits formation</li> <li>• sprayed onto plants before pollination</li> <li>• stimulate development of seedless fruits</li> </ul> <p><b>Ethene</b></p> <ul style="list-style-type: none"> <li>• fruit ripening</li> <li>• unripe fruit is harvested</li> <li>• ethene is added so the fruits ripens for selling</li> </ul>	(6) AO1 1 AO1 2

Level	Mark	Descriptor
	0	<ul style="list-style-type: none"> <li>• No rewardable material.</li> </ul>
Level 1	1-2	<ul style="list-style-type: none"> <li>• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail.</li> <li>• Presents an explanation with some structure and coherence.</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed.</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical.</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed.</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical.</li> </ul>

## Additional Guidance

Level 1	1-2	<ul style="list-style-type: none"> <li>An identification of one commercial use of auxin, gibberellins or ethene in plants</li> <li>The response links the use to the process involved or when it is used.</li> </ul>
Level 2	3-4	<ul style="list-style-type: none"> <li>An identification of at least two commercial use of auxin, gibberellins or ethene in plants</li> <li>The response links the use to the process involved or when it is used.</li> </ul>
Level 3	5-6	<ul style="list-style-type: none"> <li>An identification of the commercial uses of auxin, gibberellins and ethene in plants</li> <li>The response links the use to the process involved or when it is used.</li> </ul>

Level	Marks	Possible responses
Level 1	1	<ul style="list-style-type: none"> <li>auxins act as weedkillers/gibberellins are involved in fruit formation / ethene ripens fruit</li> </ul>
	2	<ul style="list-style-type: none"> <li>auxins act as weedkiller on broad leaf plants / gibberellins form seedless fruit which are nicer to eat / ethene ripens fruit so it can be transported unripened.</li> </ul>
Level 2	3	<ul style="list-style-type: none"> <li>auxins act as weedkillers and rooting powders /auxins act as weedkillers and gibberellins are involved in fruit formation / ethene causes fruit to ripen and auxins are in rooting powder.</li> </ul>
	4	<ul style="list-style-type: none"> <li>auxins act as weedkiller on broad leaf plants and gibberellins form seedless fruit which are nicer to eat / gibberellins form seedless fruit which are nicer to eat and ethene ripens fruit so it can be transported unripened.</li> </ul>
Level 3	5	<ul style="list-style-type: none"> <li>auxins act as weedkillers and gibberellins are involved in fruit formation and ethene ripens fruit / auxins act as rooting powders and gibberellins cause flower formation and ethene is involved in the ripening of fruits.</li> </ul>
	6	<ul style="list-style-type: none"> <li>auxins act as weedkiller on broad leaf plants and gibberellins form seedless fruit which are nicer to eat and ethene causes fruit to ripen which means they can be picked when not ripe and transported.</li> </ul>