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EDEXCEL GCSE BIOLOGY: QUESTIONS BY TOPIC

Plant Structures and Their Functions (6)

GCSE Biology (Higher) Topic 6

15 questions · 155 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Biology 1BI0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

15 questions · 155 marks · lowest tariff first



9-MARK QUESTIONS

5 questions in this booklet



- 3 A student compared the number of stomata on the upper and lower surfaces of a leaf. She completed a leaf peel as shown in Figure 5.

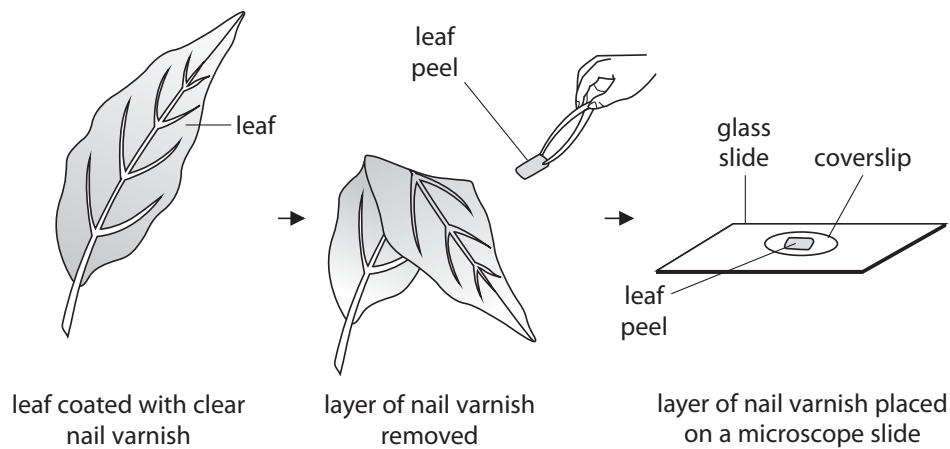


Figure 5

The layer of nail varnish shows an impression of the cells on the surface of the leaf.

- (a) (i) State why a coverslip is placed on top of the leaf peel.

(1)

- (ii) Explain why the leaf peel rather than the whole leaf was viewed with a microscope.

(2)

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- (b) The student drew a biological diagram of the leaf peel taken from the underside of the leaf.

Figure 6 shows this diagram.

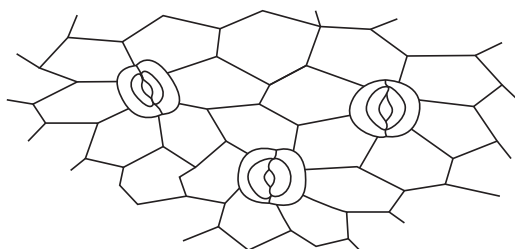


Figure 6

- (i) State the number of stomata visible on Figure 6.

(1)

- (ii) The student observed that the stomata were open.

Describe how stomata open.

(3)

- (iii) The leaf peel from the upper surface of this leaf showed no stomata.

Explain why it is an advantage to the plant to have this distribution of stomata in the upper and lower surfaces of the leaf.

(2)

(Total for Question 3 = 9 marks)



- 2 Figure 2 shows the leaves and flowers of water lily plants (*Nymphaea odorata*) on a lake.



© Oleksandr Shymanskyi/123RF

Figure 2

- (a) Water lilies have stomata on the upper surface of the leaves.

Explain why water lilies have no stomata on the lower surface of the leaves.

(2)

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(b) (i) The white petals of the water lily flowers cannot photosynthesise.

Which structure in leaf cells is the site of photosynthesis?

(1)

- ☐ A nucleus
- ☐ B vacuole
- ☐ C mitochondrion
- ☐ D chloroplast

(ii) Glucose is made by photosynthesis.

Glucose is converted to another sugar to be transported in the plant.

What is the name of this sugar?

(1)

- ☐ A glycerol
- ☐ B ribose
- ☐ C sucrose
- ☐ D starch

(iii) Describe how this sugar is transported from the leaves to the flowers of the water lily.

(2)

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(c) Figure 3 shows water lilies growing in a lake in Europe.



© lynn gladwell/123RF

Figure 3

One water lily plant was brought from America 10 years ago and planted in the lake shown in Figure 3.

Explain why this non-indigenous plant now covers the whole surface of the lake.

(3)

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(Total for Question 2 = 9 marks)

- 2 Figure 2 shows an area of woodland with some small plants growing in the ground between the trees.



small plants

(Source: © Maksym Holovinov/Shutterstock)

Figure 2

- (a) Name a group of organisms that break down the dead leaves and release mineral ions into the soil.

(1)

- (b) The mineral ions are absorbed from the soil into the roots of plants.

Describe how these mineral ions are transported from the roots to the leaves of the plants.

(2)

- (c) A scientist recorded the mean light intensity and the mean number of small plants per m^2 for six 25 m^2 areas of the woodland.

Figure 3 shows the results.

area of woodland	mean light intensity in lux	mean number of small plants per m^2
A	1500	2.7
B	1300	1.6
C	1000	1.1
D	800	0.6
E	550	0.3
F	350	0.1

Figure 3

- (i) Explain the effect of light intensity on the number of small plants per m^2 .

(2)

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- (ii) State **one** variable the scientist should have controlled to make sure the light intensity measurements could be compared.

(1)

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- (d) The scientist selects an area near the edge of the woodland where many stinging nettles are growing.

This area is partly shaded by the trees.

Describe how the scientist should use a belt transect to investigate how light intensity affects the growth of stinging nettles.

(3)

(Total for Question 2 = 9 marks)



2 (a) Figure 2 shows xylem and phloem from the stem of a plant.

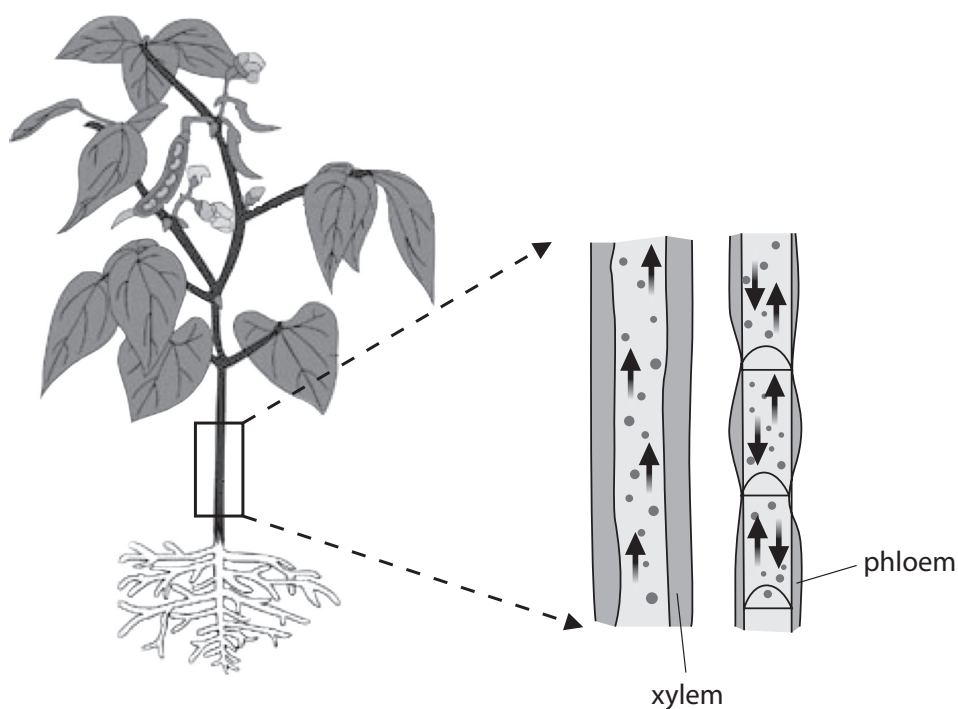


Figure 2

(i) Living cells in phloem use energy to transport sucrose.

Which organelles release energy in living cells?

(1)

- ☐ A vacuoles
- ☐ B mitochondria
- ☐ C nuclei
- ☐ D ribosomes

(ii) Describe **two** features of the structure of xylem vessels that can be seen in Figure 2.

(2)

- 1
-
- 2
-

(b) A scientist investigated how the flow of air affected the rate of transpiration in a plant.

A fan was used to change the flow of air.

The volume of water taken up by the plant was measured.

Figure 3 shows the results of this investigation.

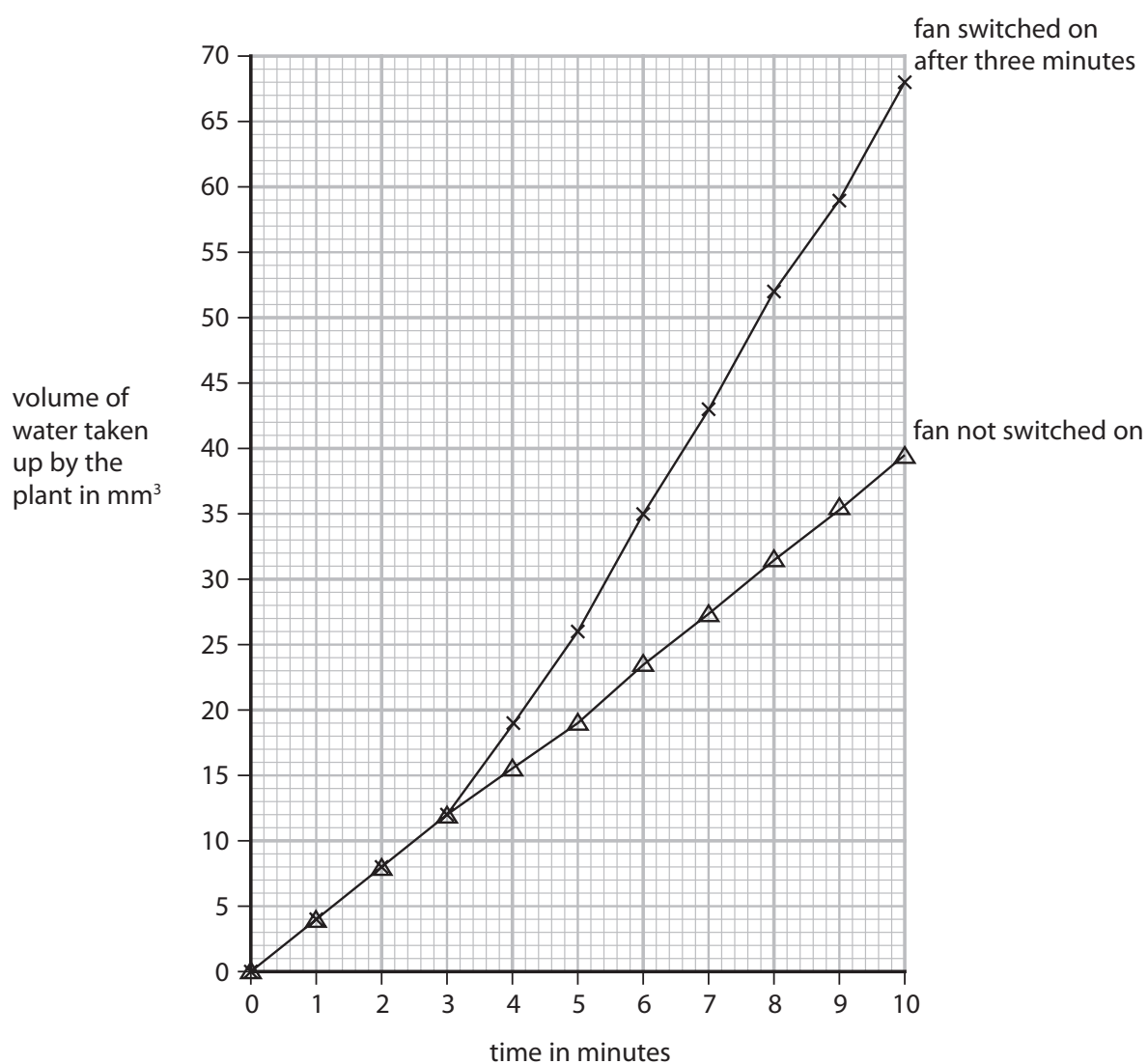


Figure 3

- (i) Explain why switching on the fan caused a change in the volume of water taken up by the plant.

(3)

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- (ii) Give **one** reason why the volume of water taken up by the plant was also measured when the fan was not switched on.

(1)

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- (iii) Calculate the rate of water uptake from 8 minutes to 10 minutes when the fan was switched on.

Use the equation

$$\text{rate of water uptake} = \frac{\text{volume of water taken up}}{\text{time taken}}$$

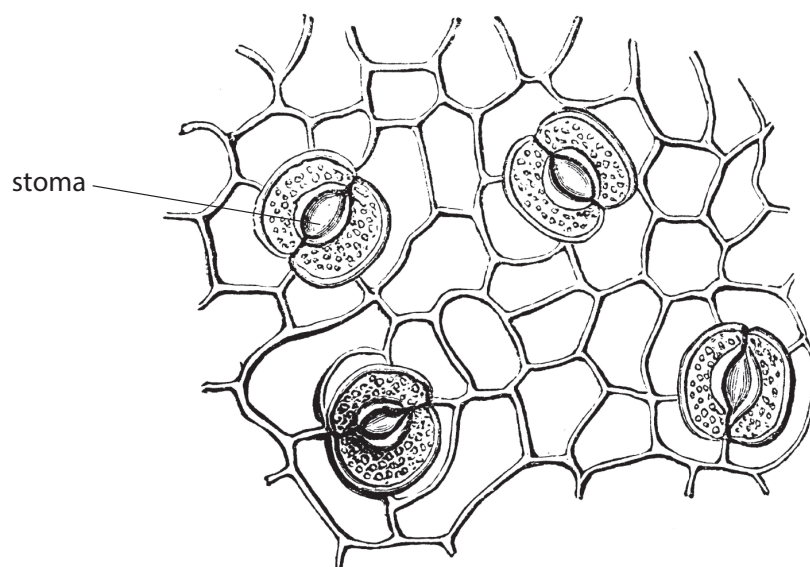
(2)

..... mm³ per minute

(Total for Question 2 = 9 marks)



6 Figure 12 shows the lower epidermis of a leaf, with a stoma labelled.



(Source: © Quagga Media/Alamy Stock Photo)

Figure 12

(a) (i) State the number of guard cells shown in Figure 12.

(1)

(ii) State **one** gas that leaves the stomata and **one** gas that enters the stomata during daylight.

(2)

gas leaving stomata

gas entering stomata

(iii) State why the stomata close.

(1)

(b) A student wanted to view the cross-section of a leaf on a prepared slide.

Describe how a light microscope would be used to observe this slide.

(3)

[illegible]

(c) Sugars are transported from the leaves to the rest of the plant.

Explain how sugars are moved through the plant.

(2)

(Total for Question 6 = 9 marks)



10-MARK QUESTIONS

2 questions in this booklet



- 7 (a) 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 m² 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 ²	
	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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(b) Some weed killers contain plant hormones.

Explain how plant hormones work as weed killers.

(3)

(c) Explain how phototropism is controlled in plant shoots.

(3)

(Total for Question 7 = 10 marks)



3 (a) Figure 2 shows a root hair cell from a plant.

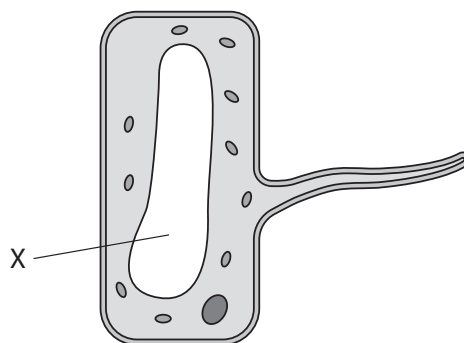


Figure 2

(i) Name the part labelled X.

(1)

(ii) State **one** way that the structure of the root hair cell increases the volume of substances it absorbs.

(1)

(iii) Explain why root hair cells do not contain chloroplasts.

(3)

(b) A student studied the water plant *Elodea*.

The student used a light microscope to observe the cells of the plant in tap water and in a 10% salt solution.

Figure 3 shows *Elodea* cells in tap water and in a 10% salt solution.

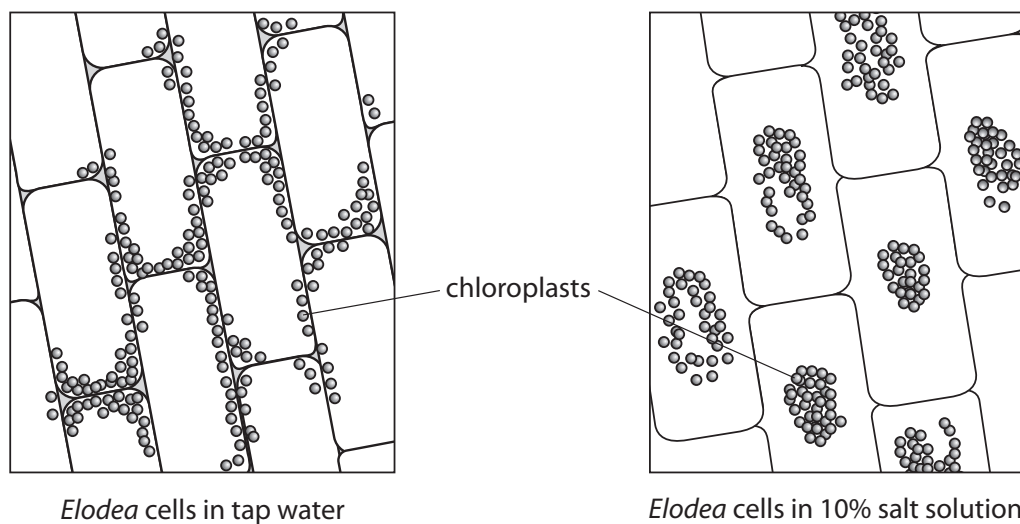


Figure 3

(i) Describe **two** ways that the *Elodea* cells in the 10% salt solution are different from the *Elodea* cells in tap water.

(2)

- 1
-
- 2
-

- (ii) Explain why placing the *Elodea* cells in the 10% salt solution causes the changes seen in Figure 3.

(3)

(Total for Question 3 = 10 marks)



11-MARK QUESTIONS

6 questions in this booklet



- 8 (a) Figure 16 shows the effect of light intensity and temperature on the rate of photosynthesis.

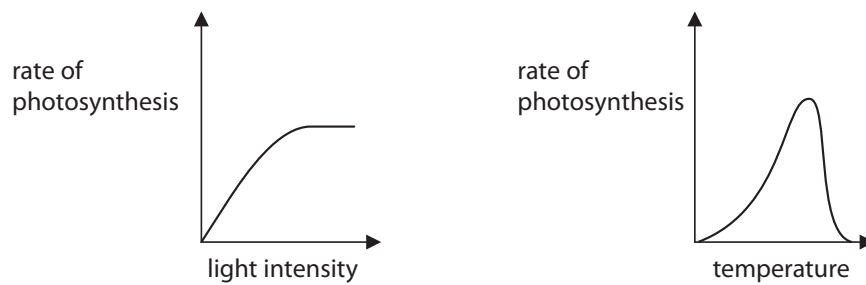


Figure 16

- (i) Describe the effect of light intensity on the rate of photosynthesis.

(2)

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- (ii) Explain the effect of temperature on the rate of photosynthesis.

(2)

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- (b) A student measured the rate of photosynthesis using algal balls in a laboratory. The tube of algal balls was kept at a temperature of 25 °C and was moved to different distances from a light source.

The results of this investigation showed that the rate of photosynthesis is

(1)

- ☐ A directly proportional to the distance from a light source
- ☐ B inversely proportional to light intensity
- ☐ C directly proportional to temperature
- ☐ D inversely proportional to the distance from a light source



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*(c) Explain how substances are moved through a plant by transpiration and translocation. (6)

Handwriting practice lines for the answer.

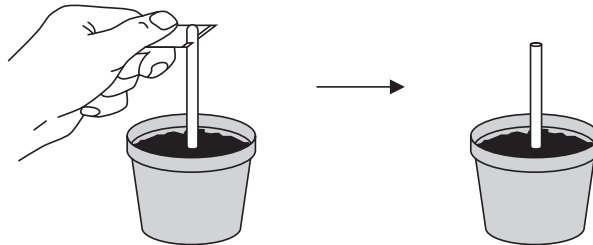
(Total for Question 8 = 11 marks)

10 (a) 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.

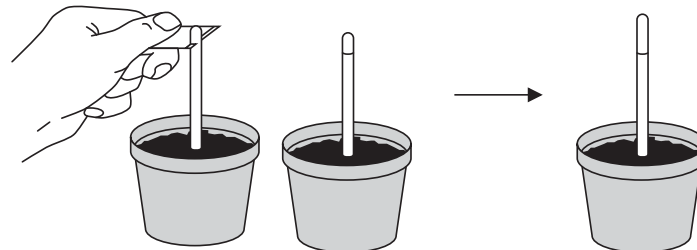


Figure 18

- (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)

(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)

QUESTION 10 CONTINUES ON THE NEXT PAGE.



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(Total for Question 10 = 11 marks)



10 (a) 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

- (b) 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 m² and all other conditions remained the same.

The results are shown in Figure 14.

field	wheat yield in kg per 100 m ²				
	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.

(3)

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[illegible]

- 5 A student investigated the effect of light intensity on the photosynthesis of pondweed.

A light source was placed at different distances from the pondweed.

The bubbles produced were counted for 2 minutes.

Figure 10 shows the apparatus that was used.

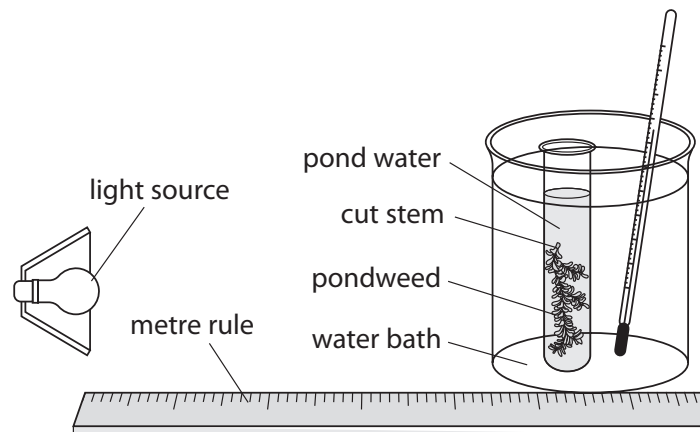


Figure 10

- (a) (i) State why the student included a water bath in the apparatus.

(1)

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- (ii) State **two** variables that should be controlled when completing this investigation.

(2)

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(b) Figure 11 shows the results of this investigation.

distance from the lamp in cm	number of bubbles in two minutes	light intensity in arbitrary units
5	62	0.04
10	60	0.01
15	43	0.0044
20	32	0.0025
25	11	?

Figure 11

- (i) The light intensity was calculated using the inverse square law for photosynthesis.

Calculate the light intensity at a distance of 25 cm from the lamp.

Include the equation for the inverse square law in your answer.

(3)

..... arbitrary units

- (ii) Explain how the student could improve this investigation to get a more accurate measurement of the gas produced.

(2)

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(c) Devise a plan to show that temperature is a limiting factor in photosynthesis.

Use the apparatus shown in Figure 10.

(3)

(Total for Question 5 = 11 marks)



7 A farmer wants to make sunflower seeds germinate faster.

(a) Which is the best hormone for the farmer to use?

(1)

- ☐ A adrenalin
- ☐ B auxin
- ☐ C thyroxine
- ☐ D gibberellin

(b) The sunflower plants grew and flowered.

The farmer noticed that the flowers faced a different direction at different times of the day.

Figure 8 shows a sunflower at different times of the day.

This movement is an example of phototropism.



(Source: © yevgeniy11/Shutterstock)

Figure 8

(i) This movement of the flower was in response to the light.

Explain how the sunflower changed direction throughout the day.

(4)

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(ii) Explain how water moves through the stem of the sunflower plant to the leaves.

(3)

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(iii) Sunflower leaves are large.
Explain why large leaves are an advantage to the plant.

(3)

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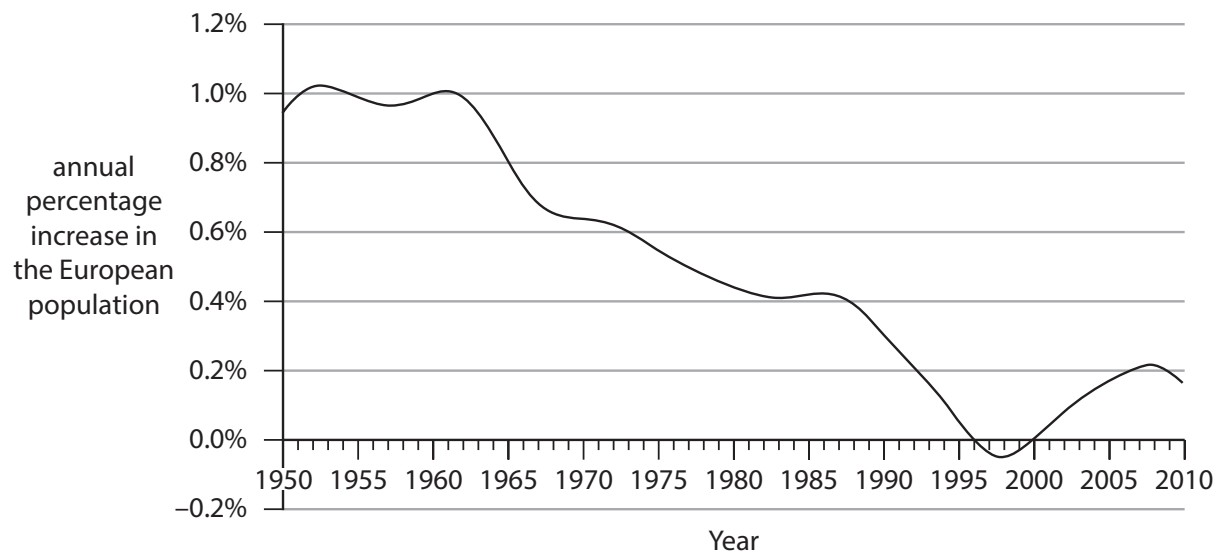
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(Total for Question 7 = 11 marks)

- 10 (a) Figure 14 shows the annual percentage increase in the European population from 1950 to 2010.



(Source: UN World Population Prospects: The 2012 revision)

Figure 14

State the number of years when there was no annual increase in the European population.

(1)

- (b) Fertilisers are used by farmers.

- (i) Give **one** advantage and **one** disadvantage of using fertilisers.

(2)

advantage

disadvantage

(ii) In an investigation, a farmer sprayed fertiliser onto three fields of the same size.

One field was sprayed with 1% fertiliser, one with 5% fertiliser and the third with 10% fertiliser.

Wheat was grown in all three fields.

Figure 15 shows the crop yield of wheat for each field.

percentage concentration of fertiliser (%)	yield of wheat in tonnes
1	3.12
5	3.75
10	3.62

Figure 15

Which is the percentage increase in the yield of wheat when 5% fertiliser was added compared with 1% fertiliser?

(1)

- ☐ A 4%
- ☐ B 17%
- ☐ C 20%
- ☐ D 83%

(iii) The farmer concluded that the 5% solution of fertiliser was the best concentration to use.

State **two** improvements to this investigation that the farmer should make to confirm this conclusion.

(2)

1

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2

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(c) Using ladybirds to reduce the number of aphids in a greenhouse is an alternative to using pesticides.

Which is the name for this method?

(1)

- ☐ **A** distribution analysis
- ☐ **B** selective breeding
- ☐ **C** biological control
- ☐ **D** genetic engineering

(d) Describe how tissue culture is used to produce genetically identical plants.

(4)

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(Total for Question 10 = 11 marks)

12-MARK QUESTIONS

2 questions in this booklet



- 7 (a) A student investigated the effect of nitrate ion concentration on plant growth. She placed barley seedlings in three test tubes containing different concentrations of nitrate fertiliser.

Test tube 1 contained distilled water with 1 pellet of nitrate fertiliser.

Test tube 2 contained distilled water with 2 pellets of nitrate fertiliser.

Test tube 3 contained distilled water with 3 pellets of nitrate fertiliser.

After 7 days, the lengths of the seedlings were measured.

Figure 13 shows an example of the apparatus used.

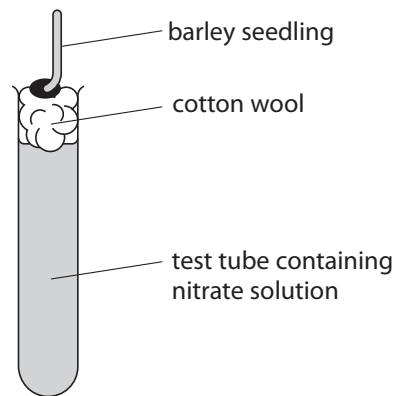


Figure 13

- (i) Describe a control for this investigation.

(2)

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- (ii) The nitrate fertiliser contains the chemical compound potassium nitrate. The hazard symbol on the bag of potassium nitrate fertiliser is shown in Figure 14.



Figure 14

Which hazard does this symbol represent?

(1)

- ☐ A flammable
- ☐ B oxidising
- ☐ C corrosive
- ☐ D explosive

- (iii) Give a method, other than measuring the change in length, that would show the growth of the seedlings.

(1)



19

(b) Figure 15 shows the results of this investigation.

seedling in test tube	length at the start in mm	length after 7 days in mm
1	4	11
2	6	17
3	5	26

Figure 15

(i) Explain why there are differences in the change in the lengths of the seedlings.

(2)

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(ii) Explain how nitrate ions were absorbed by the seedling in test tube 3.

(3)

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(c) Farmers use crop rotation to reduce the need to add nitrate fertilisers to the soil.

Plants such as peas and beans have a mutualistic relationship with nitrogen-fixing bacteria.

Explain why farmers use these plants in their crop rotation cycle.

(3)

(Total for Question 7 = 12 marks)



9 Figure 16 shows a photomicrograph of two stomata in a leaf.

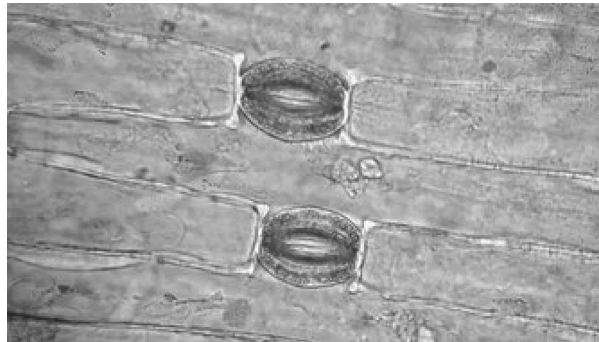


Figure 16

(a) (i) The length of one guard cell in this image is 6 mm.

Convert the length of this guard cell into micrometres (μm).

(1)

(ii) The image has been magnified 150 $\times$.

Calculate the actual size of the guard cell.

Give your answer in standard form in mm.

(3)

..... mm

(b) Explain the role of denitrifying bacteria in the nitrogen cycle.

(2)

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* (c) Describe how carbon is cycled through the biotic and abiotic components of an ecosystem.

(6)

(Total for Question 9 = 12 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Additional guidance	Mark
3(a)(i)	Any one from: • keep leaf peel flat (1) • keep leaf peel in place (1) • protect the (objective) lens (1) • protect the specimen (1)	ignore to prevent drying out	(1) AO 2 2

Question number	Answer	Additional guidance	Mark
3(a)(ii)	An explanation linking two of the following: • the leaf peel is thin / leaf is too thick (1) • as the leaf peel allows light to pass through it/the leaf would not allow light to shine through it (1) • to enable the {stomata / cells/ guard cells} to be identified (1)	accept leaf would be opaque accept to see stomata / cells	(2) AO 2 2

Question number	Answer	Additional guidance	Mark
3(b)(i)	3 / three		(1) AO 2 2

Question number	Answer	Additional guidance	Mark
3(b)(ii)	A description including three of the following points: - guard cells (1) - take in water (1) - by osmosis (1) (guard cells) become turgid/change shape/swell (1)	accept uneven thickness of guard cell walls leads to bulging	(3) AO 1 1

Question number	Answer	Additional guidance	Mark
3(b)(iii)	A explanation linking two of the following points: - no stomata (in the upper surface) to reduce water loss (1) - water loss during transpiration / evaporation (1) OR - stomata (on the lower surface) allow gas exchange (1) - gas exchange is needed for photosynthesis (1)	accept stomata (on the lower surface) {allow / reduce} water loss accept more water loss if stomata on top accept the idea of movement of oxygen or carbon dioxide for gas exchange	(2) AO 2 1

Total for Question 3 = 9 marks



Question number	Answer	Additional guidance	Mark
2(a)	An explanation including the following: - lower surface (of leaf) is not in contact with air / is in water (1) - so gas exchange cannot occur (1)	accept water would enter the stomata accept oxygen /carbon dioxide /water (vapour) accept reduced/no transpiration	(2)

Question number	Answer	Mark
2(b) (i)	D chloroplast The only correct answer is D chloroplast A is incorrect because the nucleus does not photosynthesise B is incorrect because the vacuole does not photosynthesise C is incorrect because the mitochondrion does not photosynthesise	(1)

Question number	Answer	Mark
2(b) (ii)	C sucrose The only correct answer is C sucrose A is incorrect because glycerol is not a sugar B is incorrect because although ribose is a sugar this is found in DNA D is incorrect because starch is not a sugar	(1)

Question number	Answer	Additional guidance	Mark
2(b)(iii)	A description including two from: • in the phloem (1) • dissolved (in water) (1) • by translocation (1) • using active transport (1)	reject xylem accept by diffusion	(2)

Question number	Answer	Mark
2(c)	An explanation including three of the following: • because {conditions / named conditions} are suitable for {growth / photosynthesis} /conditions similar to native conditions /it is adapted to the conditions (1) • it outcompeted the natural plants (1) • therefore, it {grows / reproduces} (1) • as no natural herbivores {eat it / restrict it} (1)	(3)

Question 2 = 9 marks

Question Number	Answer	Additional guidance	Mark
2(a)	Any one from: bacteria / fungi / decomposers / prokaryotes	accept microorganisms accept named decomposing organisms e.g. worms	(1) A01 1

Question Number	Answer	Additional guidance	Mark
2(b)	A description including two from: • (dissolved) in water (1) • diffusion through the root (1) • (so water moves) through the xylem (1) • by transpiration (stream) (1) • into leaves by diffusion (1)	accept active transport through the plant reject phloem accept evaporated from the leaves	(2) A02 1

Question Number	Answer	Additional guidance	Mark
2(c) (i)	An explanation linking: • as light intensity decreases the number of (small) plants (per m²) decreases (1) • because the (small) plants will not be able to photosynthesise enough (1)	accept reverse argument	(2) A03 1ab

Question Number	Answer	Additional guidance	Mark
2(c) (ii)	Any one from: • same time of day (1) • same meter (1) • same position(s) in area / measure the same size area (1) • same person makes the readings (1) • meter held vertically each time (1)	accept other valid variables that should be controlled	(1) A03 1ab

Question Number	Answer	Additional guidance	Mark
2(d)	A description including three from: - place a quadrat along a {rope / tape} measure (1) - tape measure to measure along the transect (1) - measure light intensity at different distances (from the wood) (1) - measure the stinging nettles {along the transect / at different light intensities} (1) - way of measuring growth of stinging nettles (in the quadrats) (1)	reject quadrant accept good descriptions of quadrats – e.g. ½ metre wire square accept use a light meter/lux meter accept named examples – e.g. {height / mass / dry mass / number of leaves / number of plants}	(3) AO3 3a

(Total for question 2 = 9 marks)



Question Number	Answer	Mark
2(a)(i)	B mitochondria The only correct answer is B <i>A is not correct because vacuoles do not release energy</i> <i>C is not correct because nuclei do not release energy</i> <i>D is not correct because ribosomes do not release energy</i>	(1) AO1 1

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An answer including: • thick walls (1) • continuous / hollow tubes / no end walls (1)	accept no cytoplasm accept made of lignin / made of dead cells (1)	(2) AO2 1

Question Number	Answer	Mark
2(b)(i)	An explanation including three from: • fan causes air to move / creates wind / increased air flow (1) • water (vapour) removed (from around leaf) (1) • increased {rate of diffusion / evaporation / transpiration} (of water vapour from leaf) (1) • causing the plant to take up more water (1)	(3) AO2 2

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	to compare (the effect) / as a control	accept to get a baseline measurement	(1) AO2 2

Question Number	Answer	Additional guidance	Mark
2(b)(iii)	$68 - 52 / 16$ (1) $(16 \div 2)$ $8 \text{ (mm}^3 \text{ per minute)}$	award full marks for correct answer with no working e.c.f. for incorrect graph readings for 1 mark	(2) AO2 1

(Total for question 2 = 9 marks)

Question number	Answer	Mark
6(a)(i)	eight / 8	(1)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	(gas leaving stomata) oxygen / water vapour (1) (gas entering stomata) carbon dioxide (1)	accept correct formula	(2)

Question number	Answer	Mark
6(a)(iii)	to prevent {water loss / the plant drying out}	(1)

Question number	Answer	Additional guidance	Mark
6(b)	An answer linking three from: - place the slide on the stage (1) - select the lowest objective lens (1) - use the focusing wheel (1) - select a higher objective lens (1)	start on the lowest magnification accept focus accept increase the magnification	(3)

Question number	Answer	Additional guidance	Mark
6(c)	An explanation linking two from: - as sucrose (1) - through the phloem (1) - by translocation (1) - active transport (1) - by bidirectional flow (1)	reject xylem reject transpiration	(2)

Total for Question 6 = 9 marks



Question number	Answer	Additional guidance	Mark
7(a)(i)	Any one from: • make sure all areas have the same amount of light/water/minerals (1) • use the same volume of solution / weedkiller (1) • temperature (1) • pH of soil (1)	ignore amount accept mass	(1)

Question number	Answer	Additional guidance	Mark
7(a)(ii)	An explanation linking the conclusion with two of the explanation marks: Conclusion • 80 (arbitrary units) is the best concentration to use (1) Explanation • because it kills the maximum amount of dandelion plants (1) • at lower concentrations not all the weeds were killed (1) • because the highest concentration contains the most weedkiller (1)	accept the highest concentration of weedkiller is the best to use accept it kills all the weeds	(3)

Question number	Answer	Additional guidance	Mark
7(b)	An explanation linking three of the following: • (weed killers contain) auxins (1) • these act on broad leaf plants /only act on the weeds (1) • causing them to overgrow (1) • (selective) weedkillers do not kill grass plants (1)	accept the weeds grow too fast	(3)

Question number	Answer	Additional guidance	Mark
7(c)	An explanation linking three of the following: • phototropism is controlled by the hormone auxin (1) • auxins move to the shaded side of the shoot (1) • causing cell elongation (1) • causing the shoot to bend towards the light (1)		(3)

Total for question 7 = 10 marks



Question Number	Answer	Mark
3(a)(i)	vacuole / large vacuole / permanent vacuole (accept phonetic spellings)	(1) A02 1

Question Number	Answer	Mark
3(a)(ii)	Any one from: - it has a large surface area / it is long / large surface area : volume (1) - thin (cell) walls (1) - many mitochondria (1)	(1) A02 1

Question Number	Answer	Additional Guidance	Mark
3(a)(iii)	An explanation including three from: (root hair cells grow) underground (1) - where there is no sunlight / light (1) - so they can't photosynthesise (1)	accept roots grow underground / in the soil accept roots can't photosynthesise / chloroplasts are needed for photosynthesis	(3) A02 1

Question Number	Answer	additional guidance	Mark
3(b)(i)	A description including two of the following: in tap water chloroplasts are near the {cell wall / cell	accept reverse argument about cells not in salt solution	(2) A03 2ab

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	An explanation including three from: • water has moved (1) • by osmosis (1) • from a high water concentration to low water concentration (1) • through a partially-permeable membrane (1)	accept correct references to the concentration gradient / water potential / low to high solute concentrations	(3) AO2 1

(Total for question 3 = 10 marks)

Question number	Answer	Additional guidance	Mark
8(a)(i)	An answer linking the following: - as light intensity increases so does the rate of photosynthesis (1) (it levels off) when light intensity ceases to be a limiting factor (1)	accept idea of another factor limiting the rate of photosynthesis accept named factor	(2) AO 3 1a AO 3 1b

Question number	Answer		Mark
8(a)(ii)	An explanation linking two of the following: - as temperature increases so does the rate of photosynthesis {as enzymes can catalyse more reactions / more collisions occur} (1) - maximum rate of photosynthesis at the optimum temperature for enzymes (1) {above the optimum/at high temperatures} enzymes become denatured (and photosynthesis decreases) (1)	accept more enzyme-substrate complexes form accept active site changes shape for denatured	(2) AO 3 2a AO 3 2b

Question number	Answer	Mark
8(b)	D inversely proportional to the distance from a light source 1. The only correct answer is D <i>A is not correct because light intensity is not directly proportional to photosynthesis</i> <i>B is not correct because light intensity is not just inversely proportional to photosynthesis it is an inverse square.</i> <i>C is not correct because temperature is not directly proportional to photosynthesis</i>	(1) AO 1 1



Question number	Indicative content	Mark
*8(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (marks) Transpiration • the movement of water • from the root through the plant • through the lignified cells/dead cells • of the xylem • driven by evaporation of water from the leaves • through the stomata • flow is only in one direction • by capillary action • according to the cohesion-tension theory Translocation • the movement of sugars from the leaves • through the plant • as sucrose • through the living sieve cells • of the phloem • flow is bidirectional • to sinks in the plant where the sucrose is needed	(6) AO 1 1
Level	Descriptor	
	No rewardable material.	
Level 1	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. • Presents an explanation with some structure and coherence.	
Level 2	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. • Presents an explanation that has a structure which is mostly clear, coherent and logical.	
Level 3	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • Presents an explanation that has a well-developed structure which is clear, coherent and logical.	

Total for Question 8 = 11 marks



Question number	Answer	Additional guidance	Mark
10(a)(i)	Any one from: - direction of light (1) - ensure equal light intensity around the plant (1)		(1) AO 2 2

Question number	Answer	Mark
10(a)(ii)	Any one from: {the substance that causes shoot growth/auxin} is found in the tip of the shoot (1) - the tip controls growth (1) - the shoot grows from the tip(1)	(1) AO 3 1b

Question number	Answer	Mark
10(a)(iii)	A auxin 1. The only correct answer is A <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
10(a)(iv)	An explanation that links two of the following: - repeat the experiment with more plant shoots (1) - in order to calculate the mean/improve validity / identify anomalies (1) OR - control a variable e.g. temperature, water (1) - in order to improve validity / make the results comparable (1) OR - place something between the tip and the shoot (e.g. agar / mica)/ cover the tip(1) - to see if it is a chemical response from the tip. (1) OR - set up a control / shoot with no tip cut off (1) - to make the results more comparable (1)	(2) AO 3 3b

Question number	Indicative content	Mark
*10(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. Plant adaptations • grass is flexible so does not break in the windy conditions • good root structure to prevent being uprooted in the windy conditions • long thin leaves to reduce wind damage / air resistance leaf structure • leaf is rolled to trap air inside • thick waxy cuticle to prevent water loss by evaporation / transpiration • no stomata on the upper surface to prevent water loss • stomata in pits on the underside of the leaf to retain moist air and reduce water loss • hairs on the lower surface reduce air movement	(6) AO 1 1 AO 2 1

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. • Presents an explanation with some structure and coherence.
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. • Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. • Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Total for Question 10 = 11 marks



Question Number	Answer	Mark
10(a)(i)	D ethene The only correct answer is D <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
10(a)(ii)	B gibberellin The only correct answer is 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

Question Number	Answer	Additional guidance	Mark
10(b)	An answer including three from: - fields with the weed killer had a higher crop yield (1) - the difference in crop yield varies (1) - this must be caused by some other external factor / named factor (1) - the weed killer caused the weeds to overgrow and die (1) - reducing competition for resources so more wheat could grow (1)	accept figures quoted from the table accept disrupts plant growth pattern accept reduced competition for named resources accept reverse argument	(3) AO3 2ab

Question number	Indicative content	Mark
10*(c)	AO1 and AO2 shoot growth • auxins • moved to the shaded part of the plant shoot • causing cells to elongate • making the plant bend towards the light • this is an example of positive phototropism root growth • auxins • collect in large amounts on the underside of the root • inhibiting cell elongation • causing the cells above to elongate faster • causing the root to grow downwards • in the direction of gravity • this is an example of positive gravitropism	(6)

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

(Total for question 10 = 11 marks)



Question number	Answer	Mark
5(a)(i)	to maintain a constant temperature / as a heat shield	(1)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Any two from: - extraneous light (1) - temperature (1) - volume of pond water (1) {length / mass / type} of pond weed (1) - carbon dioxide concentration (1)	accept use the same light bulb/source ignore amount / size of pondweed	(2)

Question number	Answer	Additional guidance	Mark
5(b)(i)	(light intensity $\propto$) $\frac{1}{d^2}$ (1) $1 \div \{25^2 / 625\}$ (1) 0.0016 (arbitrary units)	accept a written equation Correct answer with no working is full marks	(3)

Question number	Answer	Mark
5(b)(ii)	An explanation including two of the following: - collect the gas produced (1) - using a gas syringe / measuring cylinder (1) - to get a measurement of volume of {oxygen / gas} (1) OR - use a video camera / data logger (1) - playback in slow motion and count the bubbles (1)	(2)

Question number	Answer	Additional guidance	Mark
5(c)	A plan including three from the following: • keep the light at the same distance from the pondweed (1) • count the number of bubbles / measure the oxygen produced (1) • repeat at different temperatures (1) • control {carbon dioxide concentration / mass of pond weed} (1)	accept keep the same light intensity accept collect the oxygen accept gas for oxygen accept type of pondweed	(3)

(Total for question 5 = 11 marks)

Question number	Answer	Mark
7(a)	The only correct answer is D gibberellins A is incorrect because adrenalin does not cause seeds to germinate B is not correct because auxins do not cause seeds to germinate faster than gibberellins C is not correct because thyroxine is not a plant hormone	(1) AO1 1

Question number	Answer	Additional guidance	Mark
7(b)(i)	An explanation including four of the following: • auxins (collect) (1) • on the shaded part of the stem/plant (1) • causing cell elongation (1) • making the plant {bend / grow / move / face} towards the sun / light (1)	accept away from the light ignore plant or stem elongation accept heliotropism (1)	(4) AO2 1

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation including three from: • (water travels through) the xylem (1) • from root (to leaf) (1)	reject phloem carrying water	(3) AO1 1

Question number	Answer	Mark
7(b)(iii)	An explanation linking: • (large leaves have a) large surface area (1) • so more light (1) • to produce glucose by the process of photosynthesis (1)	(3) A02 1

(Total for question 7 = 11 marks)



Question number	Answer	Additional guidance	Mark
10(a)	four / 4		(1) AO3 1a

Question number	Answer	Additional guidance	Mark
10(b)(i)	An answer including: one advantage from - increased crop yield (1) - increased profit (1) one disadvantage from - ingested by {herbivores/consumers} that feed on the plants (1) - pollute rivers / runs off into water (1) - fertilisers are expensive / can cost money (1) - increases the growth of weeds (1)	accept {increased / faster} growth / provides mineral ions for growth accept idea of bioaccumulation / enters the food chain / harmful to animals accept eutrophication / causes algal growth ignore damages the environment	(2) AO2 1

Question number	Answer	Mark
10(b)(ii)	C 20% The only correct answer is C A, B and D as they are not the correct result of the calculation	(1) AO2 1

Question number	Answer	Additional guidance	Mark
10(b)(iii)	An answering including two from: • use more concentrations of fertiliser between 1 % and 10 % (1) • use a control / do not apply fertiliser to one field (1) • repeat the test {at each concentration / at each percentage / on each field} (1) • controlling a variable e.g. all fields in the same location / crop density / crop variety / volume of fertiliser (1)	accept other ranges within 0-10% accept use smaller increments of fertiliser accept repeat the test over a larger area / more fields accept soil pH / watering / aspect of fields / idea of polytunnels accept idea of using the fertilisers in the same field ignore control the area / temperature / light intensity / greenhouse	(2) A03 3a

Question number	Answer	Mark
10(c)	C biological control The only correct answer is C A, B and D are not correct because they are not the name of the method	(1) A01 1

Question number	Answer	Additional guidance	Mark
10(d)	An answer linking: • {sample / cells / tissue} taken from the (parent) plant (1) • aseptic techniques used (1) • placed on (sterile/nutrient) growth medium (1) • hormones applied (so plantlets develop) (1)	accept take leaf discs / cuttings / meristems / explants accept aseptic technique being described accept agar / Petri dish accept the cells {differentiate / specialise} accept {roots / shoots / leaves / plantlets / callus} form	(4) AO2 1

Total for Question 10 = 11 marks

Question number	Answer		Mark
7(a)(i)	- set up the apparatus as shown in figure 13 (1) - replace the nitrate solution with (distilled) water / do not add nitrate pellet (1)	accept set up with a seedling on the cotton wool ignore just idea of controlling the volume of solution	(2) AO 2 2

Question number	Answer	Mark
7(a)(ii)	B oxidising 1. The only correct answer is B <i>A is not correct because this is not the symbol for flammable</i> <i>C is not correct because the symbol for corrosive is a hand with acid</i> <i>D is not correct because the symbol for explosive has an explosion on it</i>	(1) AO 1 1

Question number	Answer	Additional guidance	Mark
7(a)(iii)	measure the (change in) mass (1)	accept idea of looking at the number/size of leaves accept the width of the seedling	(1) AO 3 3b

Question number	Answer		Mark
7(b)(i)	An explanation linking: - largest amount of growth seen with the highest concentration of nitrates / the higher the concentration of nitrates the more growth /ORA (1) - nitrates are needed to make proteins (1)	accept faster growth for more growth accept nitrates stimulate growth accept amino acids	(2) AO 3 2a AO 3 2b

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An explanation that links the following: - by the roots/ root hair cells (1) AND - by diffusion (1) - from a high concentration to a low concentration / down the concentration gradient (1) OR - by active transport (1) - from a low concentration to a high concentration / against the concentration gradient / using energy (1)	reject osmosis reject osmosis	(3) AO 2 1

Question number	Answer	Additional guidance	Mark
7(c)	An explanation linking three of the following: - to increase nitrate/ammonia levels in the soil (1) - because nitrogen fixing bacteria live in {colonies/root nodules} on the roots of pea and bean plants (nitrogen-fixing bacteria) produce {nitrates/ nitrogen compounds / ammonia} (1) - from nitrogen {atmospheric/gas} (1)	ignore live in the roots	(3) AO 1 1

Total for Question 7 = 12 marks

Question number	Answer	Mark
9(a)(i)	6000 μm 6×10^3 6.0×10^3 Reject 6×10^{-3}	(1)

Question number	Answer	Additional guidance	Mark
9(a)(ii)	$6 \div 150$ (1) 0.04 (mm) (1) 4.0×10^{-2} (mm)	accept 4×10^{-2} for full marks	(3)

Question number	Answer	Additional guidance	Mark
9(b)	A description linking the following: (denitrifying bacteria) convert nitrates (1) - back into (atmospheric) nitrogen (1)	accept nitrites	(2)

Question number	Indicative content	Mark
*9(c)	AO1 Biotic Plants • During photosynthesis plants take in carbon dioxide from the atmosphere • During respiration plants release carbon dioxide into the atmosphere • Plants store carbon compounds e.g. glucose • Carbon is transferred to animals when they are eaten Animals • Animals release carbon dioxide when they respire • Animals ingest carbon compounds e.g. glucose when they eat plants or animals Decomposers • Decomposers release carbon dioxide during respiration • Decomposers break things down Abiotic • Burning fossil fuels releases carbon dioxide or carbon (particulates) into the atmosphere • The oceans can absorb carbon dioxide • Carbon can be stored in carbonate rocks • Erosion of carbonate rocks releases carbon dioxide • Volcanoes releasing carbon dioxide	(6)

Level	Mark	Indicative content
	0	No rewardable material.
Level 1	1–2	• a simple description one way in which carbon is cycled • linked to a process involved
Level 2	3–4	• A detailed description of how carbon is cycled in the biotic or abiotic environment or a simple description of how carbon is cycled in each environment • Linked to two different processes involved
Level 3	5–6	• A detailed description of how carbon is cycled in the biotic and abiotic environment including the role of plants, animals and decomposers • Linked to the processes of respiration and photosynthesis and an abiotic process

(Total for question 9 = 12 marks)

