

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS
CHEMICAL CONTROL IN PLANTS

SCORE

/89

PERCENTAGE

%

STEMUP

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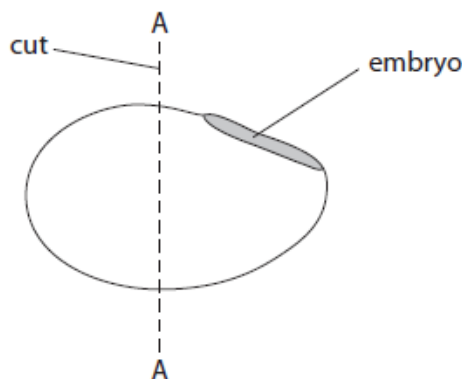
Q1.

Gibberellin stimulates amylase activity. Amylase converts insoluble starch into maltose.

A student suggested that developing embryos in seeds produce gibberellin.

To test this idea, the student carried out two experiments.

In each experiment barley seeds were cut as shown in the diagram.



The seed halves were sterilised by washing in bleach.

In the first experiment, seed halves that contained an embryo were placed on sterile starch agar.

Seed halves without an embryo were placed on sterile starch agar and on sterile starch agar containing gibberellin.

The seed halves were incubated for 48 hours at 25°C. Iodine solution was then poured over the agar.

The table shows the results of the student's first experiment.

Agar	Seed halves	Result
starch	with an embryo	clear area around seed halves
starch	without an embryo	no clear area around seed halves
starch + gibberellin	without an embryo	clear area around seed halves

In the second experiment, seed halves containing an embryo were placed onto plain agar in a "boat" made from a selectively permeable membrane.

This boat was embedded in starch agar.

These seed halves were also incubated for 48 hours at 25 °C. Iodine solution was then poured over the agar.

The diagram shows the results from the second experiment.

(Total for question = 8 marks)

Q2.

Auxins and cytokinins are plant growth regulators that control apical dominance and cell elongation.

Explain how auxins and cytokinins control the growth of lateral buds.

(3)

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(Total for question = 3 marks)

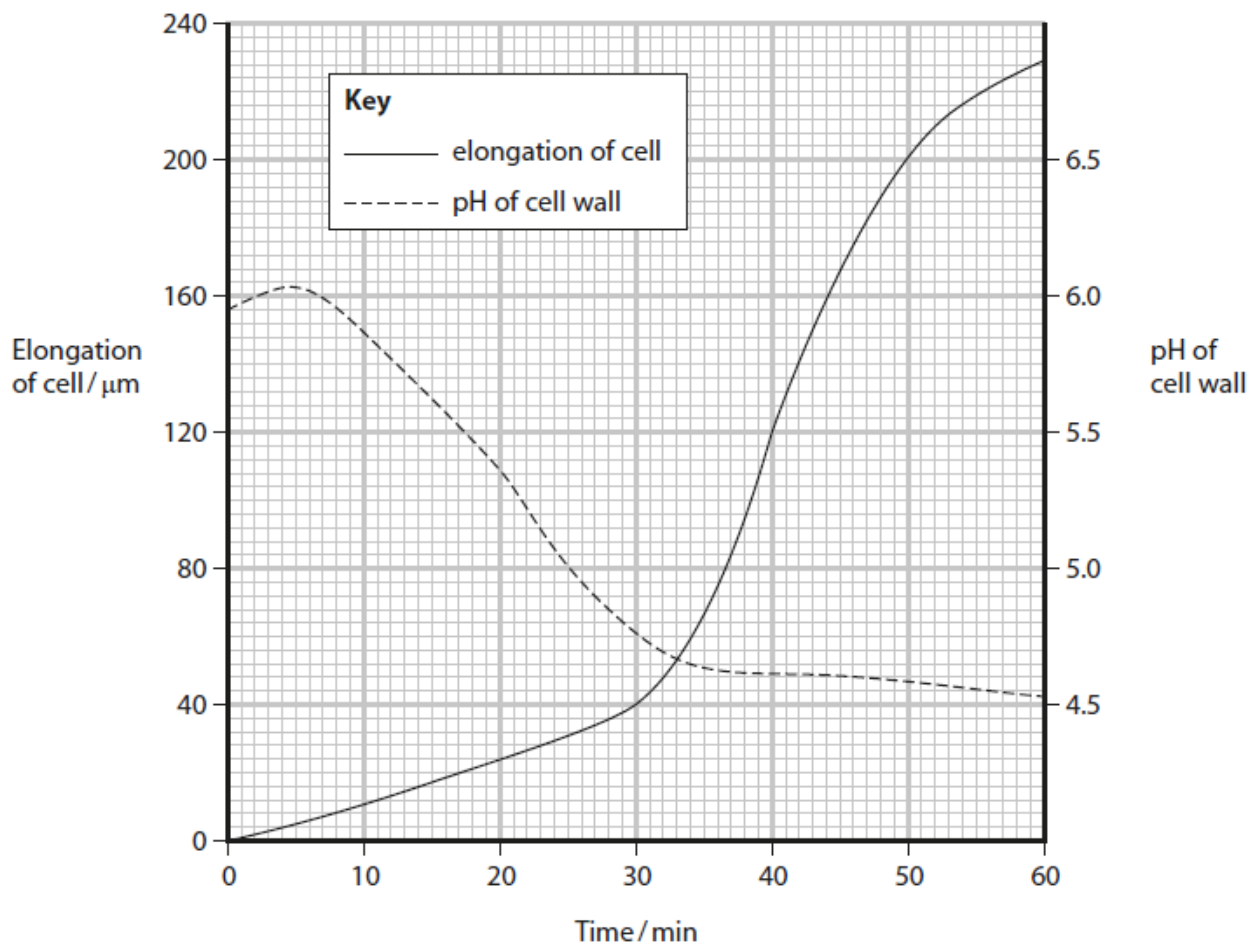
Q3.

Auxins and cytokinins are plant growth regulators that control apical dominance and cell elongation.

When auxin enters a cell, it causes hydrogen ions to be pumped out of the cell into the cell wall.

The effect of auxin on the pH of the cell wall and cell elongation was investigated. Auxin was added to plant cells. The pH of the cell wall and cell elongation were measured over a period of 60 minutes.

The results are shown in the graph.



(i) Calculate the maximum rate of elongation of the cell.

(2)

Answer

(ii) Expansin is a protein located in cell walls.

Expansin disrupts hydrogen bonds and ionic bonds of molecules in the cell wall.

Deduce a mechanism by which auxin and expansin cause cells to elongate.

(3)

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(Total for question = 5 marks)

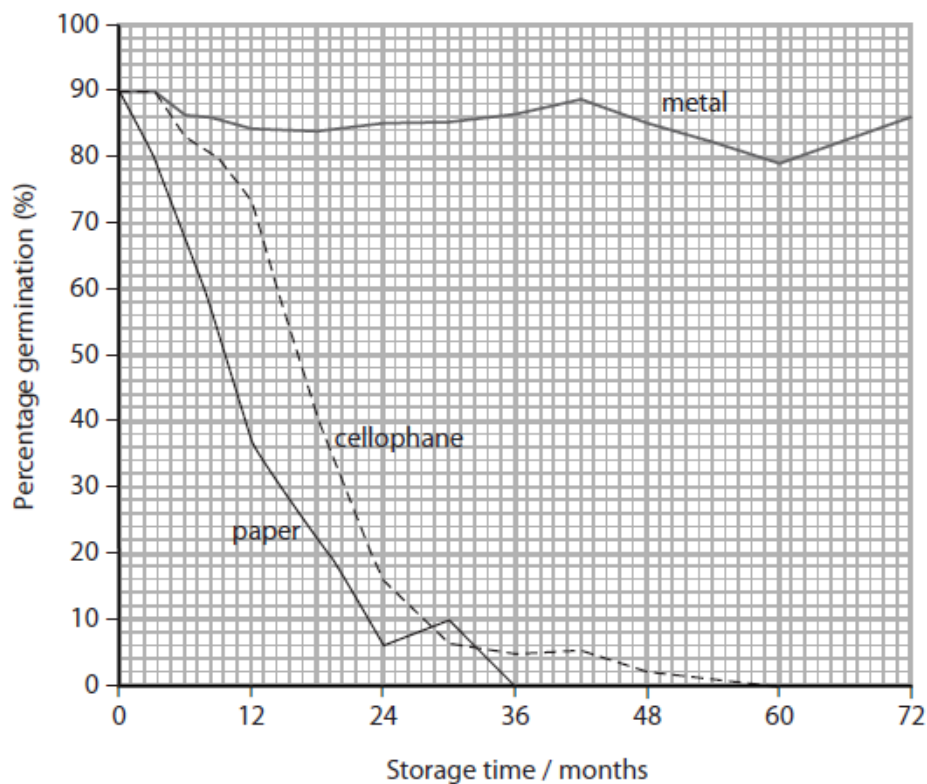
Q4.

Seed banks store seeds for future use. Seeds can be stored for a long time if the seeds are kept dry with a moisture content of less than 8%.

The seeds are stored in closed containers. The percentage germination of the seeds is measured to test their viability during storage.

At the Millennium Seed Bank, the seeds are stored in closed glass containers at 15% relative humidity at a temperature of -20°C .

The graph shows the percentage germination of seeds kept in three different closed containers: metal, cellophane and paper. They were kept for 72 months at a temperature of -20°C .



(a) Analyse the data to explain why seeds are stored in glass containers in the Millennium Seed Bank.

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(b) Each time the seeds are tested for viability, 50 seeds are used.

State why 50 seeds are used.

(1)

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(c) Calculate the rate of change in viability of the seeds stored in a cellophane container for the first two years.

(2)

Answer

(d) Seeds from other parts of the world are stored in seed banks.

(i) Explain how the viability test would be different for these seeds from other parts of the world.

(3)

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(ii) Explain why plants grown from these germinating seeds may not flower at the same time of year as they would have done in their country of origin.

(2)

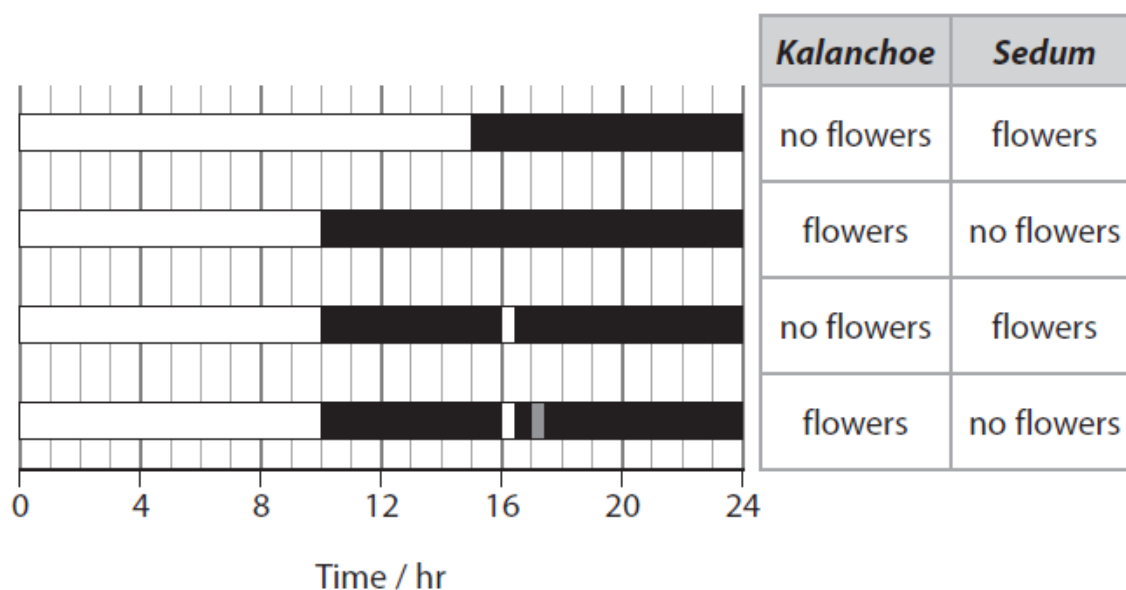
(Total for question = 12 marks)

Q5.

* The effect of day length on flowering in two species of plants, *Kalanchoe* and *Sedum*, was investigated.

The effect of different periods of light and darkness and the effects of exposure to far red light were investigated.

The diagram shows the results of this investigation.



Key

light

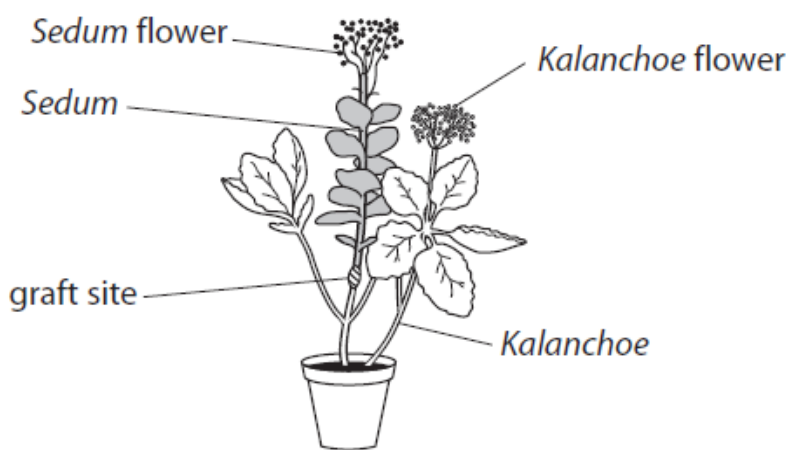
dark

far red light

In another investigation, a piece of *Sedum* was grafted onto the stem of a *Kalanchoe* plant.

This plant and graft were exposed to 10 hours of light followed by 14 hours of darkness.

The *Kalanchoe* and the *Sedum* graft both produced flowers, as shown in the diagram.



Analyse the data to explain the effects of different light periods and far red light on flowering in *Kalanchoe* and *Sedum*.

(6)

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(Total for question = 6 marks)

Q6.

Chemical control in plants involves plant growth substances.

Which of the following effects are caused by auxin?

(1)

1 cell elongation

2 suppression of lateral bud growth

3 photomorphogenesis

- ☐ **A** 1 and 2
- ☐ **B** 1 and 3
- ☐ **C** 2 and 3
- ☐ **D** 1, 2 and 3

(Total for question = 1 mark)

Q7. The scientific article you have studied is adapted from several sources.

Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in starch. Starch can be a combination of amylose and amylopectin.

Give **two** structural differences between amylose and amylopectin.

(2)

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(b) Explain why a colony of naked mole rats is considered 'a eusocial society' (paragraph 4).

(2)

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(c) Naked mole rats show evidence of poikilothermy (paragraph 5).

(i) Explain what is meant by the term **poikilothermic**.

(1)

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(ii) Suggest how each of the following 'contribute to poikilothermic responses to changing temperature of this mammal'.

(2)

'Lack of an insulating layer'

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'A marked reduction in sweat glands'

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*(e) Whilst naked mole rats are 'impervious to chemical pain' they do feel 'acute pain such as cuts and burns' (paragraph 31).

Explain how myelination increases the speed of transmission of nerve impulses in a sensory neurone.

[illegible]

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(f) Explain how a heart attack can temporarily reduce the oxygen concentration in brain tissue (paragraph 36).

(3)

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(g) Using the information in paragraph 48, name **one** hormone **and** state its function.

(1)

Hormone:

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Function:

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(h) Suggest how a change in the mid region of the sperm may make it non-motile (paragraph 48).

(2)

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(i) Disperser naked mole rats 'are laden with fat' (paragraph 50).

Suggest why it may be advantageous for disperser naked mole rats to have high levels of fat.

(3)

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(j) Explain the statement that 'a preference by reproductively active females for unfamiliar males is interpreted as inbreeding avoidance' (paragraph 52).

(2)

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(k) 'The naked mole rat hasn't yet had its genome sequenced' (paragraph 53).

Explain what is meant by the term **genome sequenced**.

(1)

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(l) 'With so much to offer science, it is no surprise that naked mole rats are becoming more common in labs' (paragraph 53).

Using information from the article, describe **two** adaptations of naked mole rats. For each adaptation, explain why it could be of interest in a medical research laboratory.

(4)

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(Total for Question = 30 marks)

The table below shows the percentage germination of lettuce seeds when exposed to light of different wavelengths.

Wavelength of light	Percentage germination (%)
red only	97
far red only	4
period of red followed by a period of far red	4
period of far red followed by a period of red	96

(4)

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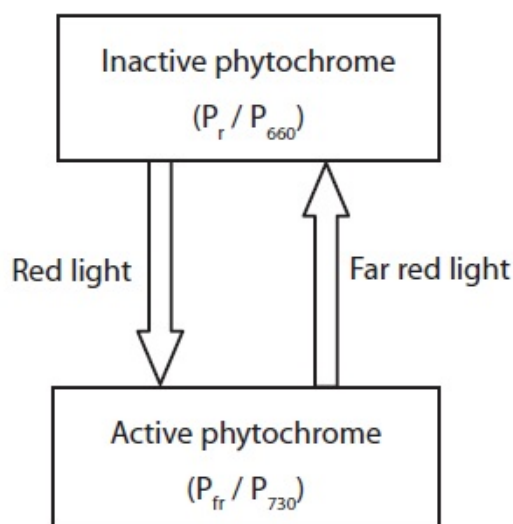
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(Total for question = 4 marks)

Q9.

Phytochromes are photoreceptors found in many plants.

(a) The diagram below shows the interconversion of inactive phytochrome (P_r / P_{660}) and active phytochrome (P_{fr} / P_{730}).



State **one** way in which the active form of phytochrome can be converted back to the inactive form, other than by exposing it to far red light.

(1)

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(b) A study was carried out to investigate the effect of red light and far red light on sunflower plants.



A sunflower
Magnification $\times 0.5$

One group of sunflower seedlings, group A, was grown under a lamp that emitted red light and far red light of the same intensity.

Another group of sunflower seedlings, group B, was grown in the same way, except that the lamp emitted a lower intensity of red light. The intensity of far red light was unchanged.

When the plants were fully grown, the mean dry mass of the flowers produced and the mean length of the plant stems were recorded.

This study was repeated using new groups of sunflower seedlings.

The results are shown in the table below.

Study	Mean dry mass of the flowers / g		Mean stem length / cm	
	Group A	Group B	Group A	Group B
Original	58	45	125	148
Repeat	43	38	124	142

(i) Using the mean dry mass of the flowers shown in the table, compare the results of group A with group B for both the original and repeat studies.

(3)

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(ii) The light conditions experienced by group B were similar to those found near ground level in woodland.

Using the mean stem lengths shown in the table, suggest the importance of these light conditions for a young seedling in the woodland.

(3)

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(iii) A statistical analysis of the data for mean stem length was carried out.

The analysis showed that there was a significant difference between the mean stem length data for groups A and B. However, there was no significant difference between the data from the original study and the repeat study.

Suggest a conclusion for the effect of light on mean stem length and use the results of this statistical analysis to comment on the reliability of the data.

(3)

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(Total for question = 10 marks)

Q10.

Plant growth substances and phytochromes are chemicals that affect the growth of plants.

Phytochrome is involved in the germination of seeds.

The effect of red (R) light and far-red (FR) light on the germination of lettuce seeds was investigated.

A scientist exposed five groups of 50 seeds to red light for one minute.

The seeds were planted and the mean number that germinated was calculated.

Another five groups each of 50 seeds were then exposed to red light for one minute, followed by far-red light for four minutes.

These seeds were planted and the mean number that germinated was calculated.

The experiment was repeated with different combinations of red light and far-red light.

The results are shown in the table.

Sequence of red (R) and far-red (FR) light	Mean number of seeds that germinated	Standard deviation (SD)
R	45	± 4
R, FR	5	± 2
R, FR, R	45	± 5
R, FR, R, FR	10	± 4
R, FR, R, FR, R	40	± 9

Analyse the data to comment on the effect of red (R) and far-red (FR) light on the germination of lettuce seeds.

(4)

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(Total for question = 4 marks)

Q11.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

Plant growth substances and phytochromes are chemicals that affect the growth of plants.

(i) Which row of the table shows the concentrations required for the fastest growth of lateral buds?

	Auxin concentration	Cytokinin concentration
☐ A	high	high
☐ B	high	low
☐ C	low	high
☐ D	low	low

(ii) Some types of auxin affect the activity of cells in the same way as hormones such as oestrogen affect human cells.

These auxins pass through the cell membrane and affect the synthesis of enzymes.

Explain how these auxins affect the synthesis of enzymes.

(3)

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(Total for question = 3 marks)

Q12.

Chemical control in plants is brought about by plant growth substances such as auxins.

Auxins cause elongation of cells.

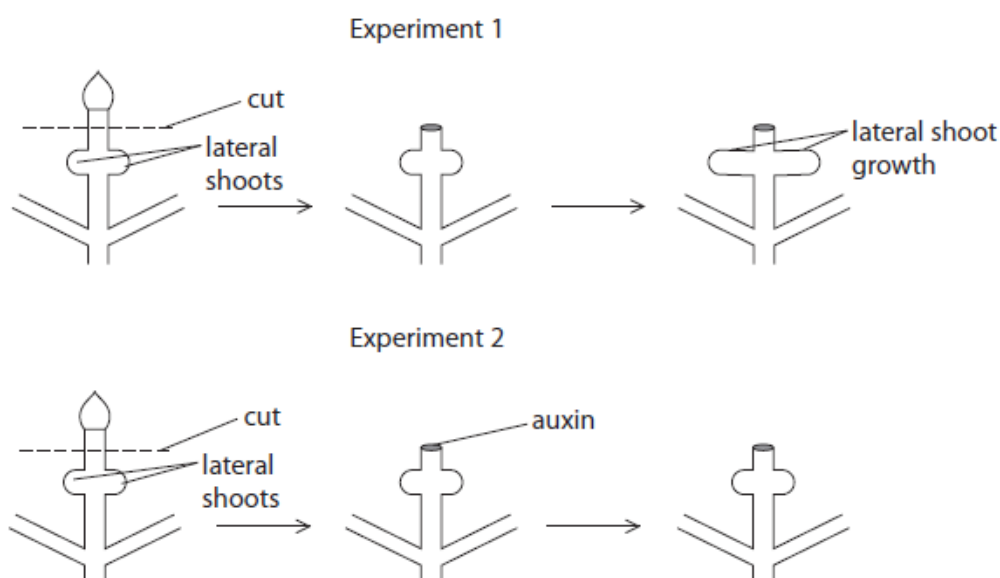
Auxins weaken the bonds between molecules found in cell walls. Molecules found in cell walls include cellulose and hemicellulose.

A scientist investigated apical dominance in plants.

In experiment 1, the shoot tips were cut off and the growth of lateral shoots assessed.

This was repeated in experiment 2, but auxin was placed over the cut end of the tips and the growth of lateral shoots was assessed.

The results are shown in the diagrams.



Explain how the interaction between auxins and cytokinins could have produced the results shown in the diagram.

Mark Scheme

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	An explanation that makes reference to the following: (1) - to prevent growth of { bacteria / fungi } which would produce amylase (1) - to prevent { bacteria / fungi } from decomposing the seeds	.	(2)

Question Number	Indicative content
(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 which is indicated as relevant. Additional content included in the response must be scientific and relevant. • seed half with embryo does have amylase activity • seed half without embryo has no amylase activity • seed half without embryo and with the gibberellin does have amylase activity • this suggests gibberellin is needed for amylase { synthesis / activity } • selectively permeable membrane shows that the active agent / gibberellins is a small molecule • amylase is not diffusing through the membrane

Level	Mark	Descriptor
	0	No awardable content
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure.
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three from: • auxin is released from the terminal bud (1) • and (diffuses down the stem) to inhibit cytokinin action / inhibit lateral shoot growth (1) • cytokinin stimulates lateral shoot growth (1) • and is produced from base of shoot (1)	Allow one mark for antagonistic effect if no MP1 or MP3?	3

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct calculation of increase of elongation from graph from tangent (1) • increase in elongation divided by time taken (1)	ecf for mp2 Allow answer between 9.5 and 12.8 $\mu\text{m min}^{-1}$ one mark for correct answer with no units a correct answer gains full credit	2
(ii)	An answer that makes reference to three from: • as pH falls / at lower pH, elongation increases (1) • because expansin is activated by lower pH (1) • weakening (intermolecular) bonds between cellulose molecules / calcium pectate / hemicelluloses (1) • cell takes in water causing it to expand (1)	Allow converse for increase in pH for all MPs Allow low pH / hydrogen ions change shape of expansin so it can weaken cell walls	3

Q4.

Question Number	Answer	Additional Guidance	Mark
(a)	An explanation that makes reference to four of the following: • {seed viability / germination} high in metal containers (1) • glass containers have similar properties to metal containers (1) • because {metal / glass} containers keep {air / moisture} out (1) • therefore seed water content is kept below 8% (1) • can see through glass without removing lid (1)	Accept converse for paper / cellophane	(4)

Question Number	Answer	Additional Guidance	Mark
(b)	• to produce valid (measure of seed viability / results / data)	Accept allows identification of anomalous result Do not accept if in list	(1)

Question Number	Answer	Additional Guidance	Mark
(c)	• difference calculated • how many times better calculated with units	<u>Example of calculation:</u> $90 - 16 = 74$ $74 \div 2 = 37 \% \text{ year}^{-1}$ or $74 \div 24 = 3.08 \% \text{ month}^{-1} /$ $3.1 \% \text{ month}^{-1} /$ $3 \% \text{ month}^{-1}$	(2)

Question Number	Answer	Additional Guidance	Mark
(d)(i)	An explanation that makes reference to the following: • {viability test / germination} requires similar conditions as the country (1) • because germination is affected by {temperature / pH / light intensity / wavelength / humidity / vernalisation} (1) • if correct conditions not used seeds would not germinate even if viable (1)	Accept other relevant abiotic factor	(3)

Question Number	Answer	Additional Guidance	Mark
(d)(ii)	An explanation that makes reference to the following: • because flowering is affected by {day length / photoperiod / light and dark period} (1) • because flowering involves {phytochrome / P_R / P_{FR}} (1)	Accept florigen	(2)

Q5.

Question Number	Indicative content
★	Answers will be credited according to candidates' 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 which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content Level 1 Descriptions (D) • Sedum flowers with long period of light / short period of dark • Kalanchoe flowers with short period of light / long period of dark • Kalanchoe is a short day plant / Sedum is a long day plant • light during dark period means Sedum flowers / Kalanchoe does not flower • light then far red during dark period means Sedum does not flower / Kalanchoe flowers Level 2 Phytochrome (P) • phytochrome converted between P_R and P_{FR} • light converts P_R to P_{FR} • dark converts P_{FR} to P_R • far red converts P_{FR} to P_R • far red converts P_{FR} to P_R rapidly • short light exposure during dark period converts P_R to P_{FR} • Sedum needs (high) P_{FR} / (low) P_R to flower / Kalanchoe needs (high) P_R / (low) P_{FR} to flower Level 3 Explanation (E) • experiment 2 Kalanchoe should flower • experiment 2 Sedum should not flower but does because Kalanchoe produces florigen / growth factor / diffusible substance / FT mRNA • florigen / growth factor is transported between the two plants • florigen / growth factor activates genes • florigen / growth factor triggers flowering in both plants

Level	Marks	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context. D only or P only
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure. 2 D and 1 P or 1 E
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. 2 D, 2 P and 1 E

Q6.

Question Number	Answer	Mark
(i)	The only correct answer is A 1 and 2 <i>B is incorrect because photomorphogenesis is incorrect</i> <i>C is incorrect because photomorphogenesis is incorrect</i> <i>D is incorrect because photomorphogenesis is incorrect</i>	1

Q7.

Question Number	Answer	Additional Comments	Mark
(a)	1. only (alpha) 1-4 glycosidic bonds in amylose / (alpha) 1-6 only found in amylopectin ; 2. only amylopectin has side branches / only amylose is {coiled / eq} ; 3. Amylopectin is a {larger / eq} molecule than amylose ;	1. ACCEPT 1-6 and 1-4 in amylopectin	(2)

Question Number	Answer	Additional Comments	Mark
(b)	1. Different individuals in the {colony / eq} take on specific {roles / jobs / eq} ; 2. Example given e.g. queen produces offspring ;	1. Accept division of labour 2. Accept dominance by queen, {few of the males / kings} involved in breeding	(2)

Question Number	Answer	Additional Comments	Mark
(c) (i)	Idea that body temperature of animal mimics the ambient temperature ;	Accept body temp follows environmental temperature	(1)

Question Number	Answer	Additional Comments	Mark
(c) (ii)	1. Lack of insulating layer: Idea that does not impede transfer of heat energy / allows exchange of heat energy more easily ; 2. A marked reduction in sweat glands: Idea that they do not need to cool down OR less water lost ;	1. Accept enables heat transfer between environment and NMR	(2)

Question Number	Answer	Additional Comments	Mark
(d)	1. (Cancer causing) gene identified / eq ; 2. Gene {cut / isolated / eq} from DNA / eq ; 3. Using a {restriction / eq} enzyme / eq ; 4. Gene in {vector / named vector} ; 5. Mechanism for getting {gene/vector} into host cells (of mice) / eq ;	1. Accept screen for the gene 2. Accept extracted 3. Accept correctly named restriction enzyme e.g. EcoR1 4. Accept Named <u>egs</u> – retrovirus, virus, liposome, plasmid, bacteria 5. Accept reference to (micro)injection, <u>microprojectiles</u> , electroporation, gene gun, inhaler, transduction	(3)

Question Number	Answer	Additional Comments	Mark
* (e)	QWC – Spelling of technical terms (<i>shown in italics</i>) must be correct and the answer must be organised in a logical sequence 1. {<i>neurone</i> (cell) surface membrane exposed / no <i>myelination</i> / eq} at nodes of <i>Ranvier</i> ; 2. Nodes are the site of clusters of {<i>sodium-gated channel proteins</i> / <i>potassium channels</i>} ; 3. Which {open / close} when <i>impulse</i> arrives / eq ; 4. Allowing <i>depolarisation</i> at nodes / eq ; 5. idea that <i>myelin</i>/eq acts as an (electrical) <i>insulator</i> (on <i>neurone</i> surface between nodes) ; 6. reference to <i>Schwann</i> cell ; 7. idea that <i>impulse/depolarisation</i> 'jumps' to next node ; 8. Reference to this being <i>saltatory conduction</i> ; 9. idea that this happens between the <i>myelin</i> layers of the <i>Schwann</i> cell ;	QWC emphasis on spelling 3. Accept influx of sodium ions	(5)

Question Number	Answer	Additional Comments	Mark
(f)	1. idea of heart working less efficiently ; 2. idea of less oxygen absorbed at lungs / eq ; 3. less blood pumped to brain ; 4. concentration gradient (for oxygen) at brain reduced / eq ; 5. less oxygen in blood (in brain) diffuses into brain tissue / eq ; 6. idea of less oxygen in brain tissue due to continual (aerobic) respiration ;		(3)

Question Number	Answer	Additional Comments	Mark
(g)	~~gonadotrophin~~-releasing (hormone) stimulates ~~gonadotrophin~~ release / ~~gonadotrophin~~ stimulates ovulation / testosterone stimulates {sperm production / (male) secondary sexual characteristics / other named example} ;		(1)

Question Number	Answer	Additional Comments	Mark
(h)	1. Idea of effect on mitochondria ; 2. (therefore) reduced {energy / ATP / eq} for flagellum movement ;	1. Accept less efficient/fewer/ none 2. Accept tail for flagellum	(2)

Question Number	Answer	Additional Comments	Mark
(i)	1. idea that fat is an energy store ; 2. reduces dependence on external food source / eq ; 3. enables disperser to travel / eq ; 4. (metabolic) water is released (on oxidation) / eq ; 5. acts as a thermal insulator / eq ;	Accept energy-rich	(3)

Question Number	Answer	Additional Comments	Mark
(j)	1. idea that unfamiliar males are likely to be genetically different ; 2. idea that this is outbreeding ; 3. idea that this increases genetic diversity ;	3. Accept producing offspring that are genetically different	(2)

Question Number	Answer	Additional Comments	Mark
(k)	the order of the {bases / genes and non-coding sequences / eq} in the DNA (of the naked mole rats) is found / eq ;	Accept exons and introns Ignore genes unqualified	(1)

Question Number	Answer	Additional Comments	Mark
(l)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. Idea of pain relief e.g. dealing with post traumatic pain, post surgical pain, joint pain after a knee operation ; 3. haemoglobin has higher affinity for oxygen ; 4. Idea of dealing with reduced oxygen situations such as due to a heart attack or stroke ; 5. Naked mole rat {incisors / eq} grow through skin (of lip) without damage ; 6. Idea of better prosthesis e.g. new {coatings / permanent seal} at {skin / bone / metal} interface, soft tissue not damaged, avoid infection ; 7. High protein stability / does not (easily) lose 3D shape ; 8. (so) reduced effect of oxidative {damage / stress} / reduced effect of oxygen-containing free radicals / live healthily into old age ; 9. Cell overcrowding early warning gene / ref. to two tiered contact inhibition / presence of gene p16 ; 10. Idea of cancer prevention e.g. cancer resistance, future cancer therapy ; 11. Naked mole rat neurones display immature {characteristics / physiological properties} / brain cells that cope with {low oxygen / hypoxia} ; 12. To treat people with temporary loss of oxygen to brain e.g. heart attack, stroke, drowning / to prevent permanent brain damage ; 13. High levels of oxytocin receptors in {brain / nucleus <u>accumbens</u> } ; 14. Idea of links to autism ; 15. Naked mole rats do not experience menopause ; 16. Ref to osteoporosis {treatment / prevention} (without side effects) ; 17. circadian rhythms / sleep patterns of naked mole rats ; 18. Idea that may help with sleep disorders ;	9. Accept anticancer mechanism	

Question Number	Correct Answer	Additional guidance	Mark
	An explanation that makes reference to four of the following: • red stimulates by converting P_R to P_{FR} (1) • far red inhibits by converting P_{FR} to P_R (1) • the last wavelength received determines the form of phytochrome present because the process is reversible (1) • P_{FR} is the active phytochrome (1) • genes involved in germination are switched on (1) • enzymes involved in germination are synthesised (1)		(4)

Q9.

Question Number	Answer	Mark
(a)	(leave it) in the dark / eq ;	(1)

Question Number	Answer	Mark
(b)(i)	1. mass higher in A (compared with B) for both studies ; 2. the difference is less in repeat study ; 3. comparative manipulation of data e.g. 13g decrease for A to B for original and 5 g for repeat ; 4. mass lower in repeats (of both A and B) / eq ;	(3)

Question Number	Answer	Mark
(b)(ii)	1. { increase / eq} in stem length ; 2. correct manipulation of the data e.g. by 23cm / 18.4% ; 3. reference to {taller / faster growing / eq} seedling ; 4. to receive {more light / higher red light / eq} / to maximize photosynthesis / eq ; 5. idea of allows {active phytochrome / eq} to be made ;	(3)

Question Number	Answer	Mark
(b)(iii)	1. less red light {increases / eq} mean stem length / more far red light increases stem length / eq ; 2. the (significant) difference in mean stem length is not due to {chance / eq} / eq ; 3. the mean length for repeat was close to the original ; 4. suggesting it is likely to be reliable ;	(3)

Q10.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following points: more seeds germinate when last colour is red (1) - number of exposures to light makes no difference (1) - significant difference when last colours are different as standard deviations do not overlap (1) - red light converts P_R into P_{FR} / far red light converts P_{FR} into P_R (1) {P_{FR} stimulates/ P_R inhibits} {germination / gibberellin release / activation of amylase / abscisic acid}	Allow converse for FR light Accept no significant difference when last colours are same as standard deviations overlap (1) Accept P725 or P730 for P_{FR} / P665 or P660 for P_R Accept high P_{FR} : low P_R ratio stimulates germination	4 exp

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	The only correct answer is: C low auxin, high cytokinin <i>A is incorrect as high auxin inhibits lateral shoots</i> <i>B is incorrect as high auxin inhibits lateral shoots</i> <i>D is incorrect as low cytokinin inhibits lateral shoots</i>		1 comp

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following points: - auxin binds with {receptor / transcription factor} (inside cell / in cytoplasm / in nucleus) (1) - transcription factor becomes active / is activated (1) - transcription factor binds to {DNA / promoter} (1) - switches on / causes {transcription / production of RNA} (1)	Accept forms auxin-receptor complex Accept forms hormone-receptor complex Do not accept if receptor on cell membrane Accept transcription factor changes shape Accept auxin-receptor complex becomes a transcription factor Accept auxin-receptor complex binds to DNA / promoter (1)	3 exp

Q12.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: {removing tip / removing meristem / absence of auxin} results in lateral shoot growth (1) - because auxin inhibits lateral shoot growth (1) - cytokinin stimulates lateral bud growth (1) - auxin {represses / inhibits / is dominant over} cytokinin action (1)	Accept if auxin is higher than cytokinin, lateral shoot growth stops Accept if cytokinin is higher than auxin, lateral shoot growth occurs	(3)