CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9700 BIOLOGY

9700/51 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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Mark schemes abbreviations:

;	separates marking points
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R	do not allow
A	allow (for answers correctly cued by the question, or guidance for examiners)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given

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Question	Expected answer	Extra guidance	Mark	AO
1 (a) (i)	*independent*: concentration of GA **;** *dependent: ref. to* the starch free, area / zone (around grains) **;**	*ignore* amount / quantity **A** diameter / radius / size **A** clear zone / brown zone / digested starch *ignore* ref. to amylase activity	[2]	P
(ii)	8 of: *independent variable* 1. *ref. to* method of diluting the ($3\,mmol\,dm^{-3}$) GA to give a minimum of (any) 5 dilutions **;** 2. *ref. to* concentrations (other than 0) that fall in the range $3\,mmol\,dm^{-3}$ to any value above zero with units **;** 3. *ref. to* soaking grains in GA solutions for, min 24 hours / max 72 hours **;** 4. *ref. to* a **control** using (distilled / deionised) water **;** 5. *ref. to* stated incubation temperature **;**	***A** seed / fruit / maize for any mark point in **(a)*** *ignore any ref. to time between soaking and putting maize onto agar plate* 1. **A** series / serial / proportional / simple, dilution as method **or** description of method 2. minimum is 2 values that are not higher than $3\,mmol\,dm^{-3}$ and are above zero $1\,mmol\,dm^{-3} = 1000\,\mu mol\,dm^{-3}$ $1\,\mu mol\,dm^{-3} = 0.001\,mmol\,dm^{-3}$ 3. *ignore* if the range of GA is incorporated into agar plates If pre-soaked in water for 24h and then in GA, must be **minimum** of 1 hour GA 4. **A** description – 'to allow comparison' / AW 5. e.g. any one temp in the range 15–35°C. **A** room temperature. **R** body temperature / 37°C		

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Question	Expected answer	Extra guidance	Mark	AO
	dependent variable 6. *ref. to* a suitable method of measuring the starch free area around the grains **;**	6. e.g. trace outline onto a grid / transparent grid / photograph and put on grid / cut out clear zone and put on grid, **and** count squares. **OR** use suitable apparatus to measure, diameter / radius, directly **or** from a grid **and** calculate area using πr^2 *ignore* metre ruler. **A** e.g. ruler / callipers / micrometer / eyepiece graticule		
	standardising variables **(max 4)**: 7. *ref. to* using, same / stated number of, grains / halves, for each concentration **;**	7. **A** 'one / a' as same number *ignore* 'same size of grains / same amount of grains. **A** quantity for number		
	8. *ref. to*, stated / same, volume of each soaking solution / GA **;**	8. **A** *idea* of: all, submerged / covered		
	9. *ref. to* method of keeping same incubation temperature **;**	9. e.g. water bath / incubator / temperature controlled room / thermostatically controlled environment / environmental chamber / propagator / thermostat *ignore* air conditioning		
	10. *ref. to* one stated time for incubation (of enzyme) **;**	10. **A** any value in the range 24–72 hours. Actual value must be stated **A** left on, plate / agar as AW for incubate		
	11. *ref. to*, same / stated, concentration of starch in agar **;**	11. **A** 'known' time		
	12. *ref. to* same, volume / depth, of agar (in the Petri dishes) **;**			
	13. covering to prevent, evaporation / contamination **;**			

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Question	Expected answer	Extra guidance	Mark	AO
	safety: 14. *ref. to*, low risk investigation / any suitable safety precaution **;** *reliability*: 15. *ref. to* replicates, **and** mean / to identify or eliminate anomalies **;**	14. e.g. cutting away from hands / using tile for cutting. *ignore* gloves for cutting. ref. to allergy / irritation, and, gloves / mask / eye protection **R** no risk 15. must be a minimum of 3 (data sets), allow as, original and 2 more / several **A** outliers for anomalies **A** average for mean	[8]	M
(b)	*x-axis*: concentration of GA **and** mmol dm^{-3} **or** μmol dm^{-3} **;** *y-axis*: (mean) area of, clear zone / starch digested **and** mm^2 **;**	**A** mmol **or** μmol, per dm^3 **or** mmol / dm^3 **or** μmol / dm^3 **A** (mean) diameter of clear zone / mm **A** cm^2 / cm **A** activity of amylase **and** arbitrary units / au labels correct – no / incorrect, unit(s) = 1 max axes reversed, correct for labels **and** units = 1 max	[2]	D
(c) (i)	3 of: 1. *idea of* areas irregular in shape **;** 2. *idea of* edges of areas difficult to see **;** 3. not sure how much GA embryo is also producing **;** 4. may be other, enzymes / chemicals, that hydrolyse the starch **;**	*ignore ref. to replicates / repeats* 1. **A** in terms of different diameters **A** in general terms like 'difficult to tell actual size' 2. **A** in terms of edges overlapping or edges blurred / brown merging into blue / AW 3. **A** grain / fruit / seed for embryo		

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Question	Expected answer	Extra guidance	Mark	AO
	5. *idea of:* no way of quantifying amylase (leaving grain) **;** 6. amylase / enzyme, may come from contamination **;** 7. *idea of:* no method of quantifying the starch disappearance **;** 8. pH may vary / AW **;**	5. **A** in terms of, not diffusing out / used inside / ref. to different surface area of (cut) grain / size of grain only in context of amylase not leaving grain or having different amounts of amylase 6. **A** coming from fungi / bacteria / coat of grain 7. *idea of*: do not know of the number of molecules of starch broken down. Look in context of the test being qualitative rather than quantitative. NOT rate ideas	[3]	E
(ii)	*method:* any 1 × 2 of: 1. stated better method of measuring, (area / diameter) **;** some brief detail of stated method **;** 2. *if overlap:* separate plates / fewer grains per plate / larger plates **;** able to distinguish edges more clearly / AW **;** *if 'blur':* really cannot be improved = 2 marks **;;** **or** do large sample **;** minimises, effect / error / AW **;** 3. *idea of:* separating the embryo from the grains (after soaking) **;** *idea of:* measure area, without embryo present / with embryo on its own **;** 4. *idea of:* extracting the amylase (from grain) **;** *idea of:* repeat with just the extract and compare **;**	1. e.g. use graticule on low power of microscope = 2 marks		

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Question	Expected answer	Extra guidance	Mark	AO
	5. *if in term of how much out / used up*: *idea of:* extracting the amylase (from grain) **;** *idea of:* repeat with just the extract and compare ; *if in terms of different surface areas:* *idea of:* measuring (surface) area **;** *idea of:* either finding similar area or calculating per unit area **;** 6. *idea of:* sterilising / disinfecting (grain / agar / dish /AW) **;** detail of possible method **;** 7. *idea of:* putting known concentrations of amylase on starch agar **;** producing a calibration curve from areas measured **;** 8. use a buffer **;** to make up the agar (plates) **;**	5. **A** remove endosperm repeat using embryo / AW 6. detail e.g. (named) disinfectant **or** sterile technique to, make plates / make up agar / handle grains **or** keep plate covered.	[2]	M
		Total:	**[17]**	

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Question	Expected answer	Extra guidance	Mark	AO
2 (a)	3 of: 1. anaerobic bacteria increase with depth **and** aerobic bacteria decrease with depth ; 2. below 1.5–2.0 m aerobic stay approximately the same **and** anaerobic continues to increase(slowly) **;** 3. *idea of:* oxygen content of soil decreases with depth **;** 4. *idea that:* anaerobic bacteria replace the aerobic bacteria as oxygen reduces / (most) aerobic unable to survive in low oxygen **;**	1. A general point – but must relate to idea of depth 3. **A** oxygen content decreases with time 4. **A** replacement in terms of succession / competition	[3]	C
(b) (i)	less activity of, dehydrogenase / enzyme **;**	**A** less <u>aerobic</u> respiration **R** less dehydrogenase	[1]	E
(ii)	2 of: 1. temperature **;** 2. pH **;** 3. *idea of:* time that determination was run for **;** 4. (soil) moisture / water **;** 5. substrate (in soil) **;**	*ignore* ref. to oxygen 5. **A** (named) nutrients (in soil)	[2]	P
(iii)	*idea of*: (soil) without, (active) bacteria / active enzyme **;**	**A** heated / boiled / disinfected / sterilised / irradiated / AW, soil **A** (soil) with, dead / killed bacteria / denatured enzyme / enzyme removed **A** ref. to add an enzyme inhibitor **A** remove the bacteria from soil **R** killed enzyme / replace with (named) inert material	[1]	P

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Question	Expected answer	Extra guidance	Mark	AO
(c) (i)	*ref. to* wide / long / big / AW, error bars, that indicate results are, less / not, reliable **;** *ref. to* data **;**	**A** reverse argument **A** suitable AW for wide e.g. 6 years least reliable **or** 6 months / 3 years most reliable **or** more reliable in **B** than **A** at 6 years	[2]	D
(ii)	6 months and 3 year , 6 months and 6 years **both** underlined / ringed **;** error bars do not overlap **;**	**A** error bars do not cross / AW	[2]	D
(d)	*idea of*: graph of, dehydrogenase / enzyme, activity, against number of bacteria per gram (plotted) **;** *idea of:* dehydrogenase / enzyme, activity located on graph and number of bacteria read from scale **;**	*ignore* orientation of graph. **A** if shown on a graph for 2 marks **A** *idea of:* comparing data against table to look for 'closest approximation' = 1 mark max *ignore* compare unqualified	[2]	D
		Total:	**[13]**	

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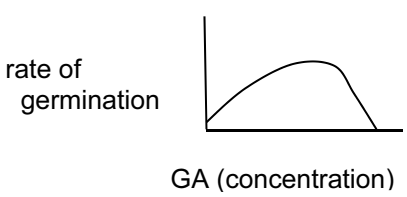
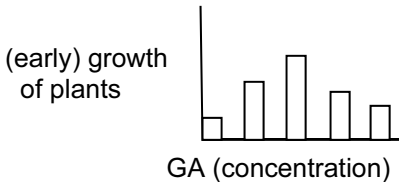
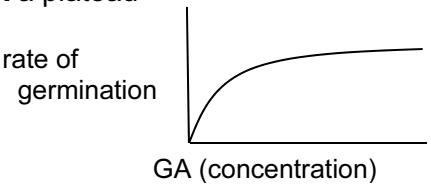
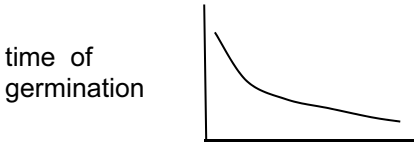
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max	indicates the maximum number of marks that can be given
ecf	error carried forward

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Question	Expected answer	Extra guidance	Mark	AO
1 (a)	axes correctly orientated **;** line graph showing rise and fall / as concentration increases **;**  	*x*-axis concentration of GA, *y*-axis length / mass / size of young plant. *units not needed* **A** rate of germination / early growth **A** lines that start and / or end at origin **A** lines that start away from *y*-axis **A** bar charts. **A** charts with no bar at zero **A** a plateau  **A** time if germination as *y*-axis 	[2]	P
(b) (i)	*independent*: <u>concentration</u> of GA : *dependent:* ref. suitable dimension of young plant / time of emergence of suitable structure **;**	e.g. mass / length of shoots / length of roots / length of young plant **A** time taken for 'testa' to split	[2]	P

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Question	Expected answer	Extra guidance	Mark	AO
(ii)	7 of: *independent variable:* 1. ref. to a method of diluting the (3 mmol dm^{-3}) GA to give a minimum of (any) five dilutions **;**	**A** *fruits, seeds for barley grains in any answer* 1. 0 and original (3 mmol dm^{-3} dm^{-3}) can be included in the number of dilutions, allow original by implication **A** serial / series / simple / proportional dilution as a method or a description or a formula		
	2. ref.to concentrations (other than 0) that fall in the range 3 mmol dm^{-3} to any value above 0 with units (μmol dm^{-3} / mmol dm^{-3} / g dm^{-3})	2. minimum of 2 stated values that are not higher than 3 mmol and are above 0 maximum 3000 μmo dm^{-3} / 1 g dm^{-3} 1 mmol dm^{-3} = 1000 μmol dm^{-3} / water 1 μmol dm^{-3} = 0.001 mmol dm^{-3}		
	3. ref. to soaking grains (in GA solutions) for min 24 hours / max 72 hours **;**	3. If pre-soaked in water for 24 hour and then in GA, must be **minimum** of 1 hour GA		
	4. ref. to (removing from GA and) growing in soil / suitable containers on paper /cotton wool **and** kept dark **;**	4. **A** other planting media e.g. compost, vermiculite, sand. **R** if kept immersed in water or GA		
	5. ref. to one stated (germination) temperature **;**	5. any one temperature in the range 15–20°C. Must be **one** number with units. *ignore* room temperature		
	6. ref. to a **control** using seeds soaked in water **;**	6 **A** a description of a control e.g. to compare with the seeds in GA		

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	dependent variable 7. ref. to a suitable method of measuring young plant **;**	7. e.g. mass **with** balance / scales / weighing machine length of shoot / length of roots **with** callipers / ruler (*ignore* metre ruler) **A** micrometer / eyepiece graticule **A** *idea of:* checking at specified time and / or daily for a stated first indication of germination **with** timer e.g. root /shoot to appear. **Or** record number of days taken for specific number of seeds to germinate in each dish		
	standardising variables ***(max 3, mp 8–12)****:* 8. ref. to using same / stated number of barley grains for each concentration **;**	8. must be more than one grain. *ignore* same size / amount. **A** quantity		
	9. ref. to suitable stated / same volume of each soaking solution / GA **;**	9. **A** *idea of:* being submerged / covered.		
	10. ref. to method of maintaining the germination temperature **;**	10. e.g. incubator, temperature-controlled room environment / environmental chamber / propagator. **A** water-bath / thermostat, *ignore* air conditioning		
	11. ref. to leaving for stated number of days (for germination / growth) **;**	11. any value in the range 3 - 20 days		
	12. ref. to (regularly) adding stated / same volume of water **;**	12. *ignore* any unrealistic value *ignore ref. to:* nutrients		
	safety: 13. ref. to low risk investigation / hazard and suitable safety precaution **;**	13. e.g. cutting away from hands / using tile for cutting. *ignore* gloves for cutting. GA irritant and gloves / eye protection **A** allergy and wearing gloves / mask/ eye protection **R** no risk		
	reliability 14. ref. to replicates and mean / to identify or eliminate anomalies **;**	14. must be a minimum of 3 (data sets), allow as original and 2 more / several **A** outliers for anomalies	[7]	M

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(c) (i)	(mean) **experimental /treated** - (mean)**control / untreated** (mean) **untreated** / **control** plants **;** × 100 **;**	**R** final – initial **A** *for denominator:* subtraction in either direction , 'difference between the treated and untreated.	[2]	D
(ii)	*idea of:* making comparisons **;** *idea that:* the control is a base line for the growth of embryos with endogenous GA **;**	*ignore* any ref. to reliability / accuracy / fair test **A** in the context of 'seeing the effect of extra GA ' / taking the 'normal GA into account'	[2]	D
(d) (i)	growth (of grains) gives a normal distribution / means of two sets of plants are being compared **;**	**R** continuous variable **A** data is not categoric / is continuous data	[1]	D
(ii)	*idea of:* there is no significant difference in between 'x' in the plants from untreated / control barley and treated / experimental barley **;** 'x' can be size / length / mass/ rate of growth / percentage growth / germination (rate) / time taken for germination, AW	**R** if 'percentage difference is in the answer' **A** the difference in 'x' is due chance	[1]	D
		Total	[17]	

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Question	Expected answer	Extra guidance	Mark	AO
2 (a)	any ref. to oxygen / O_2 **;**	must be correct formula if used. *ignore* air	[1]	P
(b)	1. *pH constant*: as variation in pH changes enzymes activity / growth (rate) of cells **;** 2. *sterile:* so no other organisms competing **or** chemicals from other organisms may effect results **or** only measuring one organism **;** 3. *Steady slow stirring:* ensures (named) nutrient /oxygen / heat/ waste / (bacterial) cells evenly distributed (so growth rate same) **;**	**A** *idea that:* pH may denature enzymes / kill cells *ignore* impurities / foreign bodies **A** 'stop bacteria clumping ' *ignore* damage to bacteria	[3]	E
(c)	*3 of*: 1. ref. to diluting the sample **;** 2. ref. to a uniform sample **;** 3. ref. counting cells **;** 4. ref. to any systematic counting process **;** *2 of:* 5. ref. to grid volume 0.2 mm × 0.2 mm × 0.1 mm / 0.004 mm^3 / 4×10^{-3} mm^3 **;** 6. ref. to dividing the number of cells by the grid volume **;** 7. × 1000 (and dilution factor) **or** multiply number of cells by 250 000 **or** by $\frac{1}{0.0004}$	**A** *any point using the number of cells in the Fig 2.1 (10, 16, 17 not 22)* 2. e.g. shaking / stirring (before being counted) 4. e.g. exclusions e.g. omit top and LHS on lines / only squares at corners and middle of grid 5. **A** 4×10^{-6} cm^3 *ignore* other grid volumes **A ecf** for other grid volumes e.g. 0.05 × 0.05 × 0.1 **A** 6 and 7 from a general formula e.g. $\frac{\text{number of cell}}{0.004} \times 1000$ **or** $\frac{\text{number of cells}}{4 \times 10^{-6}}$	[3] [2]	M D
(d)	no indication of replicates / only one set of data **;**	*ignore ref. to:* no means / standard deviation / statistical tests	[1]	E

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Question	Expected answer	Extra guidance	Mark	AO
(e)	3 of : 1. statement of time when oxygen / air was introduced **;** 2. using (mainly) anaerobic (respiration) up to 220 min / after 220 min (mainly) aerobic (respiration) **;** 3. <u>little</u> energy release / ATP from anaerobic respiration so slow increase in population (of bacteria) **;** **or** <u>large</u> energy release /ATP from aerobic respiration so fast increase in population (of bacteria) **;** 4. (population growth rate) slows down with time as nutrient runs out / waste builds up **;**	1. e.g. between 220 and 250 min, or a stated value between these two times 3. if refer to growth, must be related to the population of bacteria **not** the bacteria cell **R** if energy is produced	[3]	C
		Total:	[13]	

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(ii)	8 of: *independent variable* 1. *ref. to* method of diluting the ($3\,mmol\,dm^{-3}$) GA to give a minimum of (any) 5 dilutions **;** 2. *ref. to* concentrations (other than 0) that fall in the range $3\,mmol\,dm^{-3}$ to any value above zero with units **;** 3. *ref. to* soaking grains in GA solutions for, min 24 hours / max 72 hours **;** 4. *ref. to* a **control** using (distilled / deionised) water **;** 5. *ref. to* stated incubation temperature **;**	***A** seed / fruit / maize for any mark point in **(a)*** *ignore any ref. to time between soaking and putting maize onto agar plate* 1. **A** series / serial / proportional / simple, dilution as method **or** description of method 2. minimum is 2 values that are not higher than $3\,mmol\,dm^{-3}$ and are above zero $1\,mmol\,dm^{-3} = 1000\,\mu mol\,dm^{-3}$ $1\,\mu mol\,dm^{-3} = 0.001\,mmol\,dm^{-3}$ 3. *ignore* if the range of GA is incorporated into agar plates If pre-soaked in water for 24h and then in GA, must be **minimum** of 1 hour GA 4. **A** description – 'to allow comparison' / AW 5. e.g. any one temp in the range 15–35°C. **A** room temperature. **R** body temperature / 37°C		

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	dependent variable 6. *ref. to* a suitable method of measuring the starch free area around the grains **;**	6. e.g. trace outline onto a grid / transparent grid / photograph and put on grid / cut out clear zone and put on grid, **and** count squares. **OR** use suitable apparatus to measure, diameter / radius, directly **or** from a grid **and** calculate area using πr^2 *ignore* metre ruler. **A** e.g. ruler / callipers / micrometer / eyepiece graticule		
	standardising variables **(max 4)**: 7. *ref. to* using, same / stated number of, grains / halves, for each concentration **;**	7. **A** 'one / a' as same number *ignore* 'same size of grains / same amount of grains. **A** quantity for number		
	8. *ref. to*, stated / same, volume of each soaking solution / GA **;**	8. **A** *idea* of: all, submerged / covered		
	9. *ref. to* method of keeping same incubation temperature **;**	9. e.g. water bath / incubator / temperature controlled room / thermostatically controlled environment / environmental chamber / propagator / thermostat *ignore* air conditioning		
	10. *ref. to* one stated time for incubation (of enzyme) **;**	10. **A** any value in the range 24–72 hours. Actual value must be stated **A** left on, plate / agar as AW for incubate		
	11. *ref. to*, same / stated, concentration of starch in agar **;**	11. **A** 'known' time		
	12. *ref. to* same, volume / depth, of agar (in the Petri dishes) **;**			
	13. covering to prevent, evaporation / contamination **;**			

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	safety: 14. *ref. to*, low risk investigation / any suitable safety precaution **;** *reliability*: 15. *ref. to* replicates, **and** mean / to identify or eliminate anomalies **;**	14. e.g. cutting away from hands / using tile for cutting. *ignore* gloves for cutting. ref. to allergy / irritation, and, gloves / mask / eye protection **R** no risk 15. must be a minimum of 3 (data sets), allow as, original and 2 more / several **A** outliers for anomalies **A** average for mean	[8]	M
(b)	*x-axis*: concentration of GA **and** mmol dm^{-3} **or** μmol dm^{-3} **;** *y-axis*: (mean) area of, clear zone / starch digested **and** mm^2 **;**	**A** mmol **or** μmol, per dm^3 **or** mmol / dm^3 **or** μmol / dm^3 **A** (mean) diameter of clear zone / mm **A** cm^2 / cm **A** activity of amylase **and** arbitrary units / au labels correct – no / incorrect, unit(s) = 1 max axes reversed, correct for labels **and** units = 1 max	[2]	D
(c) (i)	3 of: 1. *idea of* areas irregular in shape **;** 2. *idea of* edges of areas difficult to see **;** 3. not sure how much GA embryo is also producing **;** 4. may be other, enzymes / chemicals, that hydrolyse the starch **;**	*ignore ref. to replicates / repeats* 1. **A** in terms of different diameters **A** in general terms like 'difficult to tell actual size' 2. **A** in terms of edges overlapping or edges blurred / brown merging into blue / AW 3. **A** grain / fruit / seed for embryo		

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Question	Expected answer	Extra guidance	Mark	AO
	5. *idea of:* no way of quantifying amylase (leaving grain) **;** 6. amylase / enzyme, may come from contamination **;** 7. *idea of:* no method of quantifying the starch disappearance **;** 8. pH may vary / AW **;**	5. **A** in terms of, not diffusing out / used inside / ref. to different surface area of (cut) grain / size of grain only in context of amylase not leaving grain or having different amounts of amylase 6. **A** coming from fungi / bacteria / coat of grain 7. *idea of*: do not know of the number of molecules of starch broken down. Look in context of the test being qualitative rather than quantitative. NOT rate ideas	[3]	E
(ii)	*method:* any 1 × 2 of: 1. stated better method of measuring, (area / diameter) **;** some brief detail of stated method **;** 2. *if overlap:* separate plates / fewer grains per plate / larger plates **;** able to distinguish edges more clearly / AW **;** *if 'blur':* really cannot be improved = 2 marks **;;** **or** do large sample **;** minimises, effect / error / AW **;** 3. *idea of:* separating the embryo from the grains (after soaking) **;** *idea of:* measure area, without embryo present / with embryo on its own **;** 4. *idea of:* extracting the amylase (from grain) **;** *idea of:* repeat with just the extract and compare **;**	1. e.g. use graticule on low power of microscope = 2 marks		

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Question	Expected answer	Extra guidance	Mark	AO
	5. *if in term of how much out / used up*: *idea of:* extracting the amylase (from grain) **;** *idea of:* repeat with just the extract and compare ; *if in terms of different surface areas:* *idea of:* measuring (surface) area **;** *idea of:* either finding similar area or calculating per unit area **;** 6. *idea of:* sterilising / disinfecting (grain / agar / dish /AW) **;** detail of possible method **;** 7. *idea of:* putting known concentrations of amylase on starch agar **;** producing a calibration curve from areas measured **;** 8. use a buffer **;** to make up the agar (plates) **;**	5. **A** remove endosperm repeat using embryo / AW 6. detail e.g. (named) disinfectant **or** sterile technique to, make plates / make up agar / handle grains **or** keep plate covered.	[2]	M
		Total:	**[17]**	

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Question	Expected answer	Extra guidance	Mark	AO
2 (a)	3 of: 1. anaerobic bacteria increase with depth **and** aerobic bacteria decrease with depth ; 2. below 1.5–2.0 m aerobic stay approximately the same **and** anaerobic continues to increase(slowly) **;** 3. *idea of:* oxygen content of soil decreases with depth **;** 4. *idea that:* anaerobic bacteria replace the aerobic bacteria as oxygen reduces / (most) aerobic unable to survive in low oxygen **;**	1. A general point – but must relate to idea of depth 3. **A** oxygen content decreases with time 4. **A** replacement in terms of succession / competition	[3]	C
(b) (i)	less activity of, dehydrogenase / enzyme **;**	**A** less <u>aerobic</u> respiration **R** less dehydrogenase	[1]	E
(ii)	2 of: 1. temperature **;** 2. pH **;** 3. *idea of:* time that determination was run for **;** 4. (soil) moisture / water **;** 5. substrate (in soil) **;**	*ignore* ref. to oxygen 5. **A** (named) nutrients (in soil)	[2]	P
(iii)	*idea of*: (soil) without, (active) bacteria / active enzyme **;**	**A** heated / boiled / disinfected / sterilised / irradiated / AW, soil **A** (soil) with, dead / killed bacteria / denatured enzyme / enzyme removed **A** ref. to add an enzyme inhibitor **A** remove the bacteria from soil **R** killed enzyme / replace with (named) inert material	[1]	P

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Question	Expected answer	Extra guidance	Mark	AO
(c) (i)	*ref. to* wide / long / big / AW, error bars, that indicate results are, less / not, reliable **;** *ref. to* data **;**	**A** reverse argument **A** suitable AW for wide e.g. 6 years least reliable **or** 6 months / 3 years most reliable **or** more reliable in **B** than **A** at 6 years	[2]	D
(ii)	6 months and 3 year , 6 months and 6 years **both** underlined / ringed **;** error bars do not overlap **;**	**A** error bars do not cross / AW	[2]	D
(d)	*idea of*: graph of, dehydrogenase / enzyme, activity, against number of bacteria per gram (plotted) **;** *idea of:* dehydrogenase / enzyme, activity located on graph and number of bacteria read from scale **;**	*ignore* orientation of graph. **A** if shown on a graph for 2 marks **A** *idea of:* comparing data against table to look for 'closest approximation' = 1 mark max *ignore* compare unqualified	[2]	D
		Total:	**[13]**	

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