CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 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 scheme abbreviations:

;	separates marking points
/	alternatives answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or extra guidance)
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
ora	or reverse argument
ecf	error carried forward
I	ignore
mp	marking point (with relevant number)

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*idea that oxygen uptake or respiration is different or the same* 1 of: respiration (rates) / oxygen uptake of the organisms will be different from **or** same as each other ; one organism / named organism will be faster **or** the same as any other (named); **ora**	allow any testable hypothesis but it must be in the context of all three organisms. e.g. the rate depends on the organism used / all the organisms have the same rate e.g. the insect larvae will have the fastest respiration	[max 1]
(ii)	*independent* : (different / named) organisms ; *dependent* : distance moved by the water / air (along capillary in a specific time);	**A** list of all names **A** distance moved **I** uptake of oxygen per unit time / rate of respiration / volume	[2]

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Questions	Expected answers	Extra guidance	Mark
(iii)	8 of: *independent variable:* 1. ref. to using, same mass of (each) organism / all named ; 2. ref. to keeping container with the organisms in the dark ; *dependent variables:* 3. (using the scale) to find the distance moved **or** take readings at start and end ; 4. ref. to (measure distance) at specific / known **time** interval ; 5. ref. to a method of holding the algae / organisms ; *Controlled variables (max* 3) 6. ref. to ensuring apparatus is airtight ; 7. ref. to keeping (appropriate) constant temperature (in the water bath) ; 8. *idea of* equilibration / acclimatisation of respirometer (containing organisms before measuring) ; 9. *idea of* replacing air / oxygen between measurements ; 10. ref. to a control with inert material (of the same mass) ;	1. **I** amount / number **A** known / fixed / similar / stated mass 2. **A** if only kept the algae in the dark 3. looking for use of the scale **A** using a ruler **R** metre ruler **I** volume 4. **A** any specified time mp3 and mp4 can be stated as same distance and measure time **or** same time and measure distance 5. e.g. inside a small container **A** on a diagram 6. **A** description of a method to make airtight **I** watertight 7. **I** method of maintaining temperature . **A** temperatures in the range 15–45 °C 8. **I** any stated times *looking for* acclimatisation AW e.g. leave for a time before starting experiment 10. e.g. glass beads / dead organisms **A** description of a control e.g. tube with beads for comparison	

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Questions	Expected answers	Extra guidance	Mark
	11. ref. to using same mass of absorbent / replacing each time the respirometer is re-used ; *safety*: 12. ref. to suitable hazard and precaution ; *reliability* 13. ref. to replicate / repeat (experiment) and mean / to identify or eliminate anomalies ;	11. **A** *idea of* 'enough' absorbent to ensure all CO_2 absorbed. **A** volume / amount / quantity of absorbent 12. ref. to broken glass <u>tube</u> cuts hand and hold bung while attaching to container **or** ref. to carbon dioxide absorbent as corrosive / caustic / harmful / irritant and gloves / eye protection. **or** ref. to allergic risk to any organism / absorbent and gloves / mask **R**. ref. to hot water **I** low risk 13. must be a minimum total of 3. **A** as original and 2 more **or** several / many **A** for single organism **A** outliers for anomalies **R** mean of readings along the capillary at timed intervals i.e. mean of distances measured 1–2 min, 2–3 min, 3–4 min	[max 8]

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Questions	Expected answers	Extra guidance	MarkII
(b)	*allow answers that describe the main stages of the calculation in words or as a formula* *elements of this calculation may be shown separately* 3 of: 1. ref. to valid <u>method</u> calculating volume of oxygen ; 2. ref. to <u>dividing</u> (volume of oxygen) by the mass ; 3. ref. to <u>dividing</u> (volume of oxygen) by time ; 4. ref. to correct units either <u>$cm^3 g^{-1}$ s^{-1}</u> or <u>$cm^3 g^{-1}$ min^{-1}</u> ; OR <u>volume of oxygen</u> (cm^3) (= y) time (s) x mass (g) ; ; (y)= <u>$cm^3 s^{-1} g^{-1}$</u> ;	**A** any valid method: e.g. distance (d) / length (l) / height (h) × πr^2 / $\pi (D \div 2)^2$ / $\pi D^2 \div 4$, pre-calibrated tube **A** min as time unit if volume is not calculated, but the oxygen is shown or described as distance moved in the tube or oxygen uptake, allow mp2 and / or mp3 e.g. divide the distance by mass and / or time **A** rate of oxygen uptake divided by mass for mp2 value of y – ignore actual value if an example is used **A** cm^3 / g / s	[max 3]
(c)	1. remove the carbon dioxide absorbent / weigh the absorbent at start and end of the experiment; 1 of: 2. difference in the measurement (between distance moved or mass) gives the carbon dioxide ; **or** 3. divide the difference in distance / volume by time ;	carbon dioxide absorbent must either be removed or weighed. **A** measure the volume	[max 2]

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Question	Expected answers	Extra guidance	Mark
(d) (i)	insect larvae = 0.8(0) and green algae = 0.97 / 1.00 ;	**A** 0.98 ÷ 1.23 **R** 0.79 **A** 0.34 ÷ 0.35	[1]
(ii)	3 of : 1. *algae* RQ suggests mainly CHO / named being metabolised ; 2. *insect larvae* RQ suggests mainly protein / amino acids being metabolised ; 3. *seeds* RQ suggests mainly fat / fatty acid / lipid / oil being metabolised ; 4. fat uses proportionally more oxygen than CHO for respiration ;	1. if value is stated should be RQ1 2. if value is stated should be around RQ8–9 **A** a mixture of lipid and protein 3. if value is stated should be around RQ7	[max 3]
			[Total: 20]

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Question	Expected answers	Extra guidance	Mark
2 (a)	*ignore all references to data quotes* 3 of: 1. there is more auxin on shaded side / side A of test 3 ; 2. (auxin) redistributes because the total 3A and 3B is approx. same as in 4 where redistribution prevented ; 3. there is no difference in the total auxin in light and dark ; 4. (so) auxin not broken down by light ; 5 the total auxin in all tests is approximately the same ;	3. **A** ref. to treatment 2 and total auxin of any other treatment being the same 5. **A** any comparison between treatment 3 and all the other treatments	[max 3]
(b) (i)	ref. to (standard deviation) shows (all) these data / results (in the table) are reliable; ref. to data / results (in the table) describing degree of reliability; **or** because the standard deviations (in the table) are all less than 1;	**I** definition of standard deviation / standard error (S_M) e.g. treatments 2 and / or 4 most reliable as values are the smallest / treatment 1 is the least reliable as the value is the largest	[max 2]
(ii)	increase the total number of shoot tips used (in each group) ; **or** replicate / repeat the investigation / experiment several times minimum of 2 more ;		[1]

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Question	Expected answers	Extra guidance	Mark
(c)	diagram of shoot with <u>flat</u> top bending to right (of page) ; marks on the left (outside) of the curve only are further apart than those on the inside of the curve ;	**R** if no top is drawn **R** if curves at both ends **I** agar block **R** if 2 diagrams drawn which are inconsistent there needs to be a clear difference in spacing on the two sides of the curve and should not be a difference anywhere else **A** if curves wrong way	[2]
(d) (i)	there is no <u>significant</u> difference in the movement (of auxin) in light compared to that in the dark ;	the difference in the movement (in auxin) in light and in the dark is <u>not significant</u> **R** insignificant	[1]
(ii)	38 ;		[1]
			[Total: 10]

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(ii)	*independent* : (different / named) organisms ; *dependent* : distance moved by the water / air (along capillary in a specific time);	**A** list of all names **A** distance moved **I** uptake of oxygen per unit time / rate of respiration / volume	[2]

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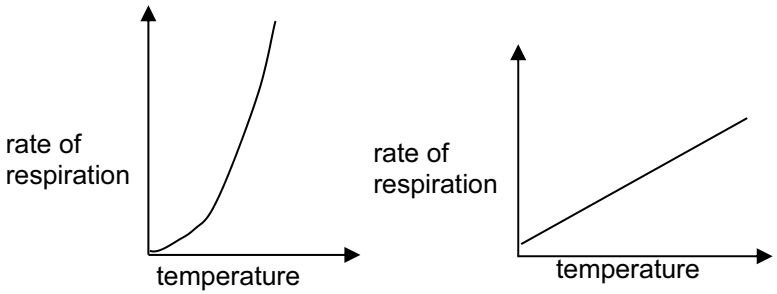
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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*independent:* temperature ; *dependent:* distance moved by, dye / air (along capillary / AW, in a specific time);	**I** volume of oxygen taken in / rate of respiration **A** distance moved / movement of, dye / air	[2]
(ii)	axes correct orientation and labelled ; line, exponential / increases with temperature; 	units not required **A** for *y*-axis, volume of oxygen / amount of oxygen / oxygen uptake / distance moved / distance along capillary / movement of dye or air line does not need to start at origin if axes not labelled assume they are correct way round and award plot mark if possible if axes inverted, look for appropriate curve	[2]

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Question	Expected answer	Extra guidance	Mark
(iii)	*8 of:* *independent variable:* 1. use, same mass / known (stated) mass, of (germinating) <u>seeds</u> ;	1. **I** amount. **A** stated number of seeds but ignore 1 seed **R** organisms / named organisms other than seeds	
	2. ref. to suitable number and range of temperatures ;	2. minimum of 4 temperatures giving minimum of three 10°C rises	
	dependent variable : 3. ref. to method of measuring distance moved ;	3. e.g. use a ruler or grid on tube / mark start and end and use a ruler / use a graduated tube / callipers **R** metre rule if first on list	
	4. ref. to measurements of distance at, specific / known / stated, time intervals ;	mp3 and mp4 can be stated as same distance and measure time or same time and measure distance either time or distance must be fixed **A** any specified time	
	5. ref. to some idea of a method of placing dye into capillary **or** ref. to use of syringe to, set / reset, dye ; *controlled variables (max 3)*	5. **A** pull dye into capillary / dye sucked in / idea of dropping pipette to insert dye / tube dipped into dye	
	6. ref. to ensuring apparatus is airtight / method described ;	6. **I** watertight **A** vaseline / plasticine / tight connections / AW, as method	

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Question	Expected answer	Extra guidance	Mark
	7. ref. to method of keeping constant temperature ;	7 e.g. in water bath / incubator / temp controlled room **I** air conditioning **R** ref. to thermometers if used to control temperature **A** thermostatically controlled device	
	8. *idea of:* equilibration / acclimatisation / AW, of respirometer containing seeds before measuring ;	8. **I** stated times - looking for acclimatisation / AW **A** 'to get a steady rate'	
	9. *idea of:* replacing, air / oxygen, between measurements ;	9. **A** refresh air at intervals	
	10. ref. to control / comparison, with inert material (of same mass) ;	10. e.g. glass beads / boiled seeds / stones / AW	
	11. ref. to using, same / stated, mass of absorbent **or** replacing, each time / from time to time / when saturated / AW ;	11. **A** *idea of* enough absorbent to ensure all carbon dioxide absorbed / excess absorbent. **I** amount / volume **A** same number of pellets	

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Question	Expected answer	Extra guidance	Mark
	safety: 12. ref. to suitable hazard and precaution ;	12. **A** carbon dioxide absorbent being, corrosive / an irritant / harmful / toxic / poisonous / AW, **and** gloves / eye protection / AW **A** ref. to allergic risk from seeds or absorbent **and** precaution (gloves / mask / AW) **A** 70 °C or above water and suitable handling like tongs **A** low risk **R** no risk	
	reliability: 13. ref. to replicates, and mean / to identify or eliminate anomalies ;	13. must be a minimum of 3 **A** as original and 2 more / several **A** repeats **A** average for mean **A** outliers for anomalies **I** mean of readings along the capillary at timed intervals i.e. mean of distances measured 1–2 min, 2–3 min, 3–4 min	[max 8]

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Question	Expected answer	Extra guidance	Mark
(b)	*allow answers that describe the main stages of the calculation in words or as a formula* *look for the elements of the calculation which may be shown separately* *3 of:* 1. ref. to valid method calculating volume of oxygen ; 2. ref. to dividing by the mass ; 3. ref. to dividing by time ; 4. ref. to correct units either $\underline{cm^3\,g^{-1}}\ \underline{s^{-1}}$ or $\underline{cm^3\,g^{-1}}\ \underline{min^{-1}}$; **or** ref. to valid method calculating volume of oxygen ; $\frac{\text{total volume of oxygen } (cm^3)}{\text{total time (s) x mass (g)}}$ (= y) ; ; (y)= $\underline{cm^3\,s^{-1}\,g^{-1}}$ or $\underline{cm^3\,g^{-1}}\ \underline{min^{-1}}$;	1. **A** any valid method, e.g. distance (d) / length (l) / height (h) × $\pi\, r^2$ / $\pi\,(D \div 2)^2$ / $D^2 \div 4$, pre- calibrated tube. d / l / h do not need to be explained. **I** surface area × d / l / h 4. **A** cm^3 / g / s **or** cm^3 / g / min **I** actual value of y if an example is used **A** cm^3 / g / s **or** cm^3 / g / min **or** per in words	[max 3]

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Question	Expected answer	Extra guidance	Mark
(c)	*2 of:* 1. idea of finding <u>range</u> at which the, oxygen uptake / dye movement / respiration rate, was greatest ; 2. ref. to repeating the measurements (in this range) at smaller temperature intervals ; 3. one with max, oxygen uptake / dye movement / respiration rate = optimum temperature ;	2. **A** do smaller intervals across whole range 3. **A** in context of plotting a graph to find optimum **A** general ref. to do at various temps and find one with highest value	[max 2]
(d) (i)	*idea that:* (most / all, of) the results are, higher / larger (than those measured at the same temperature in the other trials) ;	**A** results, furthest from / large distance from / AW, means **A** some results are significantly higher **R** does not follow the trend of others / trend different but **A** same trend but higher **I** just quoting one or two temps are out, e.g 20 **I** ref. to standard deviation	[1]
(ii)	*1 of:* *idea that* mammal, moving around / more energetic / not at rest / has higher metabolic rate ; mammal, under stress / frightened / shocked / nervous / AW ; *idea of* have not given enough time for the mammal to adapt to the apparatus ;	**I** ref. to faulty, apparatus / technique **A** different, gender / size / species / type, of mammal, (in, each trial / first trial) **A** idea of food intake before (first) trial **I** contaminated with microorganisms **A** mammal not, acclimatised / accustomed / used / AW, to conditions	[max 1]

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Question	Expected answer	Extra guidance	Mark
(iii)	*2 of :* 1. higher oxygen uptake means, higher rate of / more, respiration ; ora 2. (at, lower temperatures / this temperature,) mammal is losing more heat (to the environment) / AW ; 3. ref. to (at lower temperatures) mammal is respiring more / using more oxygen, to, release more heat / maintain (body) temperature / keep (body) temperature constant ;	**A** metabolism / ATP production, as alternative terms for respiration **A** thermal energy for heat **I** energy unqualified 1. look for a link between the higher uptake and higher rate. not just 'needs more oxygen to respire' 2. **A** faster temperature drop / looses heat more easily / AW 3. **Ignore** ref. to keeping warm	[max 2]
			[Total: 21]

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Question	Expected answer	Extra guidance	Mark
2 (a) (i)	*1 of:* temperature ; light <u>intensity</u> ; concentration of (radioactive) auxin ; composition / type, of the agar ;	mark first in list but **I** amount throughout **I** light unqualified **A** mass / weight **R** volume **A** same agar / same concentration of agar	[max 1]
(ii)	*1 of:* oxygen / air, is required for the movement of auxin ; energy / ATP / respiration, is required for the movement of auxin ; movement of auxin involves active transport ;	**A** in terms of 'most movement' **A** *idea that* movement is, greater / faster / better / more / AW, in, air / oxygen (than in nitrogen) ora but must mention air / oxygen **I** 'air is an opt medium for movement' **I** 'rate of movement is affected by surrounding air / atmosphere' **I** ref. to N being inhibitory / AW	[max 1]
(iii)	50 (mm h^{-1}) ;	**R** if units wrong **A** mm/h **or** mm per hour	[1]

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Question	Expected answer	Extra guidance	Mark
(b) (i)	mean in dark is lower / mean rate in dark is slower ; ora no overlap in terms of using the values for ***s*** / confidence intervals ;	**A** idea that lower rates overall for plants grown in the dark ora **A** raw figures **I** ref. to standard deviation being lower **I** ref. to error bars	[2]
(ii)	*idea of:* there is no <u>significant</u> difference in the rate of movement (of auxin) for, plants grown in light and (plants grown) in dark / the 2 treatments;	**A** the difference in the rate of movement (of auxin) for plants grown in light and plants grown in dark is not significant **I** differences in movement in light and dark are due to chance.	[1]
(iii)	*3 of:* 1. general idea of, finding / using, degrees of freedom 2. ref. to using 0.05 / 5% <u>probability</u> to find critical value / AW (for *t*) ; 3. idea of: compare the (calculated) *t* –value with the critical value / AW ; 4. if value of *t* is higher than critical value it is significant / not due to chance) / reject null hypothesis / accept alternative hypothesis ; ora	1. **A** using 18 degrees of freedom ; **I** any wrong number calculated and award mark if degrees of freedom cited **I** any formula e.g. (10 –1) +(10–1) 2. **A** 0.01 / 1% probability **A** significance levels for probability 3. **A** see if value of *t* is, higher / lower, than critical value **A** if refer to 'the right or left of the critical value' or 'above or below'. **A** for mp2 and mp3 alternatives to critical value, e.g.'table value / chart value / the value looked up' 4. **I** ref. to 'insignificant' / 'more significant' / 'less significant'	[3]
			[Total: 9]

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