UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9700 BIOLOGY

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

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- **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)	oxygen / gas / air, produced (by photosynthesis);	Do not allow: use / production of carbon dioxide / respiration / bubbles Allow: losing / releasing oxygen, etc.	[1]	M
(ii)	7 of: *independent variable* 1. a method of varying light intensity **or** use low light intensity; 2. ref. to a method of measuring light intensity; 3. ref. to a method of eliminating other light sources; 4. ref. to testing leaf discs for the two locations separately; *dependent variable* 5. ref. to a method of measuring photosynthesis by rising of discs; 6. ref to time taken; *standardising variables (max 3)* 7. ref. to discs from more than one leaf (from each location); 8. ref. leaf discs all being same diameter / size / number / mass. 9. ref. to same volume of hydrogen carbonate solution (in syringe); 10. ref. to using fresh hydrogen carbonate solution for each measurement / same concentration of H carbonate;	1. e.g. lamp (with standard bulb) and vary distance / lamp at same distance and vary wattage / lamp at same distance and use filters of different thickness / AW 2. e.g. (light) meter / photodiode / light dependent resistor / photometer / low wattage / 60 or below Allow ref. to using a camera meter 3. e.g. dark room or box for measurement 4. often implied 5. Do not allow: counting bubbles / leaves rising 6. e.g. time for (all or a specified number of) discs to rise / specified time and count the number of discs floating / distance risen in stated time Allow: ecf time for bubble counting 8. Allow: use same straw for cutting 9/10 Watch for confusion with hydrogen carbonate indicator – but ecf		

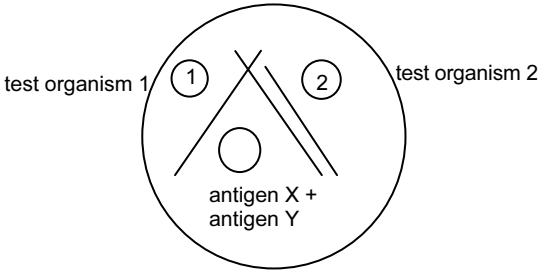
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	11. ref. to method of standardising temperature; 12. ref. to acclimatising before measuring; *Reliability* 13. ref. to repeating at least three times and taking mean; *safety:* 14. ref. to low risk investigation / AW **or** any suitable safety concern + precaution;	11. water bath / incubator / controlled room Do not allow: room temp Do not allow: pH for standardising variables 13. Allow: several or many Allow: to remove anomalies / outliers 14. e.g. hydrogen carbonate + gloves / eye protection dry hands to prevent electrical shock / AW Do not allow: be careful unqualified Do not allow: care with cutting	[7]	M
(b) (i)	*x* – light intensity *y* – rate of photosynthesis; suitable unit on one axis; Ignore other units	*light* – e.g. arbitrary / lux / lumens / candela / $1/d^2$ allow, watts / kilowatts / voltage *photosynthesis*. e.g. 1/time / arbitrary Allow: ecf for unit mark if axes wrong	[2]	D
(ii)	(rate of) photosynthesis / gas production / oxygen production for shade leaf (discs) is higher (than exposed discs) at low intensity / ref. figures; photosynthesis / gas production / oxygen production begins at lower light intensity in shade leaf discs; Allow: at high(er) light intensity shade leaves level off / AW, whilst sun leaves continue to rise / AW;	Allow: reverse arguments for sun leaves at low intensity Ignore: 'initial' if the answer is about rate Do not allow: answers that imply time e.g. starts sooner / before …. Ignore: idea that photosynthesis stops at higher light intensities assume that 'it' or 'they' is the shade leaves if not stated in the answer	[2]	E

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(c) (i)	$\underline{0.2mm^2;}$	must have units.	[1]	D
(ii)	185;; two marks if some working shown look for working if answer wrong if 0.196..... used ecf and take 188 or 189 – whole nos. only if other values in **(c) (i)** ecf by checking the calculation	$\frac{37}{0.2}$ = 185 1/0.2 = 5 5 × 37 = 185 If calculation correct but answer not transferred to table allow both marks	[2]	D
(iii)	there is no difference in the, number / frequency, of stomata in, exposed / sun, leaves and, shaded / shade, leaves;	Allow: any variation on the basic idea e.g. the (observed) means / number, are the same there is no difference (between the two leaf types) Do not allow: the experimental hypothesis	[1]	D
(iv)	t-test; comparing two means / means have a similar standard deviation / data has a normal distribution / is continuous / is not discrete;	Do not allow: 2 sets of data are being compared ecf if the test name is incorrect Allow: a correct reason for the t-test.	[2]	D
(d)	1 of: sun leaves have (fewer stomata) as more likely to lose water / transpire; ora shade leaves have (more stomata) to increase gas / CO_2 diffusion / AW;	Do not allow: to increase photosynthesis unqualified Do not allow: – stomata related to light absorption Watch out for statements that there are more stomata in sun leaves without any qualification. Assume comment applies to shade leaves if not stated. Do not allow: oxygen is given out	[1]	C
		Total:	**[19]**	

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2 (a) (i)	1 of: ref. to thickness / volume / consistency / concentration of, agar / depth of wells / volume of wells / distance of antigen wells from test organism wells; ref to temperature; ref. to volume serum / antigen volume;	Do not allow: amount for any quantitative answer Do not allow: pH	[1]	P
(ii)	the serum / antibody / antibodies (from the test organisms);	Do not allow: if antigen also mentioned Allow: organism from which serum / antibody came Ignore amount / volume etc.	[1]	P
(iii)	2 lines / 1 thick line, between 2 and antigens; 1 line between 1 and antigens;	 Allow: 2 marks if lines do not intersect If the lines are reversed / spread outside dish max. 1 Do not allow: if the lines are inverted / lines cross wells	[2]	C
(b)	2 of: 1. ref. to all antibodies not forming precipitates / AW; 2. ref. to sensitivity / AW; 3. ref. to more qualitative / difficult to quantify; 4. ref. to, slow rate / inability to diffuse of some antibodies; 5. ref to problem of identifying individual antigens / AW;	2. the idea test will not detect low concentrations 4. Allow: – if 'slow' is in the context of getting results of tests	[2]	E

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(c) (i)	*group 1* ref. to the idea of a control; *group 2 and 3* ref. to idea of finding how many organisms, give immunity / needed; *group 4* ref. to idea of finding the number of, inoculations / boosters, needed;	Be careful they are not conclusions e.g. how many are needed (to make the vaccine work) e.g. to see if another booster is needed	[3]	P
(ii)	2 of: ref. to (information that mutant) *Plasmodium* breeds / develops / AW in mosquitoes; ref. to breeding mosquitoes / culturing in salivary gland tissue / AW; ref. to extracting (*Plasmodium)* from salivary glands / culture of salivary glands;	 Allow: idea of a culture medium similar to salivary gland / saliva Ignore: from the liver of mice	[2]	M
		Total:	**[11]**	

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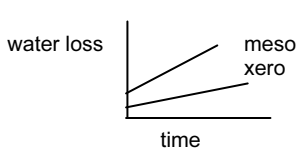
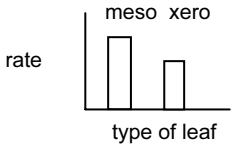
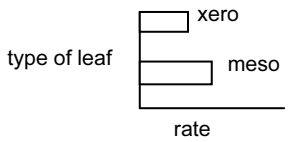
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Question	Expected answer	Extra guidance	Mark	AO
1 (a) (i)	a mesophytic plant loses more water than a xerophytic plant;	Allow: any variation on the basic idea, but it must include a plant and water loss. Do not allow: loss in xerophyte greater than mesophyte Ignore: any ref. to external conditions / water uptake	[1]	P
(ii)	8 of: *independent variable:* 1. ref. to shoots / leaves of different types of plant / xerophyte and mesophyte / type of plant used; 2. ref. to similar surface area; *dependent variable* 3. ref. to measuring / recording the movement (of water) along the capillary; 4. ref. to time (of water movement) / description of measuring time; *control variables (max 3)* 5. ref. to same (environmental) conditions; 6. ref. to inserting / cutting shoot under water / cutting shoot at an angle; 7. ref. to drying leaves before measuring; 8. ref. to airtight seal (around shoot) / airtight apparatus / no air locks; *procedure* 9. ref. to using syringe to set (water level) in capillary; 10. ref. to leaving until steady rate / equilibrate; *reliability* 11. ref. to repeats / replicates – min 3 and mean value; *safety:* 12. ref. to a low risk experiment;	1. Allow: named examples of xerophyte / mesophyte 2. Ignore: mass Allow: same / similar number of leaves 3. Do not allow: upwards movement Ignore: dye 4. Do not allow: if an inappropriate time is specified e.g. seconds 5. Allow: for any example, light / humidity / temperature 8. Ignore: watertight 9. Ignore: ref. to indicator 11. Allow: to remove anomalies 12. Allow: example of appropriate safety e.g. care in cutting shoots / pushing capillary through a bung	[8]	M

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Question	Expected answer	Extra guidance	Mark	AO
(iii)	ref. to finding surface area of the capillary; ref. to multiplying (surface area (πr^2)) by distance moved; OR use syringe to push water back to original position; measure volume from the syringe: OR idea that the capillary is pre-calibrated; (and) find the volume from the distance moved / read from scale;	Allow: both marks if formula for volume of cylinder is shown – any of these is acceptable πr^2 l / d / h $\pi \frac{d^2}{4}$ l / d / h; $\pi \left(\frac{d^2}{2} \right)$ l / d / h;	[2]	D
(b)	2 of: axes correct orientation and labelled appropriately for type of graph; mesophyte shown as having higher water loss / rate of water loss;   Allow: marks on a horizontal bar chart 	*Line Graphs and Bar Charts:* *y* axis – rate / water loss / distance moved (by water or meniscus) / rate of transpiration *Line Graph* *x* axis – time Allow: lines that start at 0 *Bar Charts* *x* axis – type of leaf *If the x axis is incorrect but y axis is related to water movement* Allow: mark for the difference in water loss *If axes reversed on a line graph*, Allow: the mark for the lines if shown correctly Allow: marks on two graphs units are not required	[2]	P

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Question	Expected answer	Extra guidance	Mark	AO

(c) (i)	area = $\frac{36}{10\,000 / 10^4}$ / 0.0036 / 3.6×10^{-3} / 36×10^{-4} (m^2);
	
	water loss = $\frac{0.018}{30}$ / 0.0006 / 6×10^{-4} ($cm^3\ min^{-1}$);
	rate = $\frac{0.0006 / 6 \times 10^{-4}}{0.0036 / 3.6 \times 10^{-3}}$ $\frac{cm^3\ min^{-1}}{36 \times 10^{-4}\ (m^2)}$ = 0.167 $cm^3\ m^{-2}\ min^{-1}$;
		Watch for area being halved or doubled 72 or 18
		Allow: ecf for the calculation
		Look for the correct figures in the answer. This may be in a combined formula.
		Allow: 0.17 / 0.$\dot{1}$6 $cm^3\ m^{-2}\ min^{-1}$
		Allow: any other valid method of calculating rate
		Do not allow: fractions
			[3]	D

(ii)	t- test; the data has a normal distribution / continuous / not discrete / comparing two means / averages;	Allow: correct reason for t-test even if the name is incorrect Do not allow: to compare 2 sets of data	[2]	D
(d)	3 of: 1. mesophyte has greater mass loss / water loss / transpiration (than a xerophyte); 2. less mass / less water is lost / less transpiration over time by (both) leaves / lower side of leaves / upper side of leaves covered; 3. both leaves / xerophyte / mesophyte lose more mass / more water / transpire more from the lower side of the leaf / when the upper surface is covered; 4. xerophyte loses almost no water from the upper side / loses most of its water from the lower side of the leaf;	Allow: reverse arguments for points 1–4 Allow: use of figures for points 1–4 1. Allow: if refer to upper and lower surface of leaves Allow: 5. there are more stomata on the lower surface (of both leaves); 6. xerophyte has fewer stomata on lower side than the mesophyte / mesophyte has more stomata on lower side than a xerophyte; 7. mesophyte has stomata on both sides of the leaf; 8. xerophyte may not have any stomata on upper side; 9. xerophyte has thicker cuticle than mesophyte; Do not allow: guard cells	[3]	C
		Total:	**[21]**	

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Question	Expected answer	Extra guidance	Mark	AO
2 (a)	2 of: ref. to culture medium / growth medium / nutrient; ref. to constant volume / concentration; ref. to amino acid; ref. to constant volume (of both types) added; ref. temperature; ref. to suitable method of providing constant temp. ref. to aeration; ref. to a method of supplying oxygen / air; ref. to pH; ref. to buffers / named buffers;	Do not allow: amount for any quantitative answer. Do not allow: ref. to cell numbers or time Allow: ref. to fermenter features – water jacket (+ monitor) water bath must refer to a constant / stated temperature Allow: ref. to fermenter features – sparger / air lift	[2] [2]	P M
(b)	<u>Increase in number of cells (after 6 days)</u>; number of cells at beginning / previous	Allow: ratio of increase in cells to the initial number of cells. Ignore: percentages	[1]	D

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(c)	***glutamine**:* *Support* 1. stimulates / shows an increase and ref to any figure or range between 0.1–10 (mmol dm^{-3}); *Not support* 2. does not stimulate / inhibits / shows decrease at 20 / 40 (mmol dm^{-3}); ***glutamic acid:*** *Support* 3. does not stimulate / inhibits / shows a decrease at 0.1 / 0.2 / 0.5 / 40 (mmol dm^{-3}); *Not support* 4. shows little effect on growth / too inconsistent / does not show any trend (to draw any conclusion*)*; *Not support* 5. at 10 (mmol dm^{-3}) / 20 (mmol dm^{-3}) appears to increase growth; ***anywhere in answer:*** *Support* 6. results should be reliable as means of 50 counts (per culture) / large number used; *Not support* 7. cell counting procedures are estimates / prone to error;	Cause and effect must be correct – watch for cell increase and amino acids concentrations being reversed. Allow: glutamate for glutamic acid 2. Allow: no cells / no growth / no changes Do not allow: cells are dead / no cells 5. Allow: may be anomalous results at these concentrations *For comparisons between figs. of glutamine and glutamic acid*: for appropriate use of figures max 2. mark points 6 and 7 can also be awarded. *Support* 8. more growth with glutamine than glutamic acid between 0–10 (mmol dm^{-3}); *Not support* 9. more growth with glutamic acid than glutamine at 20 (mm dm^{-3}) and 40 (mmol dm^{-3});	[4]	E
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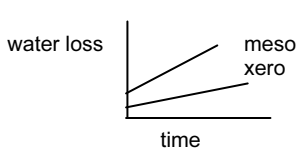
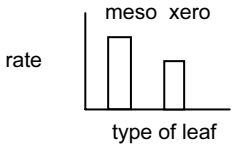
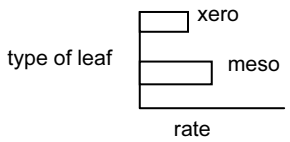
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