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**BIOLOGY**

**9700/53**

Paper 5 Planning, Analysis and Evaluation

**October/November 2016**

MARK SCHEME

Maximum Mark: 30

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**Published**

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Page 2	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark	Additional Guidance
1(a)(i)	<i>independent:</i> <u>concentration</u> of calcium chloride / $\text{CaCl}_2$ ; <i>dependent:</i> number of stomata closed / open ;	2	<b>A</b> closing / opening for closed / open <b>I</b> percentage
1(a)(ii)	serial dilution ;	1	<b>A</b> description <b>I</b> simple / standard dilution, or description of <b>I</b> proportional dilution
1(b)(i)	<i>idea of</i> the higher the concentration (of, calcium chloride / $\text{CaCl}_2$ ,) the greater the, number / percentage / proportion, of stomata that are closed / <b>ora</b> ;	1	<i>hypothesis must be testable and not repeat information given in question</i> <b>A</b> <i>idea that</i> , the number / proportion / percentage of closed stomata is (directly) proportional to the conc. of $\text{CaCl}_2$ <b>A</b> as $\text{CaCl}_2$ concentration increases more stomata close <b>ora</b> <b>A</b> a null hypothesis: different / changing concentrations of $\text{CaCl}_2$ have no (significant) effect on the number / proportion / percentage of, closed / open, stomata

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Question	Answer	Mark	Additional Guidance
1(b)(ii)	<p><i>five from</i></p> <p>1 <i>ref. to putting (epidermal) strip(s) in the (different) solutions in appropriate containers ;</i></p> <p>2 <i>ref. to keeping in the light (for the investigation) ;</i></p> <p>3 <i>ref. to using a (light) microscope (to observe the stomata) ;</i></p> <p>4 <i>count/record, (the number of/how many), closed/open stomata ;</i></p> <p>5 <i>ref. to standardising the counting ;</i></p> <p>6 <i>ref. to making <b>several</b> counts on <b>at least one</b> epidermal strip <b>and</b> taking a mean /to identify anomalies ;</i></p> <p>7 <i>max 2 for control variables (mps 7–9)</i></p> <p>8 <i>ref. to using suitable equipment for cutting <b>and</b> measuring strips (to same size) ;</i></p> <p>9 <i>ref. to method achieving constant temperature ;</i></p> <p>10 <i>ref. to method of preventing evaporation ;</i></p> <p>11 <i>one of</i>  <i>ref. to low risk ;</i>  <i>allergy to leaves/plants <b>and</b> wearing gloves/goggles ;</i>  <i>CaCl<sub>2</sub> irritant <b>and</b> avoid swallowing/wearing gloves/goggles ;</i>  <i>care when cutting with scalpel <b>and</b> cut on tile and away from, hand/body ;</i></p>	5	<p><b>A</b> named solutions  <b>A</b> e.g. beakers, watch glasses, Petri dishes, test tubes, boiling tubes, measuring cylinders, (microscope) slide / cavity slide  <b>I</b> <i>ref. to volume of solution</i> <b>I</b> <i>ref. to time</i>  <b>A</b> in dark room with fixed light  <b>R</b> electron / electronic microscope</p> <p><b>I</b> calculate / observe</p> <p>if a number of counts is given it must be a minimum of 3  <b>I</b> average <b>A</b> mean average  <b>I</b> repeat / replicate, the experiment <i>unqualified</i></p> <p>e.g. scalpel or scissors <b>and</b> ruler / calipers  <b>I</b> metre ruler  e.g. incubator, temperature controlled room, water bath to keep temperature constant  e.g. lid / film / coverslip (if slide) AW</p> <p><b>R</b> no risk  <b>I</b> allergy to CaCl<sub>2</sub></p> <p><b>I</b> scissors</p>

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Answer</b>	<b>Mark</b>	<b>Additional Guidance</b>
1(c)(i)	<i>two (for 1 mark) from</i> (same calibrated eyepiece) graticule used ;  (same) microscope ;  (same) magnification ;	<b>1</b>	<b>A</b> same calibration for measuring  <b>I</b> stage micrometer <b>I</b> same apparatus / method of measuring <b>I</b> random selection of stomata
1(c)(ii)	0.75 / $7.5 \times 10^{-1}$ ( $\mu\text{m}$ ) ;	<b>1</b>	<b>I</b> $\frac{3}{4}$

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark	Additional Guidance
1(d)(i)	<p><i>one from</i></p> <p>1 up to/at, 0.001 <math>\mu\text{mol dm}^{-3}</math> ABA/initially/at first, upper epidermis mean has increased/not changed, lower epidermis has decreased ;</p> <p>2 lower epidermis responds at 0.001 <math>\mu\text{mol dm}^{-3}</math>, ABA upper epidermis responds at 0.01 <math>\mu\text{mol dm}^{-3}</math> ABA ;</p> <p>3 confidence intervals/error bars, do not overlap (until 1.00 <math>\mu\text{mol dm}^{-3}</math> ABA) ;</p> <p>4 stomata on upper epidermis have wider aperture at, all/increasing, concentrations of ABA (until 1.00 <math>\mu\text{mol dm}^{-3}</math> ABA) ;</p>	1	<p><i>idea that</i> upper epidermis at 0.001 <math>\mu\text{mol dm}^{-3}</math> has not decreased while lower epidermis has decreased</p> <p>lower epidermis (starts to) responds at lower concentrations of ABA ;</p> <p>I standard deviation/standard error I <i>ref. to</i> one stated ABA concentration</p> <p>I <i>ref. to</i> one stated ABA concentration I longer/shorter/higher, aperture/stomata A longer/shorter, diameter/width</p>
1(d)(ii)	<p><i>one from</i></p> <p><i>definition:</i> e.g. the confidence limits are, the range/interval, in which the true value of the mean lies, with 95% probability/chance ;</p> <p><i>idea of</i> the true/AW, mean, lies within, <math>\pm, 2 \times S_M/SE</math>, with 95% probability/chance ;</p> <p><i>idea of</i> the (calculated) mean is close to the true/actual mean ;</p> <p>shows the reliability of the (calculated) mean ;</p> <p>(the confidence intervals are small) so data is reliable ;</p> <p>(the confidence limits do not overlap) so data is reliable ;</p>	1	<p><i>this must be a clear statement</i></p> <p>A 95% confident/sure/certain, that the true/actual/population mean lies within this range I <b>ora</b> for 5%</p> <p>I 95% reliable</p>

Page 6	Mark Scheme	Syllabus	Paper
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1(d)(iii)	<p><i>t</i>-test ;</p> <p>data has a normal distribution / comparing the <u>means</u> of two samples ;</p>	2	<p><i>if test not correct allow reason if correct for stated test and t-test e.g. Pearson's linear correlation because gave normal distribution</i></p> <p><b>A</b> comparing two means / comparing a pair of means / to see if two means are different  <b>A</b> data is continuous / not discrete  <b>I</b> continuous variation</p>
1(e)	<p><i>four from:</i></p> <p>1 large number of stomata / 50 stomata (from each epidermal surface) (for each ABA concentration) ;</p> <p>2 (left for) the same time / left for <u>2 hours</u> ;</p> <p>3 same age of leaf / young leaves used ;</p> <p>4 describe how one (stated) environmental condition <u>is</u> controlled ;</p> <p>5 <i>ref. to</i> how one stated method of measurement has been standardised ;</p> <p>6 random selection of stomata (to avoid bias) ;</p>	4	<p><b>I</b> <i>ref. to</i> confidence intervals</p> <p><b>I</b> large sample size unqualified  <b>A</b> 10 stomata from each (epidermal) strip</p> <p><b>I</b> time unqualified</p> <p><b>A</b> seedling leaf / leaves just expanded</p> <p><b>either</b> carbon dioxide-free air <b>or</b> pH by buffer  <b>I</b> 'ensure no carbon dioxide in environment'</p> <p>calibrated, eye piece / graticule <b>or</b> same microscope <b>or</b> same magnification</p>
	<b>Total:</b>	<b>19</b>	

Page 7	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark	Additional Guidance
2(a)(i)	<p><i>four from either</i></p> <ol style="list-style-type: none"> <li>1 <i>idea of</i> making extracts of couch grass roots, of different ages/grown for different times / 14 days old / old(er) root(s) ;</li> <li>2 grow barley (grains / young plants), supplied with (water containing) extract / has extract added ;</li> <li>3 grow (another) set of barley (grains / young plants), (supplied with water) without extract ;</li> </ol> <p><b>or</b></p> <ol style="list-style-type: none"> <li>1 grow couch grass for different times / to different ages / to 14 days / until older, <b>and</b> remove couch grass / cut off grass shoots ;</li> <li>2 grow barley (grains / young plants) where couch grass has been previously grown and removed / where couch grass shoots had been cut off leaving roots ;</li> <li>3 grow (another) set of barley (grains / young plants) on its own / where couch grass has not been grown ;</li> </ol> <p><b>then</b></p> <ol style="list-style-type: none"> <li>4 <i>ref. to</i> at least one standardised (environmental) condition ;</li> <li>5 measure / record, length / (dry) mass, of barley roots ;</li> <li>6 <i>idea of</i> compare / analyse statistically, the length / (dry) mass / growth, of the barley roots ;</li> </ol>	4	<p><b>I</b> where barley / couch grass is grown, e.g. field, green house, plot, pot, paper in petri dish etc.</p> <p><b>A</b> extracts from separately sown couch grass <b>or</b> from couch grass from original experiment 2</p> <p><b>A</b> experiment 4 acts as / is, a control</p> <p><b>A</b> <i>idea of</i> repeating experiment 2 but removing couch grass before barley is planted</p> <p><b>A</b> <i>idea of</i> growing barley where only the roots are left</p> <p><b>A</b> experiment 4 acts as / is, a control</p> <p><b>A</b> e.g. same watering / temperature / light / humidity / time / nutrients / minerals</p> <p><b>I</b> growth <i>unqualified</i></p> <p><b>I</b> measurement before investigation</p> <p><b>I</b> compare growth of barley <i>unqualified</i></p> <p><b>I</b> chi squared test</p> <p><i>must be clear that they have at least two treatments / values to compare</i></p>

Page 8	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark	Additional Guidance
2(a)(ii)	<p><i>one from</i></p> <p>1 <i>idea that</i> established / older couch grass, is (better) competitor than barley for stated resources (light / minerals / water / space) / <b>ora</b> ;</p> <p>2 <i>idea that</i> by the time barley is grown couch grass has depleted stated soil resources (light / minerals / water / space) <b>ora</b> ;</p> <p>3 <i>idea of</i> older couch spreads a, disease / herbivore, to barley ;</p> <p>4 <i>idea of</i> older couch produces a substance that inhibits / slows the germination of barley ;</p> <p>5 <i>idea of</i> older couch grass changes the pH of the soil ;</p>	1	<p><b>A</b> nutrients <b>I</b> nutrition <b>I</b> resources <i>unqualified</i></p> <p><b>A</b> nutrients <b>I</b> nutrition <b>I</b> resources <i>unqualified</i></p> <p><b>A</b> something that eats barley lives, in / on, older couch grass</p>
2(a)(iii)	there is no significant difference between yield of barley grown with couch grass and, barley grown without couch grass ;	1	<p><b>A</b> there is no significant difference between yield of, barley grown with couch grass / experiment(s) 1 / 2 / 3, and, (the yield of) the control / experiment 4</p> <p><b>A</b> no significant decrease / increase in yield when couch grass is present compared to when couch grass is not present</p>



Page 9	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark	Additional Guidance										
2(b)(i)	<p>correct calculation for <b>both</b> ground beetles ;</p> <table border="1"> <tr> <td>ground beetles</td> <td>20</td> <td><u>0.181</u></td> <td>45</td> <td><u>0.012</u></td> </tr> </table> <p>correct addition of <b>both</b> columns in table 2 ;</p> <table border="1"> <tr> <td>total</td> <td>47</td> <td>0.300</td> <td>414</td> <td>0.188</td> </tr> </table> <p>correct values for both values of <i>D</i> with pesticides <math>D=0.700</math> <b>and</b> without pesticides <math>D=\underline{0.812}</math> ;</p>	ground beetles	20	<u>0.181</u>	45	<u>0.012</u>	total	47	0.300	414	0.188	3	<p><i>ecf for wrong values for ground beetles</i></p> <p><b>A</b> 0.7/0.70 <i>ecf from wrong totals</i></p>
ground beetles	20	<u>0.181</u>	45	<u>0.012</u>									
total	47	0.300	414	0.188									

Question	Answer	Mark	Additional Guidance																		
2(b)(ii)	<p>two from</p> <p>1 the use of pesticides reduces the numbers of all, the organisms/individuals/plants and animals ;</p> <p>2 <b>either</b> the, biodiversity/species diversity, is reduced</p> <p><b>or idea that</b> <i>D</i>/diversity index/biodiversity/species diversity, does not appear to be much affected/only changed by 0.112 ;</p> <p>3 <b>either</b> use of processed data to describe percentage decrease in any one group</p> <p><b>or idea of</b> beetles are less affected/have a much lower percentage decrease ;</p> <p>4 bees (appear to have been) completely lost ;</p> <p>5 <b>idea that</b> data collected is grouped, so cannot tell if any specific species has been lost ;</p> <p>6 <b>idea of</b> reason for decline in, birds/small mammals , due to effect on food chain / non-specific nature of pesticides / herbicides ;</p>	2	<p><i>must be in terms of effect of pesticides causing the decrease</i></p> <p><b>A</b> pesticides decrease the number of organisms</p> <p><b>I ora</b> e.g. number of individuals in fields without pesticides is higher</p> <p><b>A</b> species richness</p> <p><b>I</b> diversity / <i>D</i> /, is reduced for <b>either</b></p> <p><b>I</b> diversity for <b>or</b></p> <table border="1"> <thead> <tr> <th>organism</th> <th>percentage drop</th> </tr> </thead> <tbody> <tr> <td>dicot</td> <td>95</td> </tr> <tr> <td>monocot</td> <td>88</td> </tr> <tr> <td>beetles</td> <td>56</td> </tr> <tr> <td>butterflies and moths</td> <td>89</td> </tr> <tr> <td>bees</td> <td>100</td> </tr> <tr> <td>mammals</td> <td>87</td> </tr> <tr> <td>birds</td> <td>94</td> </tr> <tr> <td><b>total</b></td> <td><b>89</b></td> </tr> </tbody> </table>	organism	percentage drop	dicot	95	monocot	88	beetles	56	butterflies and moths	89	bees	100	mammals	87	birds	94	<b>total</b>	<b>89</b>
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	<b>Total:</b>	<b>11</b>																			