Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2016**

MARK SCHEME

Maximum Mark: 30

Published

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Question	Answer	Mark	Additional Guidance
1(a)(i)	*independent:* concentration of calcium chloride / $CaCl_2$ **;** *dependent:* number of stomata closed / open **;**	**2**	**A** closing / opening *for closed / open* **I** percentage
1(a)(ii)	serial dilution **;**	**1**	**A** description **I** simple / standard dilution, or description of **I** proportional dilution
1(b)(i)	*idea of* the higher the concentration (of, calcium chloride / $CaCl_2$,) the greater the, number / percentage / proportion, of stomata that are closed / **ora ;**	**1**	*hypothesis must be testable and not repeat information given in question* **A** *idea that,* the number / proportion / percentage of closed stomata is (directly) proportional to the conc. of $CaCl_2$ **A** as $CaCl_2$ concentration increases more stomata close **ora** **A** a null hypothesis: different / changing concentrations of $CaCl_2$ 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)	*five from* 1 *ref. to* putting (epidermal) strip(s) in the (different) solutions in appropriate containers **;** 2 *ref. to* keeping in the light (for the investigation) **;** 3 *ref. to* using a (light) microscope (to observe the stomata) **;** 4 count / record, (the number of / how many), closed / open stomata **;** 5 *ref. to* standardising the counting **;** 6 *ref. to* making **several** counts on **at least one** epidermal strip **and** taking a mean / to identify anomalies **;** 7 *max 2 for control variables (mps 7 – 9)* 8 *ref. to* using suitable equipment for cutting **and** measuring strips (to same size) ; 9 *ref. to* method achieving constant temperature **;** 10 *ref. to* method of preventing evaporation **;** 11 *one of* *ref. to* low risk **;** allergy to leaves / plants **and** wearing gloves / goggles **;** $CaCl_2$ irritant **and** avoid swallowing / wearing gloves / goggles **;** care when cutting with scalpel **and** cut on tile and away from, hand / body **;**	**5**	**A** named solutions **A** e.g. beakers, watch glasses, Petri dishes, test tubes, boiling tubes, measuring cylinders, (microscope) slide / cavity slide **I** *ref. to* volume of solution **I** *ref. to* time **A** in dark room with fixed light **R** electron / electronic microscope **I** calculate / observe if a number of counts is given it must be a minimum of 3 **I** average **A** mean average **I** repeat / replicate, the experiment *unqualified* e.g. scalpel or scissors **and** ruler / calipers **I** metre ruler e.g. incubator, temperature controlled room, water bath to keep temperature constant e.g. lid / film / coverslip (if slide) AW **R** no risk **I** allergy to $CaCl_2$ **I** scissors

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Question	Answer	Mark	Additional Guidance
1(c)(i)	*two (for 1 mark) from* (same calibrated eyepiece) graticule used **;** (same) microscope **;** (same) magnification **;**	**1**	**A** same calibration for measuring **I** stage micrometer **I** same apparatus / method of measuring **I** random selection of stomata
1(c)(ii)	$0.75 / 7.5 \times 10^{-1}$ (μm) **;**	**1**	**I** ¾

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

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

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Question	Answer	Mark	Additional Guidance
2(a)(i)	*four from* **either** 1 *idea of* making extracts of couch grass roots, of different ages / grown for different times / 14 days old / old(er) root(s) **;** 2 grow barley (grains / young plants), supplied with (water containing) extract / has extract added **;** 3 grow (another) set of barley (grains / young plants), (supplied with water) without extract **;** **or** 1 grow couch grass for different times / to different ages / to 14 days / until older, **and** remove couch grass / cut off grass shoots **;** 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 **;** 3 grow (another) set of barley (grains / young plants) on its own / where couch grass has not been grown **;** **then** 4 *ref. to* at least one standardised (environmental) condition **;** 5 measure / record, length / (dry) mass, of barley roots **;** 6 *idea of* compare / analyse statistically, the length / (dry) mass / growth, of the barley roots **;**	**4**	**I** *where barley / couch grass is grown, e.g. field, green house, plot, pot, paper in petri dish etc.* **A** extracts from separately sown couch grass **or** from couch grass from original experiment 2 **A** experiment 4 acts as / is, a control **A** *idea of* repeating experiment 2 but removing couch grass before barley is planted **A** *idea of* growing barley where only the roots are left **A e**xperiment 4 acts as / is, a control **A** e.g. same watering / temperature / light / humidity / time / nutrients / minerals **I** growth *unqualified* **I** measurement before investigation **I** compare growth of barley *unqualified* **I** chi squared test *must be clear that they have at least two treatments / values to compare*

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

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Question	Answer	Mark	Additional Guidance
2(b)(i)	correct calculation for **both** ground beetles **;** ground beetles | 20 | <u>0.181</u> | 45 | <u>0.012</u> correct addition of **both** columns in table 2 **;** total | 47 | 0.300 | 414 | 0.188 *correct values for both values of D* with pesticides $D = 0.700$ **and** without pesticides $D = \underline{0.812}$ **;**	**3**	**ecf** *for wrong values for ground beetles* **A** 0.7 / 0.70 **ecf** *from wrong totals*

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<table>
<tr><th>Question</th><th>Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>2(b)(ii)</td><td>two from
1 the use of pesticides reduces the numbers of all, the organisms / individuals / plants and animals ;

2 either the, biodiversity / species diversity, is reduced

or idea that D / diversity index / biodiversity / species diversity, does not appear to be much affected / only changed by 0.112 ;

3 either use of processed data to describe percentage decrease in any one group

or idea of beetles are less affected / have a much lower percentage decrease ;

4 bees (appear to have been) completely lost ;
5 idea that data collected is grouped, so cannot tell if any specific species has been lost ;
6 idea of reason for decline in, birds / small mammals , due to effect on food chain / non-specific nature of pesticides / herbicides ;</td><td>2</td><td>must be in terms of effect of pesticides causing the decrease
A pesticides decrease the number of organisms
I ora e.g. number of individuals in fields without pesticides is higher
A species richness
I diversity / D /, is reduced for either
I diversity for or

<table><tr><th>organism</th><th>percentage drop</th></tr><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>total</td><td>89</td></tr></table></td></tr>
<tr><td></td><td>Total:</td><td>11</td><td></td></tr>
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