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BIOLOGY **9700/51**

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 potassium chloride / KC*l* **;** *dependent:* number of stomata open / closed **;**	**2**	**A** different concentrations of potassium chloride **A** number open and closed
1(a)(ii)	*three from:* correct volumes of water and KC*l* solution for making all four dilutions with units **;;** method of measuring volumes **;** *ref. to* stirring / mixing **;**	**3**	**A** *volumes either in descriptions or a table* *max 1 for correct volumes making 1, 2 or 3 dilutions*
1(b)(i)	*idea of:* the higher the concentration of (potassium chloride / KC*l*) the greater the number of stomata open / **ora** **or** the higher the concentration of (potassium chloride / KC*l*) the lower the number of stomata open / **ora** **or** the number of open stomata is directly proportional / inversely proportional to the concentration of potassium chloride / **ora ;**	**1**	***R*** *in terms of degree / speed of opening and closing of stomata e.g. more* KC*l* *the stomata are wider.* **A** a null hypothesis:

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Question	Answer	Mark	Additional Guidance
1(b)(ii)	*five from:* 1 *ref. to* putting the strips into (all KC*l*) solutions in appropriate containers **;** 2 *ref. to* keeping in the dark (when in solution) **;** 3 *ref. to* mounting on a slide **and** using a (light) microscope (to count / observe the number of stomata) **;** 4 *ref. to* count / record the number of stomata that are open or closed **;** 5 *ref. to* a method standardising the counting open / closed stomata **;** 6 *ref. to* making several counts on each leaf strip **and** taking a mean / to identify anomalies **;** *control variables max 2 (7–9)* 7 *ref. to* using suitable equipment for cutting **and** measuring strips (of same length and width / size / area) **;** 8 *ref. to* a method of maintaining a constant temperature **;** 9 covering to prevent evaporation **;** 10 *one of:* *ref. to* low risk **;** examples of hazard and precaution **;**	**5**	e.g. beakers, watch glasses, Petri dishes **R** test-tubes / boiling tubes / cavity slides **R** electron / electronic microscope / hand lens / magnifying glass e.g. out of the same fixed number of stomata **or** in field of view (at the same magnification) **A** a minimum of 3 counts on one strip **I** *ref. to* repeating whole experiment three times **R** metre rule **A** incubator / temperature controlled room / water-bath if appropriate to apparatus **R** no risk

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Question	Answer	Mark	Additional Guidance
1(c)(i)	*ref. to* using (eyepiece) graticule to measure (the aperture) **;** *one from* calibrating the (eyepiece) graticule with a (stage) micrometer AW **;** convert / calibrate the eye piece units to μm / mm **;**	**2**	**R** if use graticule **and** stage micrometer to measure **A** *ref. to* converting eyepiece units using conversion / calibration factor
1(c)(ii)	*two (for one mark) from* time / min | stomatal aperture / μm 0 | 0.5 | 0.1 | 0.2 | 0.3 | 0.4 | 0.1 | 0.5 | 0.2 | 0.3 | 0.3 | 0.1 | 0.2 | 0.2 | 0.2 | 0.4 60 | 0.9 | 1.1 | 1.0 | 1.3 | 1.2 | 1.8 | 1.5 | 0.8 | **0.2** | 1.3 | 1.1 | 0.8 | 1.0 | 1.9 | 0.9 120 | **1.9** | 2.4 | 2.6 | 2.6 | 2.5 | 2.2 | 2.8 | 2.4 | 2.4 | **3.9** | 2.6 | 2.3 | 2.5 | 2.2 | 2.7 180 | 4.1 | 4.8 | 4.2 | 4.0 | **5.7** | 4.7 | 3.9 | 4.1 | **5.5** | 4.5 | 4.3 | 4.0 | **3.1** | 4.1 | 4.3	**1**	
1(c)(iii)	<u>0.035</u> **;**	**1**	

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Question	Answer	Mark	Additional Guidance
1(c)(iv)	*three from* measure more stomata / all the stomata (per epidermal strip) **;** select stomata to be measured randomly **;** use more leaves / epidermal strips **;** measure at shorter (time) intervals / more frequently **;**	**3**	*if specify a number, should be 10 or more* **R** use different types of plant
1(d)	*idea that* the longer the time of light exposure the wider stomata open / the wider the aperture **;**	**1**	**R** *idea of* different light intensity
	Total:	**19**	

Question	Answer	Mark	Additional Guidance
2(a)	*two (for one mark) from* number of fields studied **;** (width of) the headland / strip **;** (type of) cereal / crop **;**	**1**	**A** length *if qualified by 6 m*
2(b)(i)	data is nominal / categoric **or** testing the difference between observed (O) and expected (E) results **;**	**1**	**A** data can be grouped / is discrete
2(b)(ii)	there is no <u>significant difference</u> between number of butterflies of each species when headland sprayed and when not sprayed **;**	**1**	**A** without herbicide / not treated / control *for not sprayed* **A** with herbicide / treated *for sprayed*

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Question	Answer	Mark	Additional Guidance
2(b)(iii)	<table><tr><th>species **Q**</th><th>O</th><th>E</th><th>$(O-E)^2$</th><th>$\frac{(O-E)^2}{E}$</th></tr><tr><td>number on headland sprayed with herbicide</td><td>3</td><td>20</td><td>289</td><td>14.45 ;</td></tr><tr><td>number on headland not sprayed with herbicide</td><td>37</td><td>20</td><td>289</td><td>14.45 ;</td></tr></table> $\chi^2 = 28.9$;	**3**	*if E is correct, but one row is processed incorrectly, allow ecf for correct addition to obtain χ^2 value max 2*
2(b)(iv)	3.84 ;	**1**	
2(b)(v)	significant (at $p < 0.001$) / herbicide is causing the number of butterflies to decrease ;	**1**	**ecf** *from errors in* ***(iii)*** *and / or* ***(iv)***
2(c)	*three from* 1 *idea that* where herbicide has been used there are fewer / smaller population of all species investigated ; 2 *idea of* (decrease / difference) in species **S** is only one that is not significant / **ora** ; 3 herbicide has greatest effect on the population of **R** (and **Q**) ; 4 *ref. to* the sequence of the severity of the effect of the herbicide ; 5 probability of the results being due to chance is less than 5% for all species except **S** (and **Q**) ;	**3**	sequence is (**R** >) V / W > T / U > S *if **R** included in the sequence allow mp3 and mp4* **A** probability of the result being due to herbicide is more than 95% for all species except **S**
	Total:	**11**	

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