Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2018**

MARK SCHEME

Maximum Mark: 30

Published

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underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ecf	error carried forward
mp	marking point (with relevant number)

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Question	Answer	Marks	Guidance
1(a)(i)	*independent variable*: type of leaf / type of plant / type of disc / species (of plant) **;** *dependent variable*: time for (leaf) discs to, rise to / reach, the surface / the top **;**	**2**	 **I** rate of photosynthesis
1(a)(ii)	*any 7 of:* 1 *ref. to* a method of transferring leaf discs **;** 2 same, height / volume / depth, of solution / $NaHCO_3$, in beaker (for all leaf types) **;** 3 use, timer / stop clock, to find time for leaf disc(s) to reach, surface / top **;** 4 *ref. to* using same number of leaf discs (for all leaf types) **;** 5 *ref. to* the same concentration of solution (for all leaf types) **;** 6 *ref. to* standardising some aspect of the discs **;**	**7**	*max. 6 if critical step mp9 missing* 1 e.g. forceps, glass rod, paint brush, tweezers 2 **A** other suitable containers e.g. syringe / boiling tube / test tube 3 **A** time for first leaf disc / all leaf discs / stated number of leaf discs / each one in a separate beaker **R** if different types of leaf in same beaker at same time 4 minimum of 3 6 e.g. same, size / diameter / age / position in leaf sampled

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Question	Answer	Marks	Guidance
1(a)(ii) cont	7 *ref. to* keeping same light intensity **;**		7 **A** methods that achieve same light intensity, e.g. lamp(s) at fixed distance / same wattage (bulbs) / variable resistor / dimmer
	8 *ref. to* **method** for keeping temperature of solution constant **;**		8 e.g. temperature-controlled room or chamber / environmental chamber / incubator / water-bath / thermostatic control **I** air conditioning / heat shield
	critical step 9 start timer (immediately) when disc(s) reach bottom (of beaker) **;**		
	10 low / medium, risk, experiment / investigation / procedure / assessment / AW **;**		10 **R** no risk **I** 'low hazard' experiment. **A** Allergy to leaves **and** wear, gloves / protective clothing **A** $NaHCO_3$ is a mild skin irritant to **and** wear, gloves / protective clothing **I** *ref. to* water and electricity / care with cutting discs
	11 *ref. to* minimum of 3 readings (for at least one leaf type) **and** calculating a mean **or** excluding / identifying, anomalies **;**		11 **A** having at least 3 discs in one beaker **A** one disc in 3 separate beakers **I** average / average mean **A** mean average
1(b)(i)	divide 1 by the time **;**	**1**	**A** distance disc travels divided by time **A** divide 10 / 100 / 1000 by time **I** volume of oxygen divided by time

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Question	Answer	Marks	Guidance
1(b)(ii)	*idea that:*	**3**	
	1 leaves (with thick cuticles) may be heavier which will, increase time to rise / require more oxygen to raise them **or** cuticles, are transparent / do not affect light absorption **or** thick cuticle only on upper surface so light absorption via lower surface not affected **or** difference between spiderwort with thin cuticle and sorghum with thick cuticle, is small / may not be significant **or** leaves (with thick cuticles may) have fewer stomata so less gas exchange **;**		1 **A** in terms of leaves being thicker **A** no evidence that thick cuticles reduce light absorption **I** *ref. to* no lower cuticle **A** *with ref. to* carbon dioxide in / oxygen out
	2 the purple parts of the leaf may contain chlorophyll (which is hidden by the purple pigment) / cannot assume that the purple stripes do not contain chlorophyll **or** no actual data on the chlorophyll content **or** the purple pigments may also absorb light (*idea of* accessory pigments) **or** spiderwort rate, close to sorghum / faster than ivy, which does not have purple stripes ;		2 **A** *idea that* green stripes are more chlorophyll dense (than other leaves) could relate to purple stripes or whole leaf
	3 experiment carried out at, 20 °C / room / low temperature, and C4 plants / Sorghum, only efficient at high(er) temperatures / ora **;**		

Question	Answer	Marks	Guidance
1(c)(i)	1 *idea of* using same, quantity / amount, of leaf tissue from each plant **;** e.g. (weigh to) obtain same mass / same number of discs / cut same area of leaf 2 *ref. to* outline method of extracting pigments **;** e.g. (crush / leave, the leaves in) solvent / acetone / propanone / ethanol / alcohol or extraction solvent 3 *ref. to* using red filter (in a colorimeter) **;** 4 *idea that* taking a reading for, absorbance / transmission, to compare each extract **;**	**3**	1 **A** dry mass 2 **I** water as a solvent 3 **A** *idea of* shining a red light through the extract **I** 'chlorophyll absorbs red light' **A** if leaf / discs are used e.g. 'spiderwort chlorophyll has a lower / the lowest absorbance (of red light in the colorimeter)'
1(c)(ii)	solvent / named solvent (used to extract the chlorophyll) **;**	**1**	**A** water

Question	Answer	Marks	Guidance
1(d)	*max 3 if only mp1-4 given* *use of t-test:* 1 3 **;** 2 *idea of* carrying out (separate) *t*-test on (pairs of data from) spiderwort and (each of) the other (3) plants / AW **;** *finding the significance:* 3 calculate / find / use, the degrees of freedom / *v* **;** 4 *ref. to* critical / table, value at, 0.05 (probability/significance) or 5% (confidence, level / index. limit) **;** 5 if (calculated) value of *t,* is greater than / > , critical / table, value, the difference is significant **; ora**	**4**	2 **I** value stated in mp1 3 must be in correct context **A** calculation (10–1)+(10–1) **A** 20 – 2 or statement that *v* is 18 **I** formula, as given **4** *ref. to* using 0.05 / 5% (column) **R** 0.05% **A** at 95% / 0.95 confidence limit / index 5 **A** in terms of results (of *t*-tests) were significant **I** 'values' are significant

Question	Answer	Marks	Guidance
2(a)(i)	*any 3 of*: 1 habitat / tree species / broad-leaved trees, good for grey squirrels, has increased (overall) **or** habitat / tree species / broad-leaved trees, good for grey squirrels, has increased more in Scotland than England **;** 2 habitat / tree species, good for red squirrels, has decreased **or** habitat / tree species, good for red squirrels, has decreased more in England than in Scotland **;** 3 habitat / tree species, good for both squirrel species, has decreased **;** 4 habitat / tree species, poor for both squirrel species, has increased **or** habitat / tree species, poor for both squirrel species, has increased more in Scotland than in England **;**	**3**	**I** *simple data quotes unqualified* 2 could be in terms of (large) decrease in European Larch **or** could be in terms of the Japanese Larch increase in Scotland 3 could be in terms of decrease in Norway spruce 4 could be in terms of the large increase in Sitka Spruce **or** much larger increase in Sitka Spruce in Scotland

Question	Answer	Marks	Guidance
2(a)(ii)	*any 2 of:* 1 less, habitat / suitable woods / places to live (for red squirrel) **;** 2 less food (for red squirrels) **;** 3 less, cover / places, to hide from predators **;** 4 *ref. to* disease in red squirrels **;**	**2**	2 **A** fewer nesting sites for reds **I** shelter **A** in terms of habitat / competition **R** if state <u>same</u> niche 3 **A** changed habitat conditions favour more, predators / predation **I** *ref. to* interbreeding
2(b)(i)	*any 2 of:* trap density **or** same trap density (in each / either type of woodland) **;** trap size / type **or** same sized traps / humane steel traps **;** test for antibodies **or** standard test for antibodies **;** time of sampling **or** *idea of* sampling between the same months / year / AW **;**	**2**	**A** quoted densities 1 per 0.01 km^2 (broad-leaved) / 2 per 0.01 km^2 (narrow-leaved) **A** 'number in a given area' as description of density **A** 'same time of sampling' **I** *ref. to* regular sampling
2(b)(ii)	(between 2002 and 2010 / over time) the percentage of squirrels with, immunity / antibodies / testing positive, has decreased **or** (in 2010) compared to control group the percentage of squirrels with, immunity / antibodies / testing positive is (much) lower **;**	**1**	**I** *ref. to* no. of squirrels (killed) **I** unqualified data quotes

Question	Answer	Marks	Guidance
2(b)(iii)	*idea that* on the mainland the squirrels can (rapidly) re-invade **or** *idea that* the mainland area, will be larger / has more areas to 'hide', so less easy to remove them (all) / so more survive post cull **or** *idea that* survivors post cull provide a breeding population to build up the population (rapidly) **;**	**1**	**A ora** throughout **A** in terms of no barrier to the migration of the grey squirrels **A** in terms of *idea of* (red) squirrels being isolated on the island

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1(a)(i)	*idea that* not measured / AW **;**	**1**	e.g. results show colours / no numbers / subjective / observations / description not numbers **I** categoric
1(b)	*2 of:* *idea that:* they are **all** acting as controls **;** *idea that*: they show that colour change **or** <u>the effect</u> occurs, if DCPIP chloroplast and light are present **;** *tube 2:* shows that chloroplast suspension does not change colour on its own ***or*** without DCPIP there is no colour change ***or*** DCPIP is needed for the colour change **;** *tube 3:* shows that DCPIP does not change colour on its own ***or*** without chloroplast suspension there is no colour change ***or*** chloroplast suspension is needed for the colour change **;** *tube 4:* shows that DCPIP **and** chloroplast suspension together do not change colour on their own ***or*** without light there is no colour change ***or*** light is needed for the colour change **;**	**2**	**R** controlled variable / controlled experiment *tube 2:* **A** *idea that:* acts as a colour comparison for the end point / tube 1
1(c)	*idea that*: reducing heat (from lamp) passing through / AW **;**	**1**	

Question	Answer	Marks	Guidance
1(d)(i)	*independent*: light intensity / distance of tube from light source / lamp **;** *dependent*: time taken for DCPIP to decolourise / time for green colour to appear **;**	**2**	 **I** ref. to rate of light dependent reaction **I** ref to solution / tube, decolourising / going colourless

Question	Answer	Marks	Guidance
1(d)(ii)	*7 of:* 1. method to vary light intensity **;**	**7**	1. e.g. distances between tube and lamp or different strengths of neutral density filters or wattages of bulbs / variable resistor / dimmer switch / number of lamps
	2. five values of stated distances in the range 10 to 200 cm **;**		2. for other stated methods, must have 5 stated values, e.g. wattages/ etc.
	critical step 3. start timer straight away when exposed to light **;**		
	4. record time, (at each intensity) until DCPIP decolourises / chloroplast suspension is green **;**		4. **A** record time, until blue colour disappears / colour changes **R** tube goes colourless without ref. to DCPIP
	5. use a colour comparator / tube 2, to decide when to stop timing **;**		**if using colorimeter:** mp 4 –removes samples at intervals until absorbance becomes zero or constant mp 5 – calibrating / zeroing with chloroplast suspension
	6. same volume of (same) chloroplast suspension **;**		mp6 & mp7: if volumes are stated, total volume must be minimum 10 cm^3 and maximum 50 cm^3 (so it fits in the tube) if outside this range award mp 6 or mp 7 but **not** both **I** 'same volume' of tube contents
	7. same volume of DCPIP **;**		
	8. same concentration of DCPIP **;**		

Question	Answer	Marks	Guidance
1(d)(ii)	9. water tank at same distance from test tube / light source **;** 10. ref. to a minimum of **two** replicates <u>and</u> calculate a mean **or** identify / eliminate/ remove anomalies **;** 11. medium risk **or** hazard <u>and</u> suitable safety **;**		
1(e)	2.5×10^{-3} / 0.0025 **;**	**1**	**A** 25 if converted distance to metres **I** ignore any units
1(f)(i)	*idea that*: no intermediate data for reaction between 7 and 8 minutes **;**	**1**	**A** water
1(f)(ii)	tangent drawn <u>at 6 min</u> **;** correct number in range 0.2 to 0.4 **;**	**2**	**ecf** correct calculation from incorrect tangent **I** any sign **A** rate calculated from time in seconds
1(f)(iii)	curve should be to the right of original curve **and** must be drawn from 1–12 min **;**	**1**	**A** if merges with the original after 8 min

Question	Answer	Marks	Guidance
1(g)(i)	there is no <u>significant</u> difference between the (mean) absorption values for, tubes 1 and 2 / no weed killer and weed killer **X** **or** the difference between the (mean) absorption values for, tubes 1 and 2 / no weed killer and weed killer **X**, is not <u>significant</u> **;**	**1**	
1(g)(ii)	*1 of:* continuous **;** normally distributed / normal distribution **;** standard deviations are approximately the same **;** size of the two samples is less than 30 **;**	**1**	**I** 'compare the means'
1(g)(iii)	(n =) 12 **;**	**1**	
1(g)(iv)	<u>greater than</u> (>) 2.07 / critical value **or** 2.07 / critical value <u>is less than</u> (<) calculated value / *t* value **;**	**1**	

Question	Answer	Marks	Guidance
2(a)	any suitable method of generating random numbers / co-ordinates / positions **;** use the numbers generated, as co-ordinates / grid reference, to locate or create a (10 m) plot **;**	**2**	
2(b)	*idea that:* one animal may produce carrying numbers of dung piles **or** difficulty in identifying the source of the dung **or** dropping may be hidden / washed away / decomposes / eaten **;**	**1**	**A** dung may belong to a different species of animal
2(c)	*2 of:* time when sampling was carried out **;** area of survey sites (0.25 × 0.25 km) **;** number of types of survey sites (8 of each) **;** area of study plots (10 × 10 m) **;** number of study plots per site (3) **;** dimensions (size or area) of dung collecting strips **;**	**2**	**A** stated times**,** first week in April and first week in July / the time of year sampled **A** same size survey site **A** same size study plot / quadrats

Question	Answer	Marks	Guidance
2(d)	*3 of:* 1. increased, number of plant species / plant species richness, does not necessarily mean increased plant species diversity **;** 2. *idea that:* no data for number of individuals of each species / abundance **;** *idea that:* 3. variation / range in dung count is large **;** 4. no statistical analysis **;** 5. correlation of dung data with number of species does not mean one causes the other **;** 6. no evidence for effect of sheep alone on plant species number **;**	**3**	

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ora or reverse argument
mp marking point (with relevant number)
ecf error carried forward
I ignore
AVP alternative valid point

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Question	Answer	Marks	Guidance
1(a)	(named) buffer ;	**1**	
1(b)	ref. to first mixing the algae with (sodium) alginate ; ref. to then adding (alginate and algae) to calcium chloride ; ref. to method of dropping mixture (to form beads) ;	**3**	e.g. using syringe or pipette
1(c)(i)	*independent variable:* light intensity / distance of container from lamp ; *dependent variable:* colour of indicator / pH ;	**2**	

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Question	Answer	Marks	Guidance
1(c)(ii)	*five from:* 1 method to vary light intensity **;** 2 five values of stated distances in the range 10 to 200 cm **;** 3 cover tubes with metal foil / light proof cover **;** *critical step* 4 expose to light and record, colour change / pH, after fixed time **;** 5 ref. to a suitable control **;** 6 same, (stated) volume / concentration, of hydrogencarbonate solution **;** 7 same, number / mass / volume, of algal balls **;** 8 ref. to a minimum of two replicates <u>and</u> calculate a mean *or* identify / eliminate / remove anomalies **;** 9 medium risk or hazard <u>and</u> suitable safety precaution **;**	**5**	*ignore 'amount' for any volume or concentration* 1. e.g. distances between tube and lamp or different strengths of neutral density filters or wattages of bulbs / variable resistor / dimmer switch / number of lamps 2 if any other method used, must refer to 5 stated values e.g. wattages / etc. 3 **A** work in a dark room with only one light source 4 **A** any stated time **A** time to a specific colour / pH 5 e.g. hydrogencarbonate with, glass beads / balls with no algae / balls with dead algae 9 e.g. sodium hydrogencarbonate indicator solution is harmful / irritant **and** wear gloves / goggles / mask **A** allergy to, alginate / algae, **and** wear gloves / mask / goggles

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Question	Answer	Marks	Guidance
1(c)(iii)	place a heat filter between the lamp and container **;**	**1**	**A** description of heat filter e.g. container of water / double glazed glass sheet **A** cold light source e.g. LED lights
1(d)	1.6×10^{-3} / 0.0016 / 0.002 **;**	**1**	
1(e)(i)	*one from:* judging colour alone is subjective **;** different people see colours differently **;** *idea that* pH probe is more sensitive **;**	**1**	**A** gives a numerical / quantitative result
1(e)(ii)	curve should be to the right of original curve and must be drawn from 0 to 10 minutes **;**	**1**	
1(e)(iii)	indicator solution provides, hydrogencarbonate ions / carbon dioxide **;**	**1**	
1(f)(i)	there is no <u>significant</u> difference between the (mean) pH for treatment 1 and treatment 2 / no weed killer and weed killer **A** **;** or the difference between the (mean) pH for treatment 1 and treatment 2 / no weed killer and weed killer **A** is not <u>significant</u>	**1**	
1(f)(ii)	*one from:* continuous data **;** data is normally distributed **;** standard deviations are approximately the same **;** size of the two samples is less than 30 **;**	**1**	**I** 'compare the means'
1(f)(iii)	n = 10 **;**	**1**	

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Question	Answer	Marks	Guidance
1(f)(iv)	yes for weed killers **A** and **C** / no for weed killer **B ;** *plus two from:* (significant for A or C) because *p* value / probability, is less than 0.05 **or** *p* value shows there is less than 5% chance that results are due to chance **;** effect of weed killer **A** greater than weed killer **C** (because less than 0.001) **;** (not significant for **B**) because *p* value greater than (0).05 **or** *p* value shows there is less than 5% chance that results are due to weed killer **B ;**	**3**	

Question	Answer	Marks	Guidance
2(a)	5000 / 5 × 10^3 (: 1) **;**	**1**	
2(b)(i)	*one from:* length of transect **;** number of sites surveyed / number of transects (each year) **;** geographical area / reef, in which study carried out **;** direction of, sampling / swimming / transect **;**	**1**	
2(b)(ii)	*three from:* *supports* (mean log) lionfish abundance has decreased (after 2008) **;** *does not support* increase in mean abundance decreasing from 2007–2008 so could have started catching lionfish, earlier / in 2007 **;** 95% confidence interval bars overlap **;** therefore no significant difference between means **;**	**3**	
2(c)	70 **; ; ;** from graph: 95% confidence interval = 35 **;** therefore, S_M = 35 / 2 = 17.5 $\sqrt{n}$ = 4 **;** rearranging equation: (17.5 × 4) 70 = *s* **;**	**3**	*note: correct answer with no working = 3 marks* *if incorrect answer, then check working*