Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2020**

MARK SCHEME

Maximum Mark: 30

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

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Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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- the specific skills defined in the mark scheme or in the generic level descriptors for the question
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4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
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State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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max	indicates the maximum number of marks that can be given
ora	or reverse argument

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Question	Answer	Marks
1(a)	*idea of:* mix (equal volumes of), *Chlorella* / suspension, and sodium alginate **;** (slowly) drip mixture into calcium chloride (solution) **;** using a, syringe / pipette **;**	**3**
1(b)(i)	*independent variable*: temperature **;** *dependent variable*: distance travelled by the coloured liquid **;**	**2**
1(b)(ii)	*any 2 from:* *idea that* 1 (suitable because) these are temperatures at which, enzymes are expected to be functioning / *Chlorella* may survive **;** 2 (suitable because) gives enough range for at least five temperatures **;** 3 (not suitable because) does not show effect of very, high / low, temperatures **;**	**2**

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Question	Answer	Marks
1(b)(iii)	*allow in context of using the same respirometer for each temperature, or separate respirometers set up in the same way for each temperature* *any 7 from*: 1 *idea of* adding a fixed volume of water to respirometer ; 2 *idea of* adding, fixed number / same mass, of immobilised algal balls (to the water below the shelf with CO_2 absorbent) ; 3 *idea of* attaching the tap, capillary tubing and scale so that they are airtight ; 4 *idea of* opening the tap (using syringe) to add air ; 5 *idea of* dipping capillary tube into liquid / setting position of liquid (using syringe) ; 6 *idea of* covering respirometer tube (containing *Chlorella*) with, metal foil / light proof material ; **A** carry out in a dark room 7 *idea of* placing respirometer tube into a water-bath at a known temperature ; 8 *idea of* opening tap and leaving to equilibrate ; 9 *idea of* closing the tap and marking position of liquid ; 10 *idea of* measuring movement of liquid along the scale for 5 minutes ; 11 *idea of* doing minimum of three measurements (in sequence) and taking a mean ; 12 *idea of* repeating experiment at each temperature, e.g. 20 °C, 30 °C, 40 °C and 50 °C ; **A** temperatures within the range of 10°C to 50°C 13 low risk experiment *or* medium risk experiment due to (named) CO_2 absorbent harmful and wear gloves ; 14 AVP ;	**7**
1(c)(i)	*idea of:* find radius of tubing in mm and use πr^2 (to find area) ; multiply by distance moved in mm ; **A** in terms of a formula	**2**

Question	Answer	Marks
1(c)(ii)	*any 2 from:* 1 *idea that* oxygen uptake increases as temperature increases and because enzymes, gain more kinetic energy / collide more frequently / form more enzyme-substrate complexes **;** 2 *idea that* increases faster up to 30°C and then slows down and because, optimum temperature exceeded / other factors become limiting **;** **A** doubles every 10°C increase up to 30°C then slows / Q_{10} plus explanation 3 AVP **;** e.g. *idea that* increase in metabolic rate is due to increasing enzyme activity	**2**
2(a)(i)	*any 2 from:* 1 *idea of* randomising the planting of the different types of cotton plants **;** 2 *idea of* large number of samples examined **;** 3 AVP **;**	**2**
2(a)(ii)	*any 2 from:* 1 (ambient) temperature **;** 2 (sun)light (availability) **;** 3 rainfall / soil water **;** **A** availability of water 4 humidity **;** 5 wind **;** 6 (variation in) soil pH **;** 7 other soil feature e.g. drainage / fertility / nutrients already present / aeration / type of soil **;** 8 pests other than that, bollworm / disease **;** 9 AVP **;**	**2**
2(b)(i)	*any 1 from:* 1 to show the closeness of the mean to the, true / population, mean **;** 2 for drawing error bars on graph(s) **;**	**1**

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Question	Answer	Marks
2(b)(ii)	*any 2 from:* 1 compares the means of two sets of data (for each year) ; 2 the data is continuous ; 3 data is normally distributed ;	**2**
2(b)(iii)	*any 3 from:* 1 egg density in Bt cotton and non-Bt cotton decreases (from approx 800 per plant to approx 200) ; 2 egg density increases from 2004 ; 3 larvae density on Bt cotton, fluctuates / shows little change ; 4 larvae density on non-Bt cotton decreases ; 5 AVP ;	**3**
2(c)(i)	*any 1 from:* 1 time when sampling is carried out / *idea that* sampling occurs during breeding season / AW ; 2 area of each field sampled ; 3 number of fields sampled ; 4 AVP ; e.g. training / experience, of those doing the sampling	**1**
2(c)(ii)	*idea that* the use of Bt cotton kills larvae so (each year) fewer survive to become adults and lay eggs on crops other than cotton / AW ;	**1**

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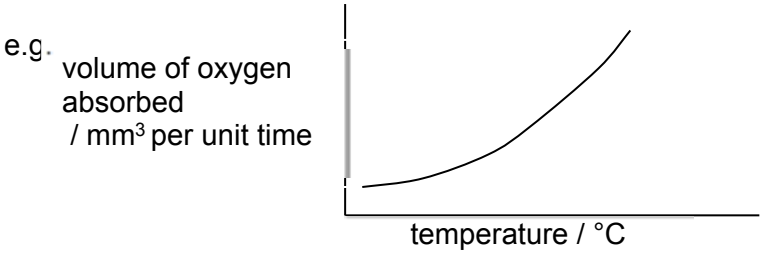
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Question	Answer	Marks
1(a)(i)	*independent variable*: temperature **;** *dependent variable*: distance travelled by liquid / volume of oxygen taken up **;**	**2**
1(a)(ii)	1 (because) these are temperatures at which, enzymes are expected to be functioning / woodlice may survive **;** 2 (intervals of) 5 °C / 3 °C / 2 °C **;**	**1**
1(a)(iii)	inert material / glass beads, of same volume (as woodlice) **; A** dead (sterilised) woodlice	**1**
1(a)(iv)	*idea that* absorption of carbon dioxide allows measurement of uptake in oxygen / AW **;**	**1**
1(a)(v)	*any 1 from*: 1 movement of woodlice **;** 2 size / age / sex, of woodlice **;** 3 AVP **;**	**1**
1(b)(i)	*allow in context of using the same respirometer for each temperature, or separate respirometers set up in the same way for each temperature* *any 7 of*: 1 *idea of* adding a fixed volume of carbon dioxide absorbent solution **;** 2 *idea of* adding fixed, number / mass, of woodlice to tube **;** 3 *idea of* method of adding dye solution to capillary tube **;** 4 *idea of* attaching tubes and making airtight **;** 5 *idea of* placing respirometer tube into a water-bath at a stated temperature **;** 6 *idea of* leaving apparatus to equilibrate with tap open **;** 7 *idea of* closing the tap and, marking / recording, position of liquid **;** 8 *idea of* measuring movement of dye on the scale for, 5 minutes / a set time **;** 9 *idea of* re-opening tap / using syringe, to allow liquid to equalise and then closing to take another measurement **;** 10 *idea of* a minimum of three measurements (in sequence) and taking a mean **;** 11 *idea of* repeating experiment at each temperature, e.g. 5 °C, 10 °C, 15 °C, etc **;** 12 low risk experiment *or* medium risk experiment due to (named) carbon dioxide absorbent is harmful and wear gloves **;** 13 AVP **;**	**7**

Question	Answer	Marks
1(b)(ii)	1 *idea of* converting the distance in cm to mm^3 by multiplying by 10 ; 2 volume calculated = volume of oxygen absorbed by woodlice ; 3 divide each of the volumes by time (oxygen uptake per unit time = rate of respiration) ;	**3**
1(b)(iii)	1 axes correctly orientated with labels ; 2 axes have units ; 3 line shows (exponential) increase as temperature increases ; e.g. 	**3**
1(c)	woodlice are using mostly carbohydrate as their energy source ; **A** using a mixed energy source **A** using, protein / lipid, under anaerobic conditions **R** using, protein / fat only	**1**

Question	Answer	Marks
2(a)(i)	*any 2 from:* 1 remove all / add, larvae ; 2 measure larvae and select, medium-sized / 9–16 mm, larvae; 3 *ref. to* way of measuring ; 4 suitable equipment for handling larvae, e.g. paint brush, pooter, (blunt) forceps ; 5 place larvae on plants, randomly / on cotton bolls / on buds / AW ; 6 *idea of* breeding cotton bollworms to use for treatment 2 ; 7 AVP ;	**2**
2(a)(ii)	*any 2 from:* 1 variety / type, of (Bt) cotton ; 2 number of rows of cotton ; 3 (1 m) length of cotton sections per test ; 4 number of plants in each section ; 5 (20 m^2) size of the plot ; 6 size of larvae ; 7 density of larvae in each treatment ; 8 time before spraying with insecticide ; 9 cotton bolls picked at same time when all bolls in each plot were open / AW ;	**2**
2(a)(iii)	(as a control) to compare the, quantity / mass / weight / yield, of cotton (fibres, and /or, seeds) from plots that were not sprayed with insecticide with that from the plots that were sprayed / AW ;	**1**
2(b)(i)	*any 1 from:* 1 compares the means of two sets of data ; 2 the data is continuous ; 3 the populations have a normal distribution ; 4 standard deviations are similar ;	**1**
2(b)(ii)	there is no (significant) difference in the mass of cotton fibre produced when sprayed with insecticide or when not sprayed with insecticide ;	**1**

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Question	Answer	Marks
2(c)	*any 2 from:* 1 (mean) yield of cotton bolls increases when sprayed with insecticide **;** 2 (mean) yield of cotton fibre increases, less / little / unchanged / AW, when sprayed **;** 3 spraying makes little difference to the (mean) yields of bolls and fibres between treatments 1 and 2 **;** 4 standard deviations appear large (e.g. for bolls sprayed in treatment 1 and 2) **;** 5 mean ± SD overlap so no conclusion can be made **;** 6 no results given for, *t*-tests / statistical tests **;** 7 AVP **;**	**2**

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Question	Answer	Marks
1(a)(i)	(approximately) 1 ; **A** value in 0.94 to 1 range to allow for mixed CHO and protein	**1**
1(a)(ii)	*any 7 from*: 1 *idea of* adding a fixed, number / mass, of peas to respirometer (below the shelf with soda lime) ; 2 *idea of* a control containing dead (sterilised) peas / glass beads of same mass ; 3 *idea of* inserting bung with tubing with clip and glass tubing with scale so that the apparatus is airtight / AW ; 4 *idea of* dipping glass tube into coloured liquid ; 5 *idea of* placing respirometer tube into a water-bath at a stated temperature in range 13°C to18°C ; 6 *idea of* (opening clip and) leaving to equilibrate ; 7 *idea of* closing the clip and marking the position of dye and *idea of* starting stop-clock immediately ; 8 *idea of* measuring movement of dye on the scale, for 5 minutes / at timed intervals ; 9 *idea of* opening clip and resetting the coloured liquid ; 10 *idea of* doing minimum of three measurements in sequence and taking a mean ; 11 *idea of* removing carbon dioxide absorbent ; 12 *idea of* again measuring movement of dye on the scale, for 5 minutes / at timed intervals ; *must be linked to mp11* 13 low risk experiment *or* 14 medium risk experiment and carbon dioxide absorbent is harmful and wear gloves ; 15 AVP ;	**7**
1(b)	*any 3 from:* 1 find radius of glass tubing and use πr^2 (to find surface area) ; 2 multiply πr^2 by distance moved by liquid with carbon dioxide absorbent to find volume of oxygen used ; 3 multiply πr^2 by distance moved by liquid without carbon dioxide absorbent ; 4 add together the volume with carbon dioxide absorbent and volume without carbon dioxide absorbent (to find volume of carbon dioxide released) ; **A** marks on a correct formula e.g. oxygen consumed = πr^2 × distance moved with carbon dioxide absorbent = 2	**3**
1(c)(i)	1 *idea of* replacing the sodium hydroxide by (a named) oxygen absorbent / replacing air with nitrogen ; 2 *idea of* setting dye position, close to the tube containing peas / half way along the tube ; 3 look for liquid moving away from the peas (showing that carbon dioxide is produced in anaerobic conditions) ;	**3**
1(c)(ii)	trial 2 and the result, is anomalous / does not fit the pattern ;	**1**

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2(a)(i)	*any 3 from:* 1 percentage of Bt cotton has increased (by 72.9 / 73%) **;** 2 (since 2007) the percentage of 1 gene Bt has decreased and 2 or more gene increased **;** 3 number of hectares of cotton grown has increased (by 0.7 million hectares) **;** 4 the use of pesticide has decreased as Bt cotton has increased **;** 5 AVP **;**	**3**
2(a)(ii)	*idea of* (less insecticide used) as more of the crop is protected from bollworm by the toxic proteins / Cry1Ac / Cry2Ab / AW **;**	**1**
2(b)(i)	*idea of* the yield will decrease as the population of resistant bollworms will increase **;** **A** in terms of greater selection pressure so only resistant insects survive	**1**
2(b)(ii)	*any 2 from:* 1 *idea of* non-Bt cotton enables non-resistant bollworms to survive **;** 2 *idea of* breeding between susceptible and resistant bollworms keeps frequency of resistance genes lower (in the gene pool) **;** **A** in terms of less selection pressure so more susceptible survive to breed 3 AVP **;**	**2**
2(c)(i)	*independent variable:* the type of cotton plant / transgenic v*ip3AcAa* / whether the cotton produces Vip3AcAa **;** *dependent variable:* the number of dead larvae **;**	**2**
2(c)(ii)	*any 1 from:* 1 number of larvae on each leaf ; 2 age of larvae ; 3 time (after adding larvae / for feeding) before counting dead larvae; 4 AVP ;	**1**

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Question	Answer	Marks
2(c)(iii)	*any 2 from:* 1 *idea of* control using non-Bt plant gives a baseline of larval death caused by factors other than toxic proteins in leaves **;** 2 *idea of* control using Bt *cry1Ac* plants for comparison with non-Bt to show, the larvae are Cry1Ac resistant / no difference in the number that die **;** 3 AVP **;**	**2**
2(c)(iv)	1 difference between the number killed with Bt cry1Ac + vip3AcAa cotton (containing the toxic protein Vip3AcAa) is significant for both types of larvae *and* (as) standard deviations do not overlap with Bt cry1Ac cotton (which does not contain the toxic protein Vip3AcAa) **;** 2 the difference between the increase in deaths of type **A** larvae and type **B** larvae killed on Bt cry1Ac + vip3AcAa (compared to those killed on Bt cry1Ac) is not significant *and* (as) standard deviations overlap **;**	**2**
2(d)	*any 1 from:* 1 *idea of* carrying out same investigation using susceptible strains of bollworm (as well as resistant types) **;** 2 AVP **;**	**1**

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