CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2024**

MARK SCHEME

Maximum Mark: 30

Published

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Question	Answer	Marks
1(a)(i)	0.40 **;**	**1**
1(a)(ii)	fucoxanthin **;** diadinoxanthin **;**	**2**
1(b)	*blue light:* 1 *S. costatum* (will have), greater / faster / AW , (rate of photosynthesis than *R. salina*) **; ora** *green light:* 2 *S. costatum* (will have), slightly / AW, greater / faster / AW , (rate of photosynthesis than *R. salina*) **; ora** *red light:* 3 *S. costatum* (will have), the same / similar / AW, (rate of photosynthesis as *R. salina*) **;**	**3**
1(c)(i)	*any **one** from:* 1 *idea that* absorbance measured (with colorimeter) / colour of indicator solution, is not affected by algae **;** 2 indicator solution can be separated from algal balls **;** 3 (more accurate) standardisation of, mass / volume / AW, of algae **;**	**1**
1(c)(ii)	*independent variables:* species / type, (of algal beads) **;** wavelength / colour, of light **;** *dependent variable:* absorbance / pH (of solution) **;**	**3**

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Question	Answer	Marks
1(c)(iii)	*any **eight** from:* 1 method for use of filters (to give blue, green, red coloured light) **;** 2 use, same / stated, number / mass / volume, of algal beads (in each bottle) **;** 3 place light source the, same / stated, distance (from algal beads) **;** 4 carry out experiment in a darkened room **;** 5 use, same / stated, volume / concentration, of indicator (in each bottle) **;** 6 (use of a control bottle) replace the algal beads with, glass / plastic / AW, beads **;** 7 use, red / pH 8.4, hydrogencarbonate indicator solution (at start) **;** 8 detail of method to take sample (of indicator solution) from bottle **;** 9 use a, same / stated, coloured, filter / light, in the colorimeter **;** 10 method to calibrate colorimeter **;** 11 *ref. to*, suitable time to leave algal beads and indicator solution (before measuring absorbance) **;** 12 for each colour (filter) and species, measure / record / AW, absorbance, at same / stated, time(s) **;** 13 use at least three measurements for each colour (filter) and species, **and** calculate a mean **;**	**8**

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<tr><td>1(c)(iv)</td><td>hazard and risk and precaution ;

<table>
<tr><th>hazard</th><th>risk</th><th>precaution</th></tr>
<tr><td>algae / beads</td><td>irritant / allergy</td><td>gloves / mask / goggles / PPE</td></tr>
<tr><td>hydrogencarbonate indicator (solution)</td><td>irritant / allergy</td><td>gloves / mask / goggles / PPE</td></tr>
<tr><td>heat from light source</td><td>burns</td><td>do not touch bulb / turn off lamp before handling</td></tr>
</table></td><td>1</td></tr>
<tr><td>1(d)(i)</td><td>any one from:

1 comparing the means of two (sets of data) ;

2 continuous data (collected) ;

3 (data are from populations that are) normally distributed ;

4 standard deviations are approximately the same ;</td><td>1</td></tr>
<tr><td>1(d)(ii)</td><td>there is no difference, in the pH of samples (taken from the small bottles / of indicator solution), between R. salina and S. costatum ;</td><td>1</td></tr>
</table>

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<table>
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<tr><td>2(a)</td><td>
1 peat bog A has a higher number of species and a higher Shannon index (than peat bog B) ; ora

examples of suitable wording for mp1:
<table>
<tr><th>number of species</th><th>Shannon index</th></tr>
<tr><td>peat bog A has a higher number of species ora

peat bog A has 12 species, peat bog B has <u>only</u> 8 species

no (individuals of) species T, U, W, V in peat bog B</td><td>peat bog A has a higher Shannon index ora

idea that number of species / species richness, is more important for Shannon index</td></tr>
</table>
2 peat bog B has a smaller range of species abundance and a higher Simpson’s index (than peat bog A) ; ora

examples of suitable wording for mp2:
<table>
<tr><th>relative species abundance</th><th>Simpson’s index</th></tr>
<tr><td>peat bog B has a smaller range of species abundance ora

peat bog B has a higher (total) number of individuals ora

peat bog B has 135 (total) number of individuals, peat bog A has only 99</td><td>peat bog B has a higher Simpson’s index ora

idea that (range of) species abundance / species evenness / total number of individuals, is more important for Simpson’s index</td></tr>
</table>
if mp1 and mp2 not awarded, then award 1 mark for:

peat bog A has a higher number of species and peat bog B has a smaller range of species abundance ; ora
</td><td>2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
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peat bog B has 135 (total) number of individuals, peat bog A has <u>only</u> 99</td></tr>
</table></td><td></td></tr>
<tr><td>2(b)(i)</td><td>any three from:

1 sample at different times of the year (not only over one month) ;

2 sample at, night / different times of day (not only between 13:00 and 16:00) ;

3 sample at sites other than along the path ;

4 use of (another) named technique to sample invertebrates ;

5 use an expert / (identification) app / guidebook (instead of an identification key) ;</td><td>3</td></tr>
<tr><td>2(b)(ii)</td><td>1 (for Tipula limbata) n / N = 0.083 and (n / N)^2 = 0.007 ;

2 Σ = 0.270 ;

3 D = 0.730 ;</td><td>3</td></tr>
<tr><td>2(b)(iii)</td><td>peat bog A has (slightly) high<u>er</u> (biodiversity than peat bog B) ; ora</td><td>1</td></tr>
</table>

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1 replace chloroplast (suspension) with, water / boiled chloroplast (suspension) ;

2 replace DCPIP with, water ;

3 keep (chloroplast suspension with DCPIP) in the dark ;</td><td>2</td></tr>
<tr><td>1(b)(i)</td><td>
<table>
<tr><th>percentage concentration of chloroplast suspension</th><th>time taken for DCPIP to decolourise / s</th><th>rate of light-dependent stage of photosynthesis / s^{-1}</th></tr>
<tr><td>10</td><td>351</td><td>2.8</td></tr>
<tr><td>20</td><td>59</td><td>16.9</td></tr>
<tr><td>30</td><td>21</td><td>47.6</td></tr>
<tr><td>40</td><td>10</td><td>100.0</td></tr>
<tr><td>50</td><td>5</td><td>200.0</td></tr>
</table>
rates calculated correctly ;

(correct) rates correctly rounded to one decimal place ;</td><td>2</td></tr>
<tr><td>1(b)(ii)</td><td>1 axes correctly orientated with labels and rate unit and appropriate scales ;

2 points plotted accurately (± ½ small square) ;

3 suitable line drawn ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
1(c)	*any **two** from:* *(Did work in 10% sucrose solution because)* 1 (sucrose solution) has, same / similar, water potential as in the chloroplast **;** 2 water will not enter (chloroplast), by osmosis / as there is no water potential gradient / ora **;** 3 chloroplasts will not burst / ora **;**	**2**
1(d)	1 one, stated, concentration of chloroplast suspension **;** *any **five** from:* 2 minimum of five, stated, temperatures within the range 10 to 60 °C **;** 3 method of maintaining a constant temperature **;** 4 allowing chloroplast suspensions to reach set temperatures (before exposing to light) **;** 5 swirl chloroplast suspension (before exposing to light) **;** 6 method for ensuring same light intensity **;** 7 carry out experiment in dark room **;** 8 colour of sample to match chloroplast suspension (alone) / green colour standard **;** 9 correct *ref. to* repeats and mean **;**	**6**

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Question	Answer	Marks
2(a)(i)	1 description of random / systematic, sampling **;** 2 use of, quadrats / (sweep) nets / (light) trap / pooter **;** 3 Count the number of each phenotypes **;** **OR** **max. 2 marks if Mark-Release-Recapture method** 4 <u>capture</u> ladybirds **and** count / find number / record, number of each phenotypes **and** <u>mark</u> **and** <u>release</u> them **;** 5 suitable marking so not harmful / too obvious / not removed 6 <u>capture</u> second sample **and** count / find number / record, number of each phenotypes **and** count / find number / record number, of marked each phenotypes **;**	**3**
2(a)(ii)	*any **two** from:* 1 *ref. to* data for spring 1929 and spring 1932 **;** 2 sample size(s) **;** 3 multiple sampling sites (in same area of Germany) **;** 4 carry out statistical analysis **;** *Sampling took place with:* 5 the same location(s) / habitat(s) / sampling site(s) / AW **;** 6 the same time of day **;** 7 the same duration (of sampling) **;**	**2**
2(b)(i)	Line for melanic phenotype is <u>steeper</u> (than non-melanic phenotype) **;**	**1**

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Question	Answer	Marks
2(b)(ii)	1 award if both graphs have been used **;** *any **two** from:* 2 all ladybirds have the same starting temperature **;** 3 all ladybirds warm up when lamp is on **;** 4 all ladybirds return to, original / starting, temperature **;** 5 melanic reaches high**er** temperature / ora **;** 6 melanic cool down fast**er** / ora **;** 7 females warm up quick**er** / ora ; 8 females reach high**er** temperature / ora ; 9 females take long**er** to cool down / ora **;** 10 heavier warm up quick**e**r / ora **;** 11 heavier ladybirds reach high**er** temperature / ora **;** 12 heavier ladybirds take long**er** to cool down / ora **;** 13 the temperature plateaus for all except non-melanic females **;**	**3**
2(c)	1 Pearson's (linear correlation) / Spearman's (rank correlation) **;** *any **two** from:* *Pearson's* 2 data (for temperature and mass) is, paired / linked **;** 3 data is continuous **;** 4 scatter diagram**,** suggests a <u>linear</u>**,** relationship / correlation / association **;** 5 there are at least 5 (paired) observations **;** **OR** *Spearman's* 6 data (for temperature and mass) is, paired / linked **;** 7 the data is ordinal / interval **;** 8 scatter diagram, suggests an <u>increasing</u>, relationship / correlation / association **;** 9 there are more than 5 (paired) observations **;**	**3**

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Question	Answer	Marks
2(d)	1 cross melanic with non-melanic **;** 2 homozygous (dominant) melanic parent(s) will only have melanic offspring **and** heterozygous (melanic) parent(s) will have both phenotypes in offspring **;** *Details about breeding experiment – max 1* 3 many breeding pairs **;** 4 each breeding pair kept separate from other pairs **or** separate offspring from parents **;** 5 count, the different phenotypes of offspring **;**	**3**

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1(a)(i)	0.40 **;**	**1**
1(a)(ii)	fucoxanthin **;** diadinoxanthin **;**	**2**
1(b)	*blue light:* 1 *S. costatum* (will have), greater / faster / AW , (rate of photosynthesis than *R. salina*) **; ora** *green light:* 2 *S. costatum* (will have), slightly / AW, greater / faster / AW , (rate of photosynthesis than *R. salina*) **; ora** *red light:* 3 *S. costatum* (will have), the same / similar / AW, (rate of photosynthesis as *R. salina*) **;**	**3**
1(c)(i)	*any **one** from:* 1 *idea that* absorbance measured (with colorimeter) / colour of indicator solution, is not affected by algae **;** 2 indicator solution can be separated from algal balls **;** 3 (more accurate) standardisation of, mass / volume / AW, of algae **;**	**1**
1(c)(ii)	*independent variables:* species / type, (of algal beads) **;** wavelength / colour, of light **;** *dependent variable:* absorbance / pH (of solution) **;**	**3**

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Question	Answer	Marks
1(c)(iii)	*any **eight** from:* 1 method for use of filters (to give blue, green, red coloured light) **;** 2 use, same / stated, number / mass / volume, of algal beads (in each bottle) **;** 3 place light source the, same / stated, distance (from algal beads) **;** 4 carry out experiment in a darkened room **;** 5 use, same / stated, volume / concentration, of indicator (in each bottle) **;** 6 (use of a control bottle) replace the algal beads with, glass / plastic / AW, beads **;** 7 use, red / pH 8.4, hydrogencarbonate indicator solution (at start) **;** 8 detail of method to take sample (of indicator solution) from bottle **;** 9 use a, same / stated, coloured, filter / light, in the colorimeter **;** 10 method to calibrate colorimeter **;** 11 *ref. to*, suitable time to leave algal beads and indicator solution (before measuring absorbance) **;** 12 for each colour (filter) and species, measure / record / AW, absorbance, at same / stated, time(s) **;** 13 use at least three measurements for each colour (filter) and species, **and** calculate a mean **;**	**8**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(c)(iv)</td><td>hazard and risk and precaution ;

<table>
<tr><th>hazard</th><th>risk</th><th>precaution</th></tr>
<tr><td>algae / beads</td><td>irritant / allergy</td><td>gloves / mask / goggles / PPE</td></tr>
<tr><td>hydrogencarbonate indicator (solution)</td><td>irritant / allergy</td><td>gloves / mask / goggles / PPE</td></tr>
<tr><td>heat from light source</td><td>burns</td><td>do not touch bulb / turn off lamp before handling</td></tr>
</table></td><td>1</td></tr>
<tr><td>1(d)(i)</td><td>any one from:

1 comparing the means of two (sets of data) ;

2 continuous data (collected) ;

3 (data are from populations that are) normally distributed ;

4 standard deviations are approximately the same ;</td><td>1</td></tr>
<tr><td>1(d)(ii)</td><td>there is no difference, in the pH of samples (taken from the small bottles / of indicator solution), between R. salina and S. costatum ;</td><td>1</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
1 peat bog A has a higher number of species and a higher Shannon index (than peat bog B) ; ora

examples of suitable wording for mp1:
<table>
<tr><th>number of species</th><th>Shannon index</th></tr>
<tr><td>peat bog A has a higher number of species ora

peat bog A has 12 species, peat bog B has <u>only</u> 8 species

no (individuals of) species T, U, W, V in peat bog B</td><td>peat bog A has a higher Shannon index ora

idea that number of species / species richness, is more important for Shannon index</td></tr>
</table>
2 peat bog B has a smaller range of species abundance and a higher Simpson’s index (than peat bog A) ; ora

examples of suitable wording for mp2:
<table>
<tr><th>relative species abundance</th><th>Simpson’s index</th></tr>
<tr><td>peat bog B has a smaller range of species abundance ora

peat bog B has a higher (total) number of individuals ora

peat bog B has 135 (total) number of individuals, peat bog A has only 99</td><td>peat bog B has a higher Simpson’s index ora

idea that (range of) species abundance / species evenness / total number of individuals, is more important for Simpson’s index</td></tr>
</table>
if mp1 and mp2 not awarded, then award 1 mark for:

peat bog A has a higher number of species and peat bog B has a smaller range of species abundance ; ora
</td><td>2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>examples of suitable wording:
<table>
<tr><th>number of species</th><th>relative species abundance</th></tr>
<tr><td>peat bog A has a higher number of species ora

peat bog A has 12 species, peat bog B has <u>only</u> 8 species

no (individuals of) species T, U, W, V in peat bog B</td><td>peat bog B has a smaller range of species abundance ora

peat bog B has a higher (total) number of individuals ora

peat bog B has 135 (total) number of individuals, peat bog A has <u>only</u> 99</td></tr>
</table></td><td></td></tr>
<tr><td>2(b)(i)</td><td>any three from:

1 sample at different times of the year (not only over one month) ;

2 sample at, night / different times of day (not only between 13:00 and 16:00) ;

3 sample at sites other than along the path ;

4 use of (another) named technique to sample invertebrates ;

5 use an expert / (identification) app / guidebook (instead of an identification key) ;</td><td>3</td></tr>
<tr><td>2(b)(ii)</td><td>1 (for Tipula limbata) n / N = 0.083 and (n / N)^2 = 0.007 ;

2 Σ = 0.270 ;

3 D = 0.730 ;</td><td>3</td></tr>
<tr><td>2(b)(iii)</td><td>peat bog A has (slightly) high<u>er</u> (biodiversity than peat bog B) ; ora</td><td>1</td></tr>
</table>

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