Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2021**

MARK SCHEME

Maximum Mark: 30

Published

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- the standard of response required by a candidate as exemplified by the standardisation scripts.

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3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
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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Examples of how to apply the list rule
State **three** reasons…. [3]

A

1. Correct	✓	**2**
2. Correct	✓	
3. Wrong	×	

B (4 responses)

1. Correct, Correct	✓, ✓	**3**
2. Correct	✓	
3. Wrong	ignore	

C (4 responses)

1. Correct	✓	**2**
2. Correct, Wrong	✓, ×	
3. Correct	ignore	

D (4 responses)

1. Correct	✓	**2**
2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct, Wrong	✓	

F (4 responses)

1. Correct	✓	**2**
2. Correct	✓	
3. Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1. Correct	✓	**3**
2. Correct	✓	
3. Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. CON (of 2.) Correct	(discount 2) ✓	

I (4 responses)

1. Correct	✓	**2**
2. Correct	×	
3. Correct CON (of 2.)	✓ (discount 2)	

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ora	or reverse argument
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Question	Answer	Marks
1(a)(i)	*independent variable* temperature **;** *dependent variable* volume of carbon dioxide / time to collect stated or fixed volume of CO_2 **;**	**2**
1(a)(ii)	*idea that:* ensures glucose and yeast are, uniformly distributed / homogeneously mixed / evenly mixed / completely mixed / AW **;**	**1**
1(a)(iii)	*any **seven** from:* 1 use a minimum of five different temperatures **;** 2 state a suitable range of identified temperatures **;** 3 *idea of* same / constant / stated / standardised / known, volume of, yeast-glucose / mixture (in the test-tube) **;** 4 method of maintaining a, constant / stated, temperature **;** 5 leave mixture to equilibrate to (each) temperature **;** 6 leave for, set time / stated time, **and** measure volume (of carbon dioxide) **or** time how long to collect same volume (of carbon dioxide) from (each) sample **;** 7 use a control using, killed yeast / water replacing yeast **;** 8 *ref. to* a minimum of, two repeats / three replicates (for each temperature), **and** calculating means **;** 9 *idea of* repeat investigation with narrower range of temperatures (around that which seems the one giving maximum rate) **;** 10 low risk **;** 'medium risk' needs hazard **and** risk **and** precaution. **A** yeast + allergy/irritant + gloves / mask / goggles /PPE 11 AVP e.g. maintaining a constant pH and using a buffer **;**	**7**

Question	Answer	Marks
1(a)(iv)	1 horizontal axis labelled temperature / ^{o}C **and** vertical axis labelled volume of carbon dioxide / cm^3 / mm^3 **;** 2 curve starts low, reaches a maximum and then decreases **;**	**2**
1(b)	1 flask 2 (provides the evidence) as in *C. tropicalis* there is lower CO_2 (production / volume / AW) **;** 2 (for flask 2, *C. tropicalis* compared to *S. cerevisiae)* 65% v 93% (after 30 minutes) CO_2 as % of maximum **or** manipulated figure i.e. 28% different **;** 3 *idea that*: when transferred from conditions with oxygen to conditions with no oxygen yeasts have to use fermentation / anaerobic respiration but *C. tropicalis* does so at a much slower rate (as no Crabtree effect) thus less CO_2 produced **ora ;**	**3**

Question	Answer	Marks
2(a)	*idea of* no (clear), relationship / trend **;** **or** as latitude increases, (bird) species diversity / numbers of (bird) species, (slightly) decreases / (might) show a downward trend **;**	**1**
2(b)(i)	*any **three** from:* 1 data (for latitude and number of species) is, paired / linked **;** 2 number of bird species and latitude / (i.e. the data points) within samples are independent of each other **;** 3 the <u>data,</u> is ordinal / is interval / is discrete / can be ranked **;** 4 (scatter) graph / Fig. 2.2, suggests a, (decreasing) relationship / correlation **;** 5 there are, 17 (paired) observations / more than 5 (paired) observations **;** 6 *idea that* bird species selected randomly / AW **;**	**3**
2(b)(ii)	*idea that* there is no, correlation / relationship, between latitude and the number of (bird) species **;**	**1**
2(b)(iii)	*any **four** from:* 1 critical value (for p = 0.05%) = 0.485 ***or*** critical value for p = 0.01% = 0.615 **;** 2 value for r_s / calculated value, is < than critical value **;** 3 null hypothesis is accepted **;** 4 there is no <u>significant</u> correlation (between latitude and number of bird species) **;** 5 there is a (weak) negative correlation (between latitude and number of bird species as shown by the negative value for r_s) **;**	**4**

Question	Answer	Marks
2(c)	*any **three** from* *all marking points are ideas that:* *limitations of the data* 1 **only** used counts of bird species (may not apply to all species) **;** 2 do not know the, number of individuals of each species / relative abundance of each species / species evenness **;** *limitations of sampling* *birds* 3 hard to identify some (bird) species / miss some (bird) species / some (bird) species look similar / miss birds that fly away / birds migrate / only resident birds or species counted / qualified ref to volunteers / AW ; *latitudes sampled* 4 nothing above 40N / nothing before 37N / need wider range of latitudes / AW **;** 5 no data on latitudes south of the equator **;** sampling sites 6 not random / only sampled in certain locations / sample locations do not cover the whole of the peninsula **/** many near the coast **/** locations may not be representative of the peninsula / only 17 sites / sampling sites do not extend beyond the peninsular / AW **;** habitats 7 no information on habitats (at locations) / not all location may be equally suited for birds / different habitats have different conditions / AW **;** timings 8 only sampled, on one day / in one year **/** sampled in, winter / one season **; ora**	**3**

Question	Answer	Marks
2(d)	*any **three** from:* 1 catch birds within area and count total captured **and** mark **and** release them **;** 2 detail e.g. *idea of:* marking technique not, harmful / too obvious e.g. *idea of:* giving time for populations to mix before second sample taken – days or weeks not more **;** 3 catch second sample **and** count total number of birds **and** number of marked birds **;** 4 *ref. to* Lincoln / Petersen, index **;**	**3**

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2	Correct	✓	
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B (4 responses)

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2	Correct	✓	
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C (4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓, ×	
3	Correct	ignore	

D (4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	×, (discount 2)	
3	Correct	✓	

E (4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

F (4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	× (discount 3)	

G (5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

H (4 responses)

1	Correct	✓	**2**
2	Correct	×	
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I (4 responses)

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Question	Answer	Marks
1(a)(i)	*independent variable* type of sugar *or* glucose / monosaccharide **and** maltose / disaccharide **;** *dependent variable* height / length, of gas **;**	**2**
1(a)(ii)	to allow yeast / cells, to be evenly distributed ;	**1**
1(a)(iii)	*any **seven** from:* 1 same / stated, concentration of glucose **and** maltose solutions **;** 2 same / stated, volume of each sugar solution **;** 3 same / stated, volume of yeast suspension (for each tube) / equally divide yeast suspension between (each tube) **;** 4 same / stated, volume of water in each (large) tube **;** 5 method of maintaining a constant temperature **;** 6 maintaining a constant pH **and** use a buffer **;** 7 measure / record, height of gas / liquid, in set time **or** measure / record, time taken, to reach a set height of gas / liquid **;** 8 use of a ruler / AW for measuring gas / liquid **;** 9 control, using killed yeast / replace yeast with water **;** 10 repeat at least twice / three replicates, **and** finding mean (for at least one sugar) **;** 11 low risk **;**	**7**

Question	Answer	Marks
1(b)(i)	*any **one** from:* divide the volume of gas collected in a stated time, by the (same) time **;** 1÷ time to reach a stated volume of gas **;** use a tangent to the line **and** divide volume by time / calculate gradient **;**	**1**
1(b)(ii)	*any **three** from:* 1 rate of respiration is high**er** for glucose (than maltose) / **ora ;** 2 initial rate of reaction / respiration faster **;** 3 gas / CO_2, production is higher with glucose / **ora ;** 4 maltose is broken down before it can be respired / glucose can be respired immediately **;** 5 maltase **/** enzyme, needed to break down maltose **;**	**3**
1(c)	*any **three** from:* **1** not subjective / **ora ;** 2 more accurate / **ora ;** 3 more precise / **ora ;** 4 can continuously record data (with data logger / computer) **;** 5 meter can be used if colour blind / **ora ;** 6 meter does not pose a risk or hazard / **ora ;**	**3**

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Question	Answer	Marks
2(a)	*any **one** from:* frog, age / size / mass / stage of maturity / from same population **;** light intensity **;** humidity **;** time of day **;** time of year **;** duration of recording ; background noise **;**	**1**
2(b)	as (body) temperature increases the interval between calls decreases **;**	**1**
2(c)(i)	*any **three** from:* 1 data (for temperature and calls) is, paired / linked **;** 2 <u>data</u> is continuous **;** 3 <u>data</u> shows normal distribution ; 4 scatter diagram**,** suggests a linear**,** relationship / correlation **;** 5 there are at least five (paired) observations **;**	**3**
2(c)(ii)	there is no, correlation / relationship, between the intervals between calls and temperature **;**	**1**
2(c)(iii)	*any **two** from:* *significant because* 1 (critical value for p = 0.05 / 5% is) 0.279 **or** (critical value for p = 0.01 / 1% is) 0.361 **;** 2 value for r / 0.717, is > than critical value (so null hypothesis is rejected / accept the alternative hypothesis) / **ora** ;	**2**

Question	Answer	Marks
2(d)	*any **two** from:* 1 duration of each call **;** 2 number of calls in a set time **;** 3 number / frequency, of pulses, within each call **;** 4 length of time between pulses within each call **;** 5 sound frequency (kHz) / pitch **;** 6 duration of each pulse **;**	**2**
2(e)	*any **three** from:* 1 capture frogs **and** count / find number / record number **and** mark **and** release them **;** 2 suitable marking **so** not harmful / too obvious / not removed **or** appropriate time between first and second capture **so** frogs time to mix **;** 3 capture second sample **and** count / find number / record number of frogs **and** count / find number / record number, of marked frogs **;** 4 use Lincoln / Petersen, index **;**	**3**

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C (4 responses)

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2. Correct, CON (of 2.)	×, (discount 2)	
3. Correct	✓	

E (4 responses)

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G (5 responses)

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/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

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Question	Answer	Marks
1(a)(i)	*independent variable* temperature **;** *dependent variable* volume of carbon dioxide / time to collect stated or fixed volume of CO_2 **;**	**2**
1(a)(ii)	*idea that:* ensures glucose and yeast are, uniformly distributed / homogeneously mixed / evenly mixed / completely mixed / AW **;**	**1**
1(a)(iii)	*any **seven** from:* 1 use a minimum of five different temperatures **;** 2 state a suitable range of identified temperatures **;** 3 *idea of* same / constant / stated / standardised / known, volume of, yeast-glucose / mixture (in the test-tube) **;** 4 method of maintaining a, constant / stated, temperature **;** 5 leave mixture to equilibrate to (each) temperature **;** 6 leave for, set time / stated time, **and** measure volume (of carbon dioxide) **or** time how long to collect same volume (of carbon dioxide) from (each) sample **;** 7 use a control using, killed yeast / water replacing yeast **;** 8 *ref. to* a minimum of, two repeats / three replicates (for each temperature), **and** calculating means **;** 9 *idea of* repeat investigation with narrower range of temperatures (around that which seems the one giving maximum rate) **;** 10 low risk **;** 'medium risk' needs hazard **and** risk **and** precaution. **A** yeast + allergy/irritant + gloves / mask / goggles /PPE 11 AVP e.g. maintaining a constant pH and using a buffer **;**	**7**

Question	Answer	Marks
1(a)(iv)	1 horizontal axis labelled temperature / ^{o}C **and** vertical axis labelled volume of carbon dioxide / cm^3 / mm^3 **;** 2 curve starts low, reaches a maximum and then decreases **;**	**2**
1(b)	1 flask 2 (provides the evidence) as in *C. tropicalis* there is lower CO_2 (production / volume / AW) **;** 2 (for flask 2, *C. tropicalis* compared to *S. cerevisiae)* 65% v 93% (after 30 minutes) CO_2 as % of maximum **or** manipulated figure i.e. 28% different **;** 3 *idea that*: when transferred from conditions with oxygen to conditions with no oxygen yeasts have to use fermentation / anaerobic respiration but *C. tropicalis* does so at a much slower rate (as no Crabtree effect) thus less CO_2 produced **ora ;**	**3**

Question	Answer	Marks
2(a)	*idea of* no (clear), relationship / trend **;** **or** as latitude increases, (bird) species diversity / numbers of (bird) species, (slightly) decreases / (might) show a downward trend **;**	**1**
2(b)(i)	*any **three** from:* 1 data (for latitude and number of species) is, paired / linked **;** 2 number of bird species and latitude / (i.e. the data points) within samples are independent of each other **;** 3 the <u>data,</u> is ordinal / is interval / is discrete / can be ranked **;** 4 (scatter) graph / Fig. 2.2, suggests a, (decreasing) relationship / correlation **;** 5 there are, 17 (paired) observations / more than 5 (paired) observations **;** 6 *idea that* bird species selected randomly / AW **;**	**3**
2(b)(ii)	*idea that* there is no, correlation / relationship, between latitude and the number of (bird) species **;**	**1**
2(b)(iii)	*any **four** from:* 1 critical value (for p = 0.05%) = 0.485 ***or*** critical value for p = 0.01% = 0.615 **;** 2 value for r_s / calculated value, is < than critical value **;** 3 null hypothesis is accepted **;** 4 there is no <u>significant</u> correlation (between latitude and number of bird species) **;** 5 there is a (weak) negative correlation (between latitude and number of bird species as shown by the negative value for r_s) **;**	**4**

Question	Answer	Marks
2(c)	*any **three** from* *all marking points are ideas that:* *limitations of the data* 1 **only** used counts of bird species (may not apply to all species) **;** 2 do not know the, number of individuals of each species / relative abundance of each species / species evenness **;** *limitations of sampling* *birds* 3 hard to identify some (bird) species / miss some (bird) species / some (bird) species look similar / miss birds that fly away / birds migrate / only resident birds or species counted / qualified ref to volunteers / AW ; *latitudes sampled* 4 nothing above 40N / nothing before 37N / need wider range of latitudes / AW **;** 5 no data on latitudes south of the equator **;** sampling sites 6 not random / only sampled in certain locations / sample locations do not cover the whole of the peninsula **/** many near the coast **/** locations may not be representative of the peninsula / only 17 sites / sampling sites do not extend beyond the peninsular / AW **;** habitats 7 no information on habitats (at locations) / not all location may be equally suited for birds / different habitats have different conditions / AW **;** timings 8 only sampled, on one day / in one year **/** sampled in, winter / one season **; ora**	**3**

Question	Answer	Marks
2(d)	*any **three** from:* 1 catch birds within area and count total captured **and** mark **and** release them **;** 2 detail e.g. *idea of:* marking technique not, harmful / too obvious e.g. *idea of:* giving time for populations to mix before second sample taken – days or weeks not more **;** 3 catch second sample **and** count total number of birds **and** number of marked birds **;** 4 *ref. to* Lincoln / Petersen, index **;**	**3**