Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2022**

MARK SCHEME

Maximum Mark: 30

Published

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1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
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.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

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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)	

Mark scheme abbreviations

; separates marking points

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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)
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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
ora	or reverse argument
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Question	Answer	Marks
1(a)(i)	*independent variable:* (type of) habitat / described **;** *dependent variable:* density / number / AW, of stomata **;**	**2**
1(a)(ii)	Radius / diameter (of field of view / image / circle / Fig 1.2) **;** number of stomata **;**	**2**
1(a)(iii)	*2 marks for density range*: 0.014–0.019 **; ;** *if outside this range* ***one*** *mark for:* *stomatal number:* 61 (full) – 69 (all) **;** *area:* 4069 – 4301 **;**	**2**

Question	Answer	Marks
1(a)(iv)	*any **six** from:* *1* *ref. to* method of, random / systematic sampling of plants **;** 2 (take leaves) from same species, that is present in both habitats **;** 3 collect a minimum of 5 leaf samples (in both habitats) **;** 4 same position / age, of leaf (on plant) **;** 5 impressions to be taken from, lower / upper / both / same, surface(s) (of leaves) **;** 6 (impressions viewed using) same, magnification / lens / size of field of view **;** 7 count stomata (in field of view) **;** 8 details of systematic counting / count only whole stomata / take a photograph and mark **;** 9 repeat, (same) experiment (both habitats) minimum of twice, and calculate a mean **;** 10 s*afety:* hazard and risk and mitigation **;**	**6**
1(b)(i)	73 (%) **;**	**1**

Question	Answer	Marks
1(b)(ii)	*support – max 2 marks:* 1 stomatal density on upper surface is higher in plants grown in high light intensity **ora ;** 2 difference in (mean) stomatal density on upper surface (between the two light intensities) is greater than the difference between the lower surfaces **ora ;** 3 stomatal density on lower surface is similar / very close **;** 4 leaf 1 stomatal density on lower surface is less than in plants grown in low light intensity **ora ;** 5 calculate pair of stomatal densities (for 1 to 4) **;** *doesn't support – max 2 marks:* 6 mean stomatal density, on lower / both, surface(s) is higher in plants grown in high light intensity **ora ;** 7 for 2 out of 3 leaves / leaf 2 and 3, stomatal density is not higher only on the upper surface / is higher on lower / both, surface(s) **;** 8 calculate pair of stomatal densities (for 6 / 7) **; ecf** 9 no statistical analysis done **;** 10 data only, for one species / *L. esculentum* **;**	**3**

Question	Answer	Marks
2(a)(i)	*any **one** from:* (faecal samples) can be, collected remotely / AW, without harming the chimpanzees / investigators **;** (faecal samples) are, non-invasive / less stressful for chimpanzees / limits human interaction / no risk of infection / no need to anesthetise chimpanzees **;**	**1**
2(a)(ii)	*any **two** from:* make into a, suspension / solution / liquify faeces **;** filtered / centrifuged (to remove solids) **;**	**2**
2(a)(iii)	*idea of:* genetic profiling / DNA fingerprinting / DNA profiling / DNA sequencing / genetic analysis / (DNA) electrophoresis **;**	**1**
2(b)	*any **three** from:* 1 (some) SIV antibodies will bind to HIV antigens **;** 2 details of, which / number of lines / bands, match / don't match / AW **;** 3 (some) SIV and HIV antibodies have similar (protein), structures / shape **;** 4 HIV– people do not contain (HIV) antibodies / SIV– chimpanzees do not contain (SIV) antibodies **;** 5 the tests are valid as there is a line in each of the control regions **;**	**3**
2(c)(i)	1 allows for, valid / meaningful, comparison (between SIV+ and SIV– chimpanzees) **;** 2 the groups have different, initial / original numbers **;**	**2**
2(c)(ii)	no difference between the, life expectancy / AW, of chimpanzees that are SIV+ and SIV– **;**	**1**

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Question	Answer	Marks
2(c)(iii)	*mp1:* probability / it, is where null hypothesis is rejected **ora ;** *or* probability / it, is where critical values are chosen **;** *mp2:* less than, 0.05 / 5% / 5 in 100, probability that the, result / it, is not significant / is due to chance **;** *or* more than, 0.95 / 95% / 95 in 100, probability that the, result / it, is significant / is not due to chance **;**	**2**
2(c)(iv)	*any **two** from:* *idea that:* 1 results, may not be due to death from SIV / may be due to disappearance **;** 2 death could be due to, hunting / accident / fighting / predators / lack of food / disease (infectious or other) / AW **;** 3 ages of chimps were estimated **;** 4 uninfected chimpanzees may catch SIV during the investigation **;** 5 no data on, male/female chimps (as life expectancy may differ) **;**	**2**

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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	×	
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<table>
<tr><th>Question</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1(a)(i)</td><td>width of red area after soaking
or
width of red area remaining ;</td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>axes correctly labelled for independent <u>and</u> dependent variable ;

line / smooth curve, showing inverse correlation ;</td><td>2</td></tr>
<tr><td>1(b)(i)</td><td>any seven from:
1 use, same / same age, beetroot ;
2 minimum 5 cubes with different, size / dimensions ;
3 widths evenly spaced / if stated must be within range 0.5–5 cm ;
4 equipment for cutting / measurement of cubes ;
5 calculate / AW, the SA:V ratio ;
6 cubes are fully, covered / submerged, (by calcium hypochlorite) ;
7 remove after, same / stated, time (minutes) ;
8 method of maintaining the same temperature (once cubes are immersed) ;
9 method of drying cubes (after soaking) ;
10 cut in half and measure the width of the red tissue after soaking ;
11 repeat experiment a minimum of twice <u>and</u> calculate a mean ;
12 named hazard <u>and</u> risk <u>and</u> precaution ;

<table><tr><td>hazard</td><td>risk</td><td>precaution</td></tr><tr><td>calcium hypochlorite</td><td>Irritant / harmful / toxic / corrosive</td><td>gloves / goggles PPE / tweezers</td></tr><tr><td>scalpel</td><td>cuts / injury, to <u>skin</u></td><td>cut away from fingers / cut on a tile</td></tr><tr><td>beetroot</td><td>allergen</td><td>gloves</td></tr></table></td><td>7</td></tr>
</table>

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Question	Answer	Mark
1(b)(ii)	1 $\frac{\text{Initial volume of (red) cube} - \text{volume final red cube}}{\text{Initial volume of (red) cube}}$; 2 $\times 100$;	**2**
1(c)(i)	17% (student 4 at 65°C) ; mean given of 89.3 at 25°C ;	**2**
1(c)(ii)	*any **two** from:* 1 all (cubes of) same, size / volume / dimension / number / SA:V ; 2 use, same / same age of, beetroot ; 3 sufficient water to cover the cubes completely ; 4 same volume of water in each beaker ; 5 same colorimeter ; 6 stir / AW, before taking sample for colorimeter reading ; 7 check / AW, temperature of water in beakers have equilibrated ; 8 zero colorimeter / calibrate, before each readings ; 9 use thermostatically controlled water-bath ;	**2**
1(c)(iii)	1 more (betalain) released as temperature increased **or** as temperature increases more betalain released ; *max 1 from:* 2 membrane, fluidity / permeability / AW, increases as temperature increases ; 3 membrane proteins denature, at high(er) temperatures ;	**2**

Question	Answer	Mark
2(a)	*any **three** from:* 1 capture a **large** sample (from one area / more than one area) **;** 2 count / record, the number caught **;** 3 test and, count / record, the **number** infected **;** 4 number / population, of infected divided by, population / total number, × 100 **;** 5 mark-release-recapture method and Lincoln Index **;**	**3**
2(b)(i)	numbers (of infected badgers / cows) per unit area **;** allow (valid) comparison (between infected cows and infected badgers) **;**	**2**
2(b)(ii)	*any **three** from:* 1 method of testing (for bTB in badgers and cows) **;** 2 year of data collection **;** 3 type / breed / of, cattle **;** 4 cattle kept, outdoors / indoors **;** 5 number of areas counted each year **;** 6 season / time of year, (data collected) **;**	**3**
2(c)(i)	no, correlation / relationship, between the number of infected badgers and the number of affected cows. **or** no, correlation / relationship, in the occurrence of infection between badgers and cows ;	**1**

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Question	Answer	Mark
2(c)(ii)	*max 2* ***support*** 1 combined data / A–J / graph / Fig 2.2, shows a positive, correlation / relationship / correct correlation described **;** 2 combined data / A–J / graph / Fig 2.2, shows a significant, correlation / relationship **;** 3 (so) culling (infected) badgers lowers infection in cattle **;** *max 2* ***does not support – graph*** 4 separated data / A–H **and** D–J are clustered **;** **or** no data between 0.4 and 0.6 per km^2 **;** 5 data taken from different years **;** ***does not support – table*** 6 separated data / A–H and D–J, shows a negative, correlation / relationship **;** 7 separated data / A–H and D–J, does not show a significant, correlation / relationship **;** 8 correlation does not mean causation **;** 9 only data sets from 10 areas / only 10 out of 30 study areas sampled **;** 10 data only from England / one country **;**	**3**

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3	Wrong	×	

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(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**
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I
(4 responses)

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

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Mark scheme abbreviations

;	separates marking points
/	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)	concentration / water potential, of sucrose (solution) ;	**1**
1(a)(ii)	(the coloured sucrose drop / it) would sink / AW ;	**1**
1(a)(iii)	1 water, leaves potato (by osmosis) ; 2 (sucrose) solution, becomes less dense ;	**2**
1(b)(i)	(add) 8 cm^3 of stock solution with 12 cm^3 of (distilled) water ;	**1**
1(b)(ii)	*ref. to* hazard <u>and</u> risk ;	**1**
1(b)(iii)	*Any **six** from:* 1 use minimum of 5 different concentrations of sucrose solution ; 2 method of maintaining the same temperature (once potato pieces are immersed) ; 3 use same, type / age, of potato ; 4 all pieces of potato are, the same / stated, dimensions ; 5 method to create potato of a certain dimensions ; 6 potato pieces are fully covered / submerged (by sucrose solution) ; 7 remove after same / stated time ; 8 ref. to measuring mass of potato before and after ; 9 method of drying potato pieces (before measuring final mass) ; 10 repeat experiment a minimum of twice and calculate a mean ; 11 *idea of* repeat with new concentrations of sucrose to get closer to the equivalent sucrose concentration ;	**6**
1(c)	–1.15 ;	**1**

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Question	Answer	Marks
1(d)(i)	*any **one** from:* 1 data is continuous **;** 2 data is normally distributed **;** 3 comparing (two) means **;** 4 standard deviations are approximately the same **;** 5 fewer than 30 values / samples (for each potato) **;**	**1**
1(d)(ii)	no difference between, the water potential of, the two types of potato / Record and Kerr's Pink (potato) **;**	**1**
1(d)(iii)	38 **;**	**1**
1(d)(iv)	*any **three** from:* 1 critical value (at df = 38 and p = 0.05%) = 2.024 **;** 2 calculated (t–) value / 1.890 is < than critical (t–) value / 2.024 **; ora** 3 null hypothesis is accepted **;** 4 there is no significant difference (between the means of the water potentials of the two varieties of potato) **;**	**3**

Question	Answer	Marks
2(a)	to, absorb / remove / take up, the carbon dioxide produced (during respiration of blowfly larvae) **;**	**1**
2(b)	*direction* the coloured fluid will, move upwards **and** *explanation* *(*oxygen is, taken in / used in respiration) so, decreases the, volume / pressure of gas (in test-tube) **;**	**1**

Question	Answer	Marks
2(c)	1 remove substance **X** ; 2 replace **X** with an inert material / glass beads / AW ;	**2**
2(d)	*any **one** from:* temperature ; number of, (blowfly) larvae ; mass of, (blowfly) larvae ; age of, (blowfly) larvae ; food source for, (blowfly) larvae ; mass / number of, substance **X** / inert material / beads ; time to, equilibrate ; time, for measurement (of meniscus movement) ;	**1**
2(e)	*any **two** from:* 1 the larvae were not fully adjusted / equilibrated ; 2 the larvae were at a lower temperature (than the apparatus) ; 3 the larvae were less active ;	**2**
2(f)	5.34 ;; *incorrect answer max **one** for working:* $(\pi \times 0.5^2 \times 68) \div 10$;	**2**

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Question	Answer	Marks
2(g)	0.56 **;;** *incorrect answer max **one** for working:* 3.00 / 5.34 **;**	**2**