CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **May/June 2024**

MARK SCHEME

Maximum Mark: 30

Published

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Generic Marking Principles

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- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
I	ignore
( )	the word / phrase in brackets is not required, but sets the context
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
AVP	alternative valid point

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>wind speed ;</td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>any six from:
1 method to use fan(s), to obtain a minimum of five different wind speeds ;
2 ref. to standardised variable for using the fan ;
3 use a method to maintain, same / stated, temperature ;
4 use a method to maintain, same / stated, light intensity ;
5 at each wind speed, measure / note / record / AW, the initial mass <u>and</u> final mass, in a fixed time ;
6 idea of equilibration / acclimatisation, of, plant / Japanese spiraea / apparatus ;
7 use at least three measurements for each wind speed <u>and</u> calculate a mean ;
8 safety comment with hazard <u>and</u> precaution ;
<table>
<tr><th>hazard</th><th>risk</th><th>precaution</th></tr>
<tr><td>Japanese spiraea / plant</td><td>irritant / allergy</td><td>gloves / mask / PPE</td></tr>
<tr><td>soil</td><td>biohazard / pathogens / allergy
I irritant</td><td>gloves / mask / PPE</td></tr>
<tr><td>fan</td><td>hair / clothing / AW, trapped in fan</td><td>method to, control loose,
hair / clothing / AW</td></tr>
</table>
9 method for measuring wind speed ;
10 idea of replacing water lost from plant (before each new measurement) ;</td><td>6</td></tr>
</table>

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Question	Answer	Marks
1(a)(iii)	as wind speed, increases: rate of transpiration - increases **or** decrease in mass, in fixed / stated time - increases **or** rate of decrease in mass - increases **or** time taken, for a fixed decrease in mass - decreases **; ora**	**1**
1(b)(i)	263 **;**	**1**
1(b)(ii)	*any **one** from:* 1 use, same / stated, size of (blue) cobalt chloride paper **;** 2 *idea of* use a (pink) colour standard (to determine end point) **;** 3 *idea of* measure different positions on (lower) surface of leaf **;** 4 *idea of* unbiased selection of, leaves / leaf position **;**	**1**

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Question	Answer	Marks
2(a)	*any **three** from:* 1 light intensity **;** 2 duration / hours / AW, of light **;** 3 volume, of water (added to soil) **;** 4 type / pH, of soil **;** 5 mineral (ion), concentration (in soil) **;** 6 humidity **;** 7 carbon dioxide concentration **;**	**3**
2(b)	(high mean temperature leads to) lower / AW (mean stomatal conductance), in both isohydric and anisohydric (species) **;** **ora**	**1**

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Question	Answer	Marks
2(c)	*any **four** from:* *conclusion:* 1 (water stress leads to) lower / AW, (mean stomatal) conductance in isohydric and anisohydric (species) **; ora** *explanation:* 2 *idea that* (lower stomatal conductance when exposed to water stress indicates that) water loss (by transpiration) is reduced **;** *conclusion:* 3 isohydric (species exposed to water stress and a high temperature) increase (mean stomatal) conductance **or** increased (mean stomatal) conductance for isohydric (species exposed to water stress and a high temperature) is (statistically) significant **;** *explanation:* 4 *idea that* (increased mean stomatal conductance in isohydric species exposed to water stress and a high temperature) has a cooling effect **;** *conclusion:* 5 anisohydric (species exposed to water stress and a high temperature) do not change (mean stomatal) conductance **or** change / difference / decrease / AW, in (mean stomatal) conductance for anisohydric (species exposed to water stress and a high temperature) is not (statistically) significant **;** *explanation:* 6 *idea that* (unchanged mean stomatal conductance in anisohydric species when exposed to water stress and a high temperature) to allow carbon dioxide uptake (for photosynthesis) **;** *conclusion:* 7 paired data quote to support conclusion **;**	**4**

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Question	Answer	Marks
2(d)(i)	*idea that* there is no difference between the (mean) percentage of leaves that were dead on (young trees from) isohydric species and (young trees from) anisohydric species **;**	**1**
2(d)(ii)	1883 **;** t = (190 – 35) / 8231 **;**	**2**
2(d)(iii)	1 calculated value of, t / 1883, is less than, 2011 / critical value (at p = 0.05) **or** calculated value of, t / 1883, is less than, 2682 / critical value (at p = 0.01) **; ora** 2 null hypothesis is accepted (at p = 0.05 / p = 0.01) **;** 3 there is no significant difference (at p = 0.05 / p = 0.01) **;**	**3**

Question	Answer	Marks
3(a)(i)	(human volunteer / person and) no (mosquito) repellent / spray **or** (human volunteer / person and) water (spray) **;** **or** (human volunteer / person and) solvent (from repellent / spray) **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(ii)</td><td>named risk <u>and</u> matching precaution ;
<table>
<tr><th>risk</th><th>precaution</th></tr>
<tr><td>mosquitoes take blood meal (from scientist)
or
mosquitoes bite (scientist)</td><td>protective clothing / gloves / masks / PPE</td></tr>
<tr><td>mosquitoes transmit, disease / pathogen / yellow fever / AW</td><td>protective clothing / gloves / masks / PPE
use, disease / pathogen, free mosquitoes
vaccine (against yellow fever)</td></tr>
<tr><td>(mosquito) repellent / spray / solvent,
allergy / irritant / toxic</td><td>protective clothing / gloves / masks / PPE</td></tr>
</table></td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)	*any **four** from:* 1 98% DEET is effective (at repelling mosquitoes) **;** 2 *idea that* standard error / SE, overlap for 98% DEET and lemon eucalyptus oil, so these mosquito repellents are equally effective / no significant difference between these mosquito repellents **;** 3 *idea that* lemon eucalyptus oil is, (slightly) more effective / equally effective (as 98% DEET), but, has a low concentration (of chemical) / might be safer **or** *idea that* lemon eucalyptus oil is, (slightly) more effective / equally effective, (as 98% DEET) but DEET is, toxic / irritant / harmful **;** 4 *idea that* not true for all concentrations of DEET / 40% (concentration) DEET is much less effective **; ora** 5 no statistical test carried out **;** 6 only one human volunteer tested **;** 7 *idea that* some mosquitoes are still attracted to the human volunteer (when using 98% DEET) **;** 8 *idea that* mosquitoes used / *Aedes aegypti*, do not transmit malaria **;** 9 *idea that* mosquitoes were not able to, take a blood meal from / bite, the human volunteer / investigation only measured attraction of mosquitoes (to the human volunteer) **;**	**4**

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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.
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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Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

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7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

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Question	Answer	Marks
1(a)(i)	species of tree **or** type of tree **;**	**1**
1(a)(ii)	*any **two** from:* 1 (same) number of / 3, plantations for each tree species **;** 2 (same) size/area of, plot/(sampling)area / 36 m x 36 m / 1296m^2 **;** 3 (same / used a) belt transect (same method in all plots/plantations) **;** 4 (same) months / seasons (of the year) **or** sampling at the same times **;**	**2**

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Question	Answer	Marks
1(b)	*any **five** from:* *using a belt transect:* 1 use of tape / line / string, and quadrat (to create belt transect) **;** 2 selecting a start point for the, transect / placement of tape / line / string **or** all transects same length, in plots / plantations / repeats **;** 3 same (size) quadrat **;** 4 sample at / use quadrat at, regular intervals / stated distances along the, tape / line / string / transect **or** continuous belt transect **;** *collecting data:* 5 method to identify each of the plant (species in the quadrat) **;** 6 count / record / note the number **of** (individuals), each plant species (n) (in each quadrat / at each sampling point) **or** estimate percentage (%) cover of each plant species (in each quadrat) **;** 7 use at least 3 different transects (in each plot) **;** 8 named hazard and risk and precaution **;** e.g. (see table below)	**5**

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<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(b)</td><td>
<table>
<tr><th>hazard</th><th>risk</th><th>precaution</th></tr>
<tr><td rowspan="3">plants / fungi</td><td>falling trees / branches</td><td>hard hat</td></tr>
<tr><td>thorns</td><td>gloves / goggles / mask / long trousers / PPE</td></tr>
<tr><td>irritant / allergy
infection (spores)</td><td>antihistamines / cover skin / first aid equipment</td></tr>
<tr><td>(named)
animal(s)
parasite</td><td>bites / infection / attack / stings / allergy</td><td>antivenom / antihistamine / trained, professionals / medics, available / insect
repellent / gloves / goggles / mask / PPE / cover skin</td></tr>
<tr><td rowspan="2">plantation terrain</td><td>trip hazard</td><td>correct footwear / watch where you are walking / use walking sticks</td></tr>
<tr><td>getting lost</td><td>work in group / maps / use GPS / guide</td></tr>
<tr><td>poachers</td><td>being attacked / shot</td><td>trained, professionals/ medics, available</td></tr>
</table>
</td><td></td></tr>
<tr><td>1(c)</td><td>any one from:

(does not support)
1. acacia and mango have the same means
or
acacia and mango have similar, D values / index
or
mango and invasive species have overlapping, D values / index / means +/- SD ;

(does support / partially support)
2. sal tree has the highest, D value / index / mean
or
sal tree has greater, D values / Index / mean, than both alien species ;</td><td>1</td></tr>
</table>

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<table>
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<tr><td>1(d)(i)</td><td>
<table>
<tr><td>concentration / mg cm^{-3}</td><td>volume of stock solution / cm^3</td><td>volume of (distilled) water / cm^3</td></tr>
<tr><td>7.5</td><td>37.5</td><td>12.5 ;</td></tr>
<tr><td>2.5</td><td>12.5</td><td>37.5 ;</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>1(d)(ii)</td><td>1 correct processes <u>and</u> correct figures ;

2 (correct) answer to 3 significant figures ; ecf if mp1 is incorrect

3 decrease / minus (number) ;</td><td>3</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(e)</td><td>
any three from:
<table>
<tr><th></th><th>improvement</th><th>impact</th></tr>
<tr><td>1</td><td>More, intermediate / smaller values / intervals
appropriate examples accepted</td><td>better idea of the, trend / pattern / effect ;</td></tr>
<tr><td>2</td><td>exclude anomalous results</td><td>improve reliability ;</td></tr>
<tr><td>3</td><td>repeat reading for 2.5 / 5.0 / 7.5 mg cm^{-3} (any of these 3 might be anomalous)</td><td>check the anomaly / improve reliability ;</td></tr>
<tr><td>4</td><td>repeat investigation at least twice
or
repeat with more marigolds</td><td>better idea of trend / improve reliability /
reduce effect of anomalies ;</td></tr>
<tr><td>5</td><td>(calculate) standard error / standard deviation / confidence intervals / statistical analysis</td><td>check for significance (difference between the means) / checking accuracy ;</td></tr>
<tr><td>6</td><td>use marigold clones</td><td>exclude genetic effects / improve validity ;</td></tr>
<tr><td>7</td><td>use Vernier calliper</td><td>more precise measurements ;</td></tr>
<tr><td>8</td><td>measure the mass of all the roots</td><td>improve reliability ;</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>1(f)</td><td>
any two from:

1 (same) mass of soil ;

2 sample from same depth ;

3 sampled at the same time ;

4 sample from same, distance from roots / position in the pot ;
</td><td>2</td></tr>
</table>

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Question	Answer	Marks
2(a)	1 correct counting / correct number of divisions / 28 ± 2 **;** 2 for correct conversion(s) to micrometres **;** 3 correct answer / 8.96 / 8.32–9.6 **;**	**3**
2(b)(i)	measure the, widest / narrowest / longest, part of the each nucleus **;**	**1**
2(b)(ii)	*any **one** from:* 1 (same) magnification / × 400 **;** 2 (same) number of / 100 nuclei (measuring) per, person **;** 3 (sample from / same) thyroid / gland **;** 4 same / one, scientist (measuring the diameter) **;** *5 idea that*: type of tumour cell is unknown **;**	**1**
2(b)(iii)	there is no difference, in / between the (mean) nuclear diameters of, the Pap-stained cells and H&E- stained cells **;**	**1**
2(b)(iv)	accept null hypothesis **or** there is no significant difference **;**	**1**
2(b)(v)	*state* 1 *idea that* this technique can be used to distinguish between benign and malignant cells **or** the mean nuclear diameter of benign cells is smaller than in malignant cells / **ora** **;** *explain* 2 mean ± 2 SE, do not overlap **or** there is a significant difference in the mean nuclear diameters of benign cells and malignant cells **;**	**2**

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Question	Answer	Marks
2(b)(vi)	*disadvantages* • time consuming (prepping / counting / measuring) • labour intensive • shortage of skilled scientists • invasive • only thyroid / one tissue, used • human error – due to, small values / very close values / large numbers counted *impact:* • infection / bleeding • pain • tissue damage • metastasis • anxiety • delayed treatment • unnecessary treatment • idea of misdiagnosis • possibly not feasible on large scale • may not be true of other tumours	**2**

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ecf	error carried forward
AVP	alternative valid point

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Question	Answer	Marks
1(a)(i)	*independent variable* type of blood vessel / artery and vein and *dependent variable* mass required to break (the blood vessel) **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(ii)</td><td>
any six from:

1 method to cut the blood vessel ;

2 method to measure blood vessel of, same / stated, length / AW ;

3 idea of discard samples that are damaged ;

4 idea of waiting (to see if the blood vessel breaks) before adding the next (10 g) mass ;

5 use, artery and vein / blood vessels, from the same source ;

6 add (10 g) masses, to the mass hanger, until the blood vessel breaks ;

7 idea of measuring mass of mass hanger / including mass of mass hanger ;

8 for each type of blood vessel, measure / note / record / AW, (total) mass when the blood vessel broke ;

9 use at least three measurements for each type of blood vessel <u>and</u> calculate a mean ;

10 safety comment with hazard <u>and</u> precaution ;

<table>
<tr><th>hazard</th><th>risk</th><th>precaution</th></tr>
<tr><td>knife / scalpel</td><td>injury</td><td>cut away from hand</td></tr>
<tr><td>blood vessels</td><td>biohazard / pathogens / allergy</td><td>gloves / mask / PPE /
use disinfectant / wash hands</td></tr>
<tr><td>mass hanger falling</td><td>injury</td><td>suitable precaution to prevent injury</td></tr>
</table>
11 idea of repeat procedure with smaller mass intervals near to breaking mass ;
</td><td>6</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(b)(i)</td><td>
<table>
<tr><th>mass added / g</th><th>length of vein / mm</th><th>percentage increase in length of ring of vein</th></tr>
<tr><td>0</td><td>21</td><td>0</td></tr>
<tr><td>10</td><td>36</td><td>71</td></tr>
<tr><td>20</td><td>38</td><td>81</td></tr>
<tr><td>30</td><td>40</td><td>90</td></tr>
<tr><td>40</td><td>41</td><td>95</td></tr>
<tr><td>50</td><td>41</td><td>95</td></tr>
</table>
three values correct ;;
one or two correct max 1
</td><td>2</td></tr>
<tr><td>1(b)(ii)</td><td>1 to make a valid comparison (with other blood vessels / veins) ;
2 allows comparison as, initial / starting, length (of veins) is, not constant / AW ;</td><td>1</td></tr>
<tr><td>1(b)(iii)</td><td>1 correct orientation for axes <u>and</u> linear scale ;
2 axes labelled <u>and</u> units;
3 all points plotted correctly <u>and</u> line drawn accurately ;</td><td>3</td></tr>
<tr><td>1(b)(iv)</td><td>1 curve for artery starts at same point as the vein ;
2 curve for artery below curve for vein <u>and</u> does not intersect ;</td><td>2</td></tr>
</table>

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Question	Answer	Marks
1(b)(v)	*any **two** from:* 1 starts at, same point / origin, as using percentage increase **;** 2 (muscular) arteries have a thicker, wall / tunica media / muscle layer (than the vein) **or** 3 (muscular) arteries have more (smooth) muscle (than the vein) **;** 4 *idea of* (muscular artery) withstands more (blood) pressure so stretches less (than the vein) **;**	**2**
1(b)(vi)	*any **two** from:* 1 use smaller mass intervals **;** 2 extend the range of the masses added **;** 3 use a, force meter / Newton meter / data logger / AW, (to apply force) **;** 4 attach a, pointer / fiducial mark, to the ring of blood vessel (to improve length measurement / removing parallax) **;** 5 use, same / stated, width of blood vessel **;**	**2**

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Question	Answer	Marks
2(a)	1 cm^3 of stock solution to 149 cm^3 of distilled water **;** (dilution factor is) 150 **;**	**2**
2(b)	*any **one** from:* 1 measure from, top of the soil / bottom of stem / AW, to top of the stem / AW **;** 2 straighten the stem (while measuring length) **;** 3 place string along stem, and measure length of string **;**	**1**
2(c)(i)	1.9 **;**	**1**
2(c)(ii)	*any **one** from:* 1 (mean stem) length was measured, in / to the nearest, cm **;** 2 many anomalies in the results / identified anomaly **;** 3 no statistical test carried out **;**	**1**
2(c)(iii)	*any **one** from:* 1 measure lengths in mm **;** 2 *idea of* repeat high concentration GA_3 experiment (to check anomaly) **;** 3 measure, at same time every day / for more days **;** 4 measure more seedlings / increase sample size **;**	**1**
2(d)	(SE =) 0.067 **;** (95% CI =) 1.38 $\pm$ 0.13 **;**	**2**

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Question	Answer	Marks
2(e)	*any **three** from:* 1 highest (concentration of) GA_8 with, red light / 680 nm **or** lowest (concentration of) GA_1 with, blue light / 470 nm **or** highest (concentration of) GA_1, in the dark / with no light **;** 2 lower (concentration of) GA_1 for all wavelengths of light (compared to dark) **or** higher (concentration of) GA_8 for all wavelengths of light (compared to dark) **;** 3 95% CI, does not overlap (for the lower concentration of GA_1 for all wavelengths of light), so there is a significant difference **or** 95% CI, does not overlap, (higher concentration of GA_8 for all of the wavelengths of light), so there is a significant difference **;**	**3**

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