CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **February/March 2025**

MARK SCHEME

Maximum Mark: 100

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the February/March 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

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	<u>'List rule' guidance</u> 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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6	Calculation specific guidance 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'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7	Guidance for chemical equations Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than normal)
ecf	error carried forward
underline	actual word underlined 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
( )	the word / phrase in brackets is not required, but sets the context

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>all three correct = 1 mark ;

<table>
<tr><th rowspan="2">type of respiratory substrate</th><th colspan="2">energy value / kJ g^{–1}</th></tr>
<tr><th>approximately 17</th><th>approximately 37</th></tr>
<tr><td>carbohydrate</td><td>✓</td><td></td></tr>
<tr><td>lipid</td><td></td><td>✓</td></tr>
<tr><td>protein</td><td>✓</td><td></td></tr>
</table>
</td><td>1</td></tr>
<tr><td>1(b)(i)</td><td>respirometer ;</td><td>1</td></tr>
<tr><td>1(b)(ii)</td><td>to, absorb / remove, carbon dioxide ;</td><td>1</td></tr>
<tr><td>1(c)(i)</td><td>3 ;</td><td>1</td></tr>
<tr><td>1(c)(ii)</td><td>1.33 ; ecf from (b)(i)</td><td>1</td></tr>
<tr><td>1(d)(i)</td><td>any three from:

1 RQ value falls ;

2 data quote ;
RQ = 0.9 at, start of torpor / 8:00 or maximum RQ = 0.98
and
RQ = 0.75 at, end of torpor / 17:12

3 respires / metabolises, lipid / protein ;

4 AVP ; e.g. running out of available, carbohydrate / glycogen</td><td>3</td></tr>
</table>

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Question	Answer	Marks
1(d)(ii)	*any **two** from:* 1 during, winter / cold weather, when food is limited / to conserve energy / to reduce heat loss / AW **;** 2 during, summer / hot weather / dry conditions, to, conserve water / prevent overheating **;** 3 to avoid predation **;** 4 AVP **;** e.g. factor plus reason	**2**

Question	Answer	Marks
2(a)(i)	no geographical separation / AW **;**	**1**
2(a)(ii)	*any **three** from:* 1 do not, interbreed / interact / recognise each other **;** 2 due to differences in, courtship / mating **;** e.g. mating calls / time of year 3 different group sizes **; A** description (e.g. groups vs solitary) 4 different, hunting / feeding / diets **;**	**3**

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Question	Answer	Marks
2(b)(i)	*any **one** from:* 1 no black patch on, top of body / back **;** 2 small eyepatch **;** 3 grey patch just behind dorsal fin **;** 4 taller dorsal fin **;** 5 larger pale patch on underside near tail **;** 6 bulbous / rounded / squarer, head **;**	**1**
2(b)(ii)	*any **three** from:* 1 population, isolated from other populations / migrated **;** 2 small (starting) population **;** 3 small gene pool / low genetic diversity **;** 4 reference to, chance / founder effect **;** 5 change in allele frequency / some alleles lost **;** 6 AVP **;**	**3**

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Question	Answer	Marks
2(c)	*any **two** from:* 1 habitat, size / destruction / disturbance / pollution **;** 2 hunting (by humans) **;** 3 reference to food source **;** 4 measure sea temperature **;** 5 genetic diversity / inbreeding **;** 6/7 AVP **; ;** e.g. geographical range / migration patterns / movements / disease / breeding frequency / mortality rate	**2**

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Question	Answer	Marks
3(a)(i)	*any **four** from:* 1 DNA polymerase **;** 2 synthesises, complementary / new, DNA strand **;** 3 binds to primers on (target) DNA **;** 4 adds (DNA) nucleotides to the end of primers **or** used in extension stage **;** 5 (optimum) working temperature of 72 °C **; A** 70–75 °C 6 thermostable / does not denature at 95 °C **;** 7 (so) can be used for many PCR cycles / does not need replacing **;** 8 AVP **;** e.g. forming phosphodiester bonds (between adjacent nucleotides)	**4**
3(a)(ii)	(child) 2 **and** (child) 3 **;**	**1**
3(a)(iii)	*any **three** from:* 1 separates DNA fragments of different, sizes / lengths / mass **;** 2 DNA fragments are negatively charged **;** 3 (so) DNA fragments move (from cathode) to anode **;** 4 smaller DNA fragments migrate, faster / further **; ora** 5 DNA fragments from, normal (*MT-RNR1*) gene travels shorter distance **; ora**	**4**
3(b)	horizontal transmission / transfer plasmids / conjugation / transduction / transfection / transformation **;**	**1**

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Question	Answer	Marks
4(a)	*parental gametes* H h × H h ; **accept** from Punnett square *offspring genotypes* HH Hh Hh hh ; **accept** from Punnett square *offspring phenotypes* no disease disease / haemochromatosis ;	**3**
4(b)	*any **two** from:* 1 reference to using knowledge of DNA sequence of, *HFE* gene / C282Y (mutation) ; 2 (from) databases / bioinformatics ; 3 (to) find / identify, the, *HFE* gene / C282Y (mutation), in fossil DNA sequences ; 4 compare DNA sequence of fossil *HFE* gene with (sequence for), normal *HFE* allele / C282Y (mutation) ;	**2**
4(c)(i)	*any **four** from:* 1 low, iron / meat, (in diet), acts as a selection pressure ; 2 people, with, C282Y / mutant allele, absorb more iron ; 3 (so), survive / reproduce ; 4 *idea that* (allele) frequency of mutant allele increased in the population ; 5 natural selection ; 6 (named) heterozygote advantage ; e.g. less likely to be iron deficient / not get haemochromatosis ; 7 AVP ; e.g. C282Y (in heterozygotes) is neutral in present-day diets (so maintained) **or** gives protection from other diseases	**4**

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Question	Answer	Marks
4(c)(ii)	*any **three** from:* 1 highest / AW, percentage in Ireland where it first occurred **;** 2 higher percentages nearer Ireland due to migration **; ora** 3 migration affected by, barriers / borders **;** 4 type of diet **;** 5 different treatments available (for hereditary haemochromatosis) in different countries **;** 6 AVP **;**	**3**
4(d)	any valid difference **;** e.g. small database / ethnicity / region / location	**1**
4(e)	282 **; ;** if answer is incorrect **allow** 1 mark for correctly calculating the number of heterozygotes from incorrect 2pq i.e. 2501 × incorrect 2pq	**2**

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Question	Answer	Marks
5	*any **five** from:* 1 (meiosis) II **;** 2 two cells are visible / four groups of chromosomes **;** 3 anaphase **;** 4 as two groups of chromosomes per daughter cell **;** 5 centromeres / kinetochores, attached to, spindle fibres / microtubules **;** 6 spindle fibres / microtubules, shorten / contract **;** 7 to pull, (daughter) chromosomes / (sister) chromatids, to opposite poles / described **;** 8 the centromeres lead with the chromosome arms following behind / AW **;** 9 reference to no nuclear envelope **;**	**5**

Question	Answer	Marks
6(a)(i)	**P** – insulin **;** **Q** – muscle / liver **;** **R** – glycogen **;**	**3**
6(a)(ii)	negative feedback **;**	**1**

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Question	Answer	Marks
6(b)	*any **seven** from:* 1 glucagon ; 2 binds to receptor on cell surface membrane (of liver cell) ; 3 G-protein activated ; 4 adenyl(yl) cyclase activated ; 5 ATP converted to cAMP ; 6 second messenger ; 7 enzyme cascade / described ; 8 enzymes activated by phosphorylation ; 9 signal amplified ; 10 glycogen broken down into glucose / glycogenolysis ; 11 glucose enters blood ; 12 gluconeogenesis / described ;	**7**

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Question	Answer	Marks
7(a)(i)	10.8 (year^{-1}) **; ;** if value for rate is incorrect **allow** 1 mark for: $\frac{1010-470}{50}$ **or** $\frac{540}{50}$	**2**
7(a)(ii)	*any **three** from:* 1 ban, hunting / poaching / trade **;** 2 enforcement / strict penalties **;** 3 national parks / protected reserves / habitat protection / AW **;** 4 tracking devices / monitoring **;** 5 raise awareness / education **;** 6 AVP **;** e.g. veterinary care	**3**

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Question	Answer	Marks
7(b)	*any **four** from:* 1 maintain, gene pool / genetic diversity **;** 2 ecotourism **;** 3 ethical / moral, reasons **;** 4 reference to effect on, ecosystems / food chains / food webs **;** 5 aesthetic reasons **;** 6 idea of research **;** 7 cultural significance **;** 8 pollination **;** 9 AVP **;** e.g. keystone species	**4**

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Question	Answer	Marks
7(c)	<table><tr><th>correct order</th><th>letter</th></tr><tr><td>1</td><td>C</td></tr><tr><td>2</td><td>G</td></tr><tr><td>3</td><td>A</td></tr><tr><td>4</td><td>F</td></tr><tr><td>5</td><td>D</td></tr><tr><td>6</td><td>B</td></tr><tr><td>7</td><td>E</td></tr></table> **CGA** in correct order **; ignore** intervening letters **CGA** above **F ;** **DBE** in correct order **;ignore** intervening letters **DBE** below **F ;**	**4**

Question	Answer	Marks
8(a)	decarboxylation **;** dehydrogenation / oxidation **;**	**2**

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Question	Answer	Marks
8(b)	*any **four** from:* 1 reduces activity of citrate synthase **or** activity of citrate synthase is higher without succinyl-coA than with succinyl-coA **;** 2 comparative data quote **;** 3 succinyl-coA binds to citrate synthase active site **;** 4 succinyl-coA acts as a competitive inhibitor / described **;** 5 slows down Krebs cycle **;** 6 prevents build up / reduces production, of, citrate / intermediates **;** 7 AVP **;**	**4**
8(c)	*any **four** from:* 1 hydrogen carrier / reduced **;** 2 in, link reaction / Krebs cycle **;** 3 moves to, inner mitochondrial membrane / cristae **;** 4 releases hydrogen (atoms) **; A** protons and electrons 5 for use in, oxidative phosphorylation **;** 6 NAD, oxidised / recycled **;**	**4**

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Question	Answer	Marks
9(a)	*any **two** from:* 1 accessory pigment **;** 2 absorbs light wavelengths **not** absorbed by, reaction centre / primary pigment / chlorophyll a **;** 3 so extends the range of wavelengths absorbed **;** 4 pass **energy** to, reaction centre / primary pigment / chlorophyll *a* **;** 5 *idea that* improves efficiency of light-dependent stage **;**	**2**
9(b)(i)	1 rate of photosynthesis / rate of oxygen production, increases then levels off in both (plants) **;** 2 rate of mutant plants higher than rate of normal plants **;** 3 comparative data quote **;**	**3**
9(b)(ii)	*any **four** from:* 1 absorbs more light **;** 2 so faster rate of, photosynthesis / light-dependent stage **;** 3 more ATP and reduced NADP produced **;** 4 more turns of Calvin cycle / AW **;** 5 more, triose phosophate / TP, produced **;** 6 more, hexose/ AW, for respiration **;** 7 more energy for growth **;** 8 more synthesis of, amino acids / proteins / lipids / cellulose / starch **;**	**4**

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Question	Answer	Marks
10(a)	*any **four** from:* 1 Na^+ (ions) enter cell **;** 2 through channels / by facilitated diffusion **;** 3 depolarisation of cell surface membrane **;** 4 reference to, receptor potential / threshold **;** 5 Ca^{2+} channels open / Ca^{2+} enter cell **;** 6 vesicles with neurotransmitter move towards cell surface membrane **;** 7 vesicles fuse with cell surface membrane and release neurotransmitter / exocytosis **;**	**4**
10(b)	*any **three** from:* 1 albino / albinism **or** described **;** e.g. no pigment or melanin in skin / pale skin / white hair 2 poor vision **or** described **;** e.g. red or pink eyes / irises, eyes sensitive to light / jerky eye movements 3 tyrosinase, non-functioning / not produced **;** 4 tyrosine not converted to, DOPA / dopaquinone **;** 5 no melanin produced **;**	**3**

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