CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **May/June 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 May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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PUBLISHED

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	‘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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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.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	correct point or mark awarded
 or 	correct awarding one mark from marking point or marking group 1. similar numbered ticks are used for marking point or marking groups 2, 3, 4 etc.
	incorrect point or mark not awarded
	working towards marking point
	information missing or insufficient for credit
	used to highlight part of an extended response
	used to highlight part of an extended response
	allow or accept
	benefit of the doubt given

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Annotation	Meaning
BP	blank page
CON	contradiction in response, mark not awarded
ECF	error carried forward applied
GM	mark already given
I	incorrect or insufficient point ignored while marking the rest of the response
MAX	maximum number of marks for a marking point has been awarded
NBOD	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied
O	or reverse argument
R	incorrect point or mark not awarded
SEEN	point has been noted, but no credit has been given or blank page seen

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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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Question	Answer	Marks
1(a)(i)	2 **;**	**1**
1(a)(ii)	pumps / actively transports, protons / hydrogen ions, into intermembrane space **;** *ref. to* proton gradient **;**	**2**
1(a)(iii)	*any **three** from:* 1 ATP synthase **;** 2 protons / hydrogen ions, move (from intermembrane space) to matrix **;** 3 by facilitated diffusion **;** 4 ATP synthesised from ADP + Pi **; A** ADP is phosphorylated to ATP 5 *ref. to* chemiosmosis **;**	**3**

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Question	Answer	Marks
1(b)	*any **four** from:* 1 electron transport chain / ETC, stops / reduced **;** 2 oxygen does not act as (final) electron acceptor **;** 3 no / less , protons pumped into intermembrane space **or** no / less steep, proton gradient **;** 4 build-up of, reduced NAD / reduced FAD **or** no / less, reduced NAD / reduced FAD, oxidised / recycled **or** no / less, NAD / FAD, regenerate / recycled **;** 5 no / less, ATP production **or** no / fewer, protons pass through ATP synthase **;** 6 Krebs cycle / link reaction / oxidative phosphorylation, stops / reduced **;** 7 *ref. to* glycolysis / anaerobic respiration / lactate produced / ethanol produced / substrate level phosphorylation **;**	**4**

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Question	Answer	Marks
2	*any **six** from:* *for either* 1 random / chance (event) **;** 2 not (natural) selection / not caused by selection pressure **;** 3 loss of (some) alleles **; I** loss of gene 4 (so) increase in frequency of, one / small number of, allele(s) **or** increase in homozygosity / decrease in heterozygosity **;** 5 small(er) gene pool / reduction in genetic variation **;** *genetic drift* 6 (random), fusion of gametes / mating / death of individual / mutation **;** 7 larger effect in small population **;** *founder effect* 8 small number of individuals, isolated / start new population / migrate **;** 9 not all alleles present from original population / alleles not representative of original population **;** 10 AVP **;** e.g. *ref. to* bottleneck effect genetic drift occurs gradually over time founder effect is a one-off event	**6**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(i)</td><td>F1 genotypes: AaBb x AaBb ;

gametes: AB Ab aB ab (AB Ab aB ab) ;

F2 genotypes:

<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>ab</th><th></th></tr>
<tr><td>AB</td><td>AABB
awn</td><td>AABb
awn</td><td>AaBB
awn</td><td>AaBb
Awn</td><td></td></tr>
<tr><td>Ab</td><td>AABb
awn</td><td>AAbb
awn</td><td>AaBb
awn</td><td>Aabb
awn</td><td></td></tr>
<tr><td>aB</td><td>AaBB
awn</td><td>AaBb
awn</td><td>aaBB
awn</td><td>aaBb
awn</td><td></td></tr>
<tr><td>ab</td><td>AaBb
awn</td><td>Aabb
awn</td><td>aaBb
awn</td><td>aabb
no awn</td><td>;</td></tr>
</table>

F2 phenotypes linked to genotypes (see Punnet Square) ;

ratio of F2 phenotypes: 15:1
awn: no awn ;</td><td>5</td></tr>
<tr><td>3(a)(ii)</td><td>autosomal dominant / epistasis ;
I dihybrid</td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)	*any **one** from:* for seed dispersal **;** idea of protection **;** anchor into the ground **;** obtain more, nutrients / water **;**	**1**
3(c)(i)	*any **four** from:* 1 artificial selection / selective breeding / humans act as selection pressure **;** 2 select (rice) plants / seeds / grains, with no awns **;** 3 *idea of* breeding (selected) plants / self pollination of (selected) plants **;** 4 seeds germinate / plants grow / offspring grow **;** 5 repeat (selection and breeding) over generations **;** 6 AVP **;** e.g. *ref. to* genetic technology detail of pollination	**4**

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Question	Answer	Marks
3(c)(ii)	*any **three** from:* 1 mutation / change in base sequence, (in *An-1*) **or** *An-1* not expressed **;** 2 transcription factor has different, primary structure / tertiary structure / 3D shape **or** transcription factor not, produced / functional **or** transcription factor faulty **;** 3 transcription factor does not bind to, the promoter / DNA **;** 4 decrease in expression of gene(s) for awn development **;** 5 increase in expression of gene(s) for number of grains produced **;**	**3**

Question	Answer	Marks
4(a)	*any **three** from:* 1 (diploid) cell formed from (two) haploid gametes **;** 2 (diploid) cell has two sets of chromosomes / one set of chromosomes from each gamete **;** 3 (homologous chromosomes) maternal and paternal chromosomes **;** 4 (homologous chromosomes) has same, genes / loci / banding pattern / centromere position / size / length **;**	**3**
4(b)	anaphase 1 / telophase 1 **;** separation of, homologous chromosomes / bivalent **;**	**2**

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Question	Answer	Marks
4(c)(i)	*Fig. 4.1* metaphase 2 **;** **A** anaphase 2 *Fig. 4.2* telophase 1 **;** **A** anaphase 1	**2**
4(c)(ii)	48 **;**	**1**

Question	Answer	Marks
5(a)	*any **four** from:* 1 find, nucleotide / base / gene / DNA, sequence **;** 2 from database / using bioinformatics / from gene library **;** 3 make the gene (chemically) using nucleotides **;** 4 extract mRNA from cell, making the protein / expressing the gene **;** 5 use reverse transcriptase (with mRNA) to make cDNA **;** 6 use DNA polymerase (with cDNA) to make dsDNA **;** 7 cut out / extract / isolate, the gene from DNA **;** 8 using restriction enzyme **;**	**4**

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Question	Answer	Marks
5(b)	*any **three** from:* **ora** for animal insulin 1 large scale supply / supply can match demand **;** 2 no / less, likely to cause, immune / allergic, response **or** fewer side-effects **;** 3 faster to act / smaller dose needed **;** 4 no / less, likely for (insulin) tolerance to occur **;** 5 no / less, risk of infection / disease **;** 6 no / less, ethical / religious objections **or** suitable for, vegetarians / vegans **;** 7 AVP **;** e.g. cheaper to produce / easier to purify	**3**
5(c)	DNA from two different sources (joined together) **or** DNA from (human) gene joined to DNA from, bacteria / plasmid **;**	**1**

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Question	Answer	Marks
5(d)	*any **four** from:* 1 find, nucleotide / base / gene / DNA, sequence (of human insulin gene) **;** 2 from database / using bioinformatics / from gene library **;** 3 gene editing **;** 4 insertion / deletion / replacement, of nucleotide(s) **;** 5. at specific sites (of the gene) **;** 6 (results in) changes to the, (DNA) triplet / codon **;** 7 (so codes for a) different amino acid **;** 8 AVP **;** e.g. detail of gene editing / CRISPR / Cas9	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)</td><td>any four from:
1 variable thickness of cell wall described ;

2 no plasmodesmata (between guard cell and other epidermal cells) ;

3 many, chloroplasts / mitochondria ;

4 chloroplasts have few grana ;

5 mitochondria have many cristae ;

6 cell surface membrane, often folded / contains many transport proteins ;

7 AVP ; e.g. cellulose microfibrils arranged in bands / shape description has several small vacuoles nucleus is relatively larger than in mesophyll cells</td><td>4</td></tr>
<tr><td>6(b)(i)</td><td>1 (more) stomata open at (mid)day
<u>and</u>
(more) stomata closed, at (mid)night / in darkness – ora ;

2 data quote – two values of time of day and percentage of stomata open ;

<table>
<tr><th>time of day</th><th>percentage of stomata open (± 0.5)</th><th>mean percentage</th></tr>
<tr><td>06:00</td><td>90 / 80 / 64</td><td>78</td></tr>
<tr><td>12:00 / midday</td><td>93 / 70 / 90</td><td>84.3</td></tr>
<tr><td colspan="3"><u>and</u></td></tr>
<tr><td>18:00</td><td>25 / 35</td><td>30</td></tr>
<tr><td>24:00 / midnight</td><td>10 / 15 / 10</td><td>11.7</td></tr>
</table>
</td><td>2</td></tr>
</table>

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Question	Answer	Marks
6(b)(ii)	*any **two** from:* 1 water stress / drought ; 2 high temperature ; 3 low humidity / dry (atmosphere); 4 high carbon dioxide concentration in leaf (air spaces) ; 5 low light intensity ; 6 high wind speed ;	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(c)</td><td>
<table>
<tr><th>correct order</th><th>letter of event</th></tr>
<tr><td>1</td><td>D</td></tr>
<tr><td>2</td><td>E</td></tr>
<tr><td>3</td><td>G</td></tr>
<tr><td>4</td><td>B</td></tr>
<tr><td>5</td><td>F</td></tr>
<tr><td>6</td><td>J</td></tr>
<tr><td>7</td><td>I</td></tr>
<tr><td>8</td><td>A</td></tr>
<tr><td>9</td><td>H</td></tr>
<tr><td>10</td><td>C</td></tr>
</table>
E G B between D and F ;
E G B in correct order throughout table ;

J I A H between F and C ;
J I A H in correct order throughout table ;
</td><td>4</td></tr>
</table>

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Question	Answer	Marks
7(a)	*any **six** from:* 1 sodium–potassium pumps (in axon membrane) **;** 2 transport, sodium ions / Na^+, out and, potassium ions / K^+, in **;** 3 by active transport / uses ATP **;** 4 three, sodium ions / Na^+, and two, potassium ions / K^+ **;** 5 sets up an electrochemical gradient **;** 6 potassium ions / K^+, diffuse out through channels **;** 7 membrane more permeable to K^+ / membrane has more K^+ channels **;** 8 (so) more, potassium ions / K^+, move out of axon than, sodium ions / Na^+, move in **;** 9 *ref. to* anions / negatively charged ions / negatively charged proteins, inside **;** 10 inside negative (relative to outside) **;** 11 -60 mV to -70 mV **;**	**6**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(b)(i)</td><td>
any three from:

hypokalaemia ora for normal
1 longer, action potential / depolarisation / repolarisation
or
larger depolarisation ;

2 longer hyperpolarisation
or
more negative / smaller, hyperpolarisation ;

3 longer refractory period ;

4 more negative / lower, resting potential ;

5 data quote ;

<table>
<tr><th></th><th>normal</th><th>hypokalaemia</th></tr>
<tr><td>mp1 longer action potential
mp1 longer depolarisation
mp1 longer repolarisation
mp1 larger depolarisation</td><td>2.6 ms
1.0 ms
1.0 ms
110 mV</td><td>3.25 ms
1.25 ms
1.3 ms
140 mV</td></tr>
<tr><td>mp2 longer hyperpolarisation
mp2 more negative hyperpolarisation
mp2 smaller hyperpolarisation</td><td>0.7 ms
–92 mV
–22 mV</td><td>1.0 ms
–112 mV
–12 mV</td></tr>
<tr><td>mp4 resting potential</td><td>–70 mV</td><td>–100 mV</td></tr>
</table>
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
7(b)(ii)	*any **two** from:* 1 harder stimulus / larger stimulus / larger depolarisation, needed, to reach threshold required / to generate an action potential **;** 2 fewer, impulses / action potentials, transmitted **or** lower frequency of impulses **;** 3 slower, nervous coordination / reaction times / responses / cognition **or** weaker, sensation / muscle contraction **;** *allow named examples*	**2**

Question	Answer	Marks
8(a)	*any **four** from:* 1 eukaryotic / have nucleus **;** 2 no, chlorophyll / chloroplasts **;** 3 heterotrophic / saprophytic / saprotrophic / parasitic / described **;** 4 cell wall made of, chitin / mannoproteins / glucans **;** 5 reproduce by spores **;** 6 hyphae / mycelium **;** 7 cells may be multinucleate **;** 8 either unicellular or multicellular **;**	**4**
8(b)	fungus receives, (named) organic compounds / nutrients / food / oxygen **;** alga receives, support / stability / protection / water / minerals / carbon dioxide **;**	**2**

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Question	Answer	Marks
8(c)(i)	(photosystem) II / 2 / 680 **;**	**1**
8(c)(ii)	***A** to **B*** (occurs in very low light conditions) respiration (rate) greater than photosynthesis (rate) **;** (so) oxygen, consumed / not released **;** *after **C*** light intensity not limiting **;** carbon dioxide concentration / temperature, is limiting **;**	**4**

Question	Answer	Marks
9(a)	*any **four** from:* 1 *ref. to* quadrat of, known / same / standard, area / size **;** 2 *ref. to* setting out a grid **;** 3 random number generator (to produce coordinates) for quadrat placement **;** 4 use a key **;** 5 count number of species / numbers of individuals of each species / abundance / percentage cover / ACFOR / Braun-Blanquet **;** 6 *ref. to* large sample size / repeats **;** 7 (use results to calculate) Simpson's Index of Biodiversity / species density **;**	**4**

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Question	Answer	Marks
9(b)(i)	– 0.923 **;;;** *allow 2 marks if no minus* *allow 2 marks if not three decimal places* *allow 2 marks if incorrect value of n used* if n is 10 answer = – 2.333 if n is 120 answer = 0.998	**3**
9(b)(ii)	r_s > critical value **or** 0.923 > 0.504 **;** null hypothesis rejected as there is a, significant / strong / negative, correlation **or** null hypothesis rejected as correlation not due to chance / probability that correlation due to chance is less than 5% **;** ***ecf*** *from 9(b)(i)*	**2**

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Question	Answer	Marks
10(a)	*any **four** from:* *during – increase in lactate concentration* 1 (initially) lactate concentration low due to aerobic respiration **;** 2 no / less, oxygen available so (increase in) anaerobic respiration **;** 3 pyruvate, reduced / converted, to lactate **;** *after – decrease in lactate concentration* 4 (more) oxygen available so aerobic respiration occurs **;** 5 lactate, oxidised / converted, to pyruvate **;** 6 idea that lactate is processed by liver **;** 7 AVP **;** e.g. *ref. to* oxygen debt / EPOC	**4**
10(b)	*any **three** from:* 1 (captive) breeding programs / described / frozen zoos **;** 2 marine reserves / protected areas **;** 3 ban on hunting / trade, (of seals) **;** 4 *ref. to* education / awareness **;** 5 research **;** 6 reduce, ocean / sea, pollution / described **;** 7 reduce fishing **;** 8 reduce climate change **;**	**3**

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