CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **October/November 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.

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Generic Marking Principles

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GENERIC MARKING PRINCIPLE 1:

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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).
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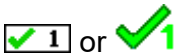
Annotations guidance for centres

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 standard isation 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
	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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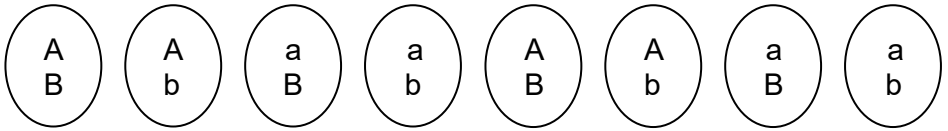
Annotation	Meaning
BP	blank page
CON	contradiction in response, mark not awarded
ECF	error carried forward applied
GM	mark already given
I	incorrect or insufficient point ignored while marking the rest of the response
MAX	maximum number of marks for a marking point has been awarded
O	or reverse argument
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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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>AABB AABb AaBB AaBb ; ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>long chocolate ;</td><td>1</td></tr>
<tr><td>1(b)</td><td>


;
<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>Ab</th></tr>
<tr><td>AB</td><td>AABB</td><td>AABb</td><td>AaBB</td><td>AaBb</td></tr>
<tr><td>Ab</td><td>AABb</td><td>AAbb</td><td>AaBb</td><td>Aabb</td></tr>
<tr><td>aB</td><td>AaBB</td><td>AaBb</td><td>aaBB</td><td>aaBb</td></tr>
<tr><td>Ab</td><td>AaBb</td><td>Aabb</td><td>aaBb</td><td>aabb ;</td></tr>
</table>
F2 offspring phenotype number ratio:
9 : 3 : 3 : 1 ;

short black | short chocolate | long black | long chocolate ;

Mp 4 need phenotypes linked to genotypes by colour, symbol or initials
</td><td>4</td></tr>
<tr><td>1(c)</td><td>1 structural gene codes for, (named) structural / functional, protein / polypeptide ;
2 regulatory gene codes for, transcription factor / repressor protein
or
regulatory gene, controls / helps / restricts, expression of (other) genes ;</td><td>2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>
<table>
<tr><td></td><td>E. turcicum</td><td>Z. mays</td></tr>
<tr><td>1
structural
difference</td><td>chitin cell wall
or
no chloroplasts
or
hyphae / cells long and branching
or
syncytial / multinucleate / several nuclei per cell</td><td>cellulose cell wall
or
chloroplasts
or
no hyphae / cells not long and branching
or
one nucleus per cell ;</td></tr>
<tr><td>2
functional
difference</td><td>heterotroph(ic) / parasitic / obtain food from host / do not photosynthesise</td><td>autotroph(ic) / phototrophic / photosynthesis(e) ;</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>2(a)(ii)</td><td>any four from:

1 large groups divide into smaller groups ;
2 common / similar / shared, features within a group ;
3 ref. three of: kingdom – phylum – class – order – family ;
4 genus and species = binomial / Linnaean / Latin / scientific, name ;
5 (both in domain) Eukarya ;
6 different kingdoms / Fungi and Plantae ;</td><td>4</td></tr>
<tr><td>2(b)(i)</td><td>any two from:

1 low percentage leaf damage means high resistance (to infection) ;
2 SKV50 = 22% <u>and</u> CML153 = 58% ;
3 SKV50 shows greater resistance (to infection) ;</td><td>2</td></tr>
<tr><td>2(b)(ii)</td><td>continuous ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(b)(iii)	*any **four** from:* **1** many / different / several / multiple, genes **;** **2** affect, same trait / (percentage) area of leaf damage / resistance **;** **3** <u>alleles</u> of, one / each, gene have a small effect **;** **4** (different) <u>genes</u> have, additive / combined / interactive, effects **;** **5** mathematical treatment to illustrate additive effect **;**	**4**

Question	Answer	Marks
3(a)(i)	0.95 (no units) **; ;**	**2**
3(a)(ii)	*any **two** from:* **1** **B**, run for less time / stopped early **;** **2** chlorophyll, converted / changed, to phaeophytin **;** **3** AVP **;**	**2**
3(a)(iii)	*any **one** from*: **1** different solvents **;** **2** different, TLC plate / chromatogram / stationary phase (material) **;** **3** different temperatures **;**	**1**

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Question	Answer	Marks
3(b)	*any **four** from*: *similarities* **1** both absorb, blue / between 400 and 475 nm **;** **2** both absorb, little / no, light between 525 and, 600 / 630, nm **or** both absorb, little / no, green / yellow, light **;** **3** AVP **;** *max three differences* **4** chlorophyll *a* absorbs, at more / a larger range of, wavelengths **;** **5** chlorophyll *a* absorbs, more / better, between 400 and 445 nm **;** **6** carotenoids absorb, more / better, between 445 and 525 nm **;** **7** chlorophyll *a* absorbs between, 600 / 640, and, 680 / 690 nm, <u>and</u> carotenoids do not **;** **8** chlorophyll *a* (blue absorption) peak / highest, at 425 / 430 nm <u>and</u> carotenoids (blue absorption) peak / highest, at 460 / 465 nm **;** **9** chlorophyll *a* has blue peak and red peak but carotenoids have two blue peaks and no red peak **or** chlorophyll *a* has two peaks but carotenoids have three peaks **;**	**4**
3(c)	*any **four** from*: **1** gibberellin, moves to / acts on / stimulates, <u>aleurone</u> layer **;** **2** binds to, (gibberellin) receptor / GID(1) **;** **3** breaks down <u>DELLA</u> (protein) **;** **4** releases, PIF / transcription factor **;** **5** switches on <u>gene</u> for, amylase / maltase / protease **;** **6** amylase, breaks down / hydrolyses, starch to maltose **;** **7** sugars / glucose, for, respiration / growth, of embryo **;**	**4**

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Question	Answer	Marks
4(a)	**1** diploid **;** **2** allele **;** **3** dominant (allele) **;**	**3**
4(b)	*any **four** from:* **1** CDV acts as a selection pressure **;** **2** DNA / allele, for black (coat) gives resistance to CDV **or** DNA / allele, for black (coat), gives (selective) advantage / is selected for, if / when, CDV is common / dogs are common **;** *in the south (context must be established at least once):* **3** more CDV (infection) in wolves **;** **4** black wolves, more likely to survive / have selective advantage / are selected for **; ORA** greys **5** black wolves more likely to, breed / reproduce **; ORA** greys **6** pass on / increase the frequency of, allele for black coat **; ORA** grey	**4**
4(c)	**1** positive (linear) correlation / positive relationship / direct relationship / directly proportional **or** as % with (anti-CDV) antibodies increases the % of black wolvesincreases **;** *plus any **three** from:* **2** wolves that survive CDV will, later / as a result, have antibodies **;** **3** high % of antibodies show population with high level of CDV **;** **4** in population with high % antibodies, grey wolves have died / more black wolves are left **;** **5** gene / DNA / allele / protein, that gives black coat, helps survival / gives resistance to CDV / defends against CDV **;** **6** AVP **;**	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>feature</th><th>ADH</th><th>glucagon</th><th>insulin</th><th></th></tr>
<tr><td>binds to receptors on cell surface membranes</td><td>✓</td><td>✓</td><td>✓</td><td>;</td></tr>
<tr><td>results in molecules moving from cells into the blood</td><td>✓</td><td>✓</td><td>×</td><td>;</td></tr>
<tr><td>is secreted as a result of detection by osmoreceptors</td><td>✓</td><td>×</td><td>×</td><td>;</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>5(b)</td><td>any four from:

1 impulses / action potentials / neurotransmitters, in nervous system <u>and</u> hormones in endocrine system ;
2 electrical in nervous system <u>and</u> chemical in endocrine system ;
3 neurones / nerve cells, in nervous system <u>and</u> blood in endocrine system ;
4 effects are / target is, specific / localised, in nervous system <u>and</u> (can be) widespread in endocrine system ;
5 effect / response, happens quickly in nervous system and slowly in endocrine system ;
6 effect / response, lasts a short time in nervous system <u>and</u> long time in endocrine system ;
7 AVP ;</td><td>4</td></tr>
<tr><td>5(c)(i)</td><td>C ;</td><td>1</td></tr>
<tr><td>5(c)(ii)</td><td>B ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
5(c)(iii)	**1** (**D** / it), shortens / contracts / decreases ; *and any **three** from:* **2** calcium ions / Ca^{2+}, bind to troponin ; **3** tropomyosin, moves / shifts position / exposes binding sites on actin ; **4** myosin (head) binds to actin / myosin-actin cross-bridges form ; **5** power stroke / myosin head, pulls actin ; **6** more actin, enters / overlaps with, A band / **B** **or** more overlap between actin and myosin ;	**4**

Question	Answer	Marks
6(a)(i)	*any **three** from:* **1** identify / protect / prioritise, species most at risk ; **2** provide data to / advise, governments / scientists / zoos / industry ; **3** so action can be taken to protect a <u>species</u> ; **4** example of conservation action ; **5** AVP ;	**3**
6(a)(ii)	*in Europe / west **or** where, endangered / EN (context must be stated)* **1** *P. arion* less abundant (compared to, Asia / NT) ; **2** more threatened / higher risk of extinction ; **3** AVP ;	**2**
6(b)(i)	**1** <u>habitat</u>, degradation / change / loss ; **2** due to, (change in) farming / development ; **3** lack of, food plants / flowers for food ;	**2**

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Question	Answer	Marks
6(b)(ii)	*any **four** from:* **1** prevent extinction / allow survival (of species) ; **2** maintain / increase, biodiversity ; **3** aesthetic / recreational / wellbeing (reasons / benefits) ; **4** for, scientific interest / research / education ; **5** ethical / moral / stewardship (obligation) ; **6** local cultural significance / save local heritage / ecotourism ; **7** maintain / protect / restore / stability of, food chains / food webs ; **8** pollination / ecosystem, services ;	**4**

Question	Answer	Marks
7(a)	*any **three** from:* **1** breaks down / hydrolyses to / converted to, ADP / AMP, and Pi ; **2** releases energy / energy donor ; **3** reversible reaction / high turnover / can be regenerated ; **4** small / soluble, so can, diffuse / move (freely), in cell ; **5** AVP ;	**3**
7(b)	*any **six** from*: **1** ETC / electron flow, less / stops ; **2** no / less, energy, available / released / supplied (from electron flow) ; **3** no / fewer, H^+ ions / protons, pumped to intermembrane space ; **4** no / smaller, H^+ / proton, gradient ; **5** no / fewer, protons diffuse through ATP synthase ; **6** no / fewer, electrons reach, last carrier / end of chain ; **7** no / fewer, electrons can react with oxygen to form water ; **8** (oxidised) NAD not regenerated / lack of NAD ; **9** no / less, glycolysis / link reaction / Krebs cycle ; **10** AVP ;	**6**

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Question	Answer	Marks
8(a)	*any **four** from:* **1** (Liberty Link soybean / it, is) not harmed by / not killed by / resistant to, herbicide / glufosinate **;** **2** herbicide / glufosinate, kills, weeds / unwanted plants **;** **3** reduces / removes / less / no, <u>competition</u> (with, weeds / unwanted plants) **;** **4** *ref. to* (sun)light / water / (named) <u>soil</u> minerals **;** **5** higher yield **or** more crop, harvested / produced **;** **6** AVP **;**	**4**
8(b)(i)	restriction, enzyme / endonuclease **;**	**1**
8(b)(ii)	(DNA) ligase **;**	**1**
8(c)	*any **three** from:* *some / other / 21, countries:* **1** may, have, unsuitable / described problem in, climate / weather / soil **;** **2** no regulatory approval / may have banned (GM / Liberty Link) **;** **3** may have, (activist) groups / people, opposed to GM crops **;** **4** may not have land space available **;** **5** may have banned, herbicide / glufosinate **;** **6** AVP **;**	**3**

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Question	Answer	Marks
9(a)	(**X** =) (renal) pelvis **;** (**Y** =) medulla **;**	**2**
9(b)	*any **four** from*: **1** glucose oxidase (present / immobilised, in sensor / on strip) **;** **2** glucose → hydrogen peroxide **;** **3** hydrogen peroxide (oxidised) → oxygen / electrons **;** **4** (magnitude of) e– flow / current / voltage, (generated) is proportional to, hydrogen peroxide / glucose, concentration **;** **5** digital / numerical / quantitative, reading / result / value (on screen) **;** **6** AVP **;**	**4**

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Question	Answer	Marks
10	*marks from any two groups of mark points to max 6:* **1** mutant *TYR* gene codes for non-functioning tyrosinase **;** **2** albinism / albino, recessive (disorder / allele) **;** **3** lack of melanin / no melanin produced **;** **4** giving, pale / fair, skin / hair **or** giving, transparent / pink, iris **;** **5** mutant *HBB* gene codes for, abnormal (β) globin / haemoglobin S **;** **6** sickle cell, anaemia / disease, codominant (disorder / allele) **;** **7** less soluble / sticky / rod-forming, haemoglobin makes red blood cells sickle **;** **8** sickle cells, block capillaries / cause pain (in low O_2 conditions) **;** **9** mutant *F8* gene codes for non-functional factor VIII **;** **10** haemophilia, recessive **/** sex-linked / on X chromosome **;** **11** fibrinogen not changed to fibrin **;** **12** blood clotting problem / risk of excessive bleeding **;** **13** mutant *HTT* gene codes for abnormal huntingtin protein **;** **14** Huntington's disease dominant (disorder / allele) **;** **15** *ref. to* additional / number of, CAG repeats **;** **16** cognitive / movement, difficulty **;** *other human genetic conditions (max 2 conditions with 4 possible marks each)* **17** mutant named gene codes for abnormal named protein **; ;** **18** type of allele that causes named condition **; ;** **19** biochemical detail re. gene / protein / molecule **; ;** **20** physiological effect **; ;**	**6**

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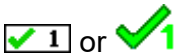
Annotations guidance for centres

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Annotations

Annotation	Meaning
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	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
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MAX	maximum number of marks for a marking point has been awarded
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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;	separates marking points
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AVP	alternative valid point

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>A oxygen ;

B ethanol ;

C aerenchyma ;</td><td>3</td></tr>
<tr><td>1(b)</td><td>ref. to ethanol dehydrogenase (to break it down) ; A alcohol dehydrogenase</td><td>1</td></tr>
<tr><td>1(c)(i)</td><td>as gibberellin concentration increases, the length of stem increases
or
positive correlation between concentration of gibberellin and length of stem ;

data quote – two concentrations and two lengths with units ;

<table>
<tr><th>conc gibberellin / au</th><th>length of stem / mm ± 0.5 mm</th></tr>
<tr><td>1</td><td>3</td></tr>
<tr><td>2</td><td>19</td></tr>
<tr><td>3</td><td>27</td></tr>
<tr><td>4</td><td>45</td></tr>
<tr><td>5</td><td>52</td></tr>
</table>
</td><td>2</td></tr>
</table>

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Question	Answer	Marks
1(c)(ii)	*any **three** from :* 1 ethylene causes break down of ABA, **so** gibberellin, active / stimulated / functional **;** 2 plants grow tall(er) / stems increase in length / stem elongation / increase in internodal length **;** 3 (so) leaves / flowers, held above the water **;** 4 (so) photosynthesis can occur / increased access to light / AW **or** (so) gas exchange / reproduction, can occur **;**	**3**

Question	Answer	Marks
2(a)	*gene* a section of DNA / sequence of (DNA) bases, coding for a (specific) polypeptide **;** *genotype* all the alleles / alleles in an organism / (two) alleles of one gene **;** *phenotype* (observable) features / characteristics / traits / appearance, (of an organism) **;**	**3**

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Question	Answer	Marks
2(b)	*any **four** from:* 1 mate / breed / cross, homozygous (parents) **;** 2 **dominant** (parent) with **recessive** (parent) **;** 3 **to** produce the F1, offspring / generation **;** 4 (F1) offspring are heterozygotes **;** 5 mate / breed / cross, F1 offspring / F1 generation / heterozygotes **or** self an F1 offspring (plant) **;** 6 **to** produce the F2, offspring / generation **;** **plus** 7 25% (F2) offspring are, homozygous dominant, / AA and 50% are, heterozygotes / Aa and 25% are, homozygous recessive / aa **;** **A** a ratio e.g. AA Aa Aa aa 1 : 2 : 1	**5**

Question	Answer	Marks
3(a)(i)	*any **three** from:* 1 glucose diffuses into the cell (through, **A** / transport protein) **;** 2 *idea that* the enzyme / **B**, loses phosphate group **;** 3 (dephosphorylated) **B** binds to lactose permease **;** 4 causes, shape change / allosteric change, to lactose permease **;** 5 lactose permease cannot function (so lactose cannot enter) **;**	**3**
3(a)(ii)	*any **two** from:* 1 no / less, (protein) synthesis of, lactose permease / β-galactosidase / transacetylase **or** no / less, transcription / expression, of (named structural) genes (of lac operon) **;** 2 no / less, ATP / energy, wasted **;** 3 no / fewer, amino acids wasted **;** 4 glucose is respired more easily / AW **or** fewer steps / less energy, required to break down glucose **or** lactose has to be broken down (to glucose and galactose) **;**	**2**

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Question	Answer	Marks
3(a)(iii)	*any **three** from:* 1 splits into / forms, **two,** triose phosphate / TP (molecules) **;** 2 (TP) oxidised / dehydrogenated, to pyruvate **;** 3 ATP production **;** 4 substrate-linked phosphorylation **;** 5 production of reduced NAD **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>
any two from:

lactose diet
1 increases (over six days) ;

no lactose diet
2 small increase / increases slightly / little change / stays around 50% (over six days) ;

3 comparative data quote – 2 percentages of either diet over time
or
percentage of each diet on one day ;
<table>
<tr><th>time / days</th><th colspan="2">percentage lac⁺ ± 0.5 mm</th></tr>
<tr><td></td><td>lactose diet</td><td>no lactose diet</td></tr>
<tr><td>0</td><td>50</td><td>50</td></tr>
<tr><td>1</td><td>65.5</td><td>54</td></tr>
<tr><td>2</td><td>75.5</td><td>56.5</td></tr>
<tr><td>3</td><td>83.5</td><td>60</td></tr>
<tr><td>4</td><td>84</td><td>59</td></tr>
<tr><td>5</td><td>85</td><td>57.5</td></tr>
<tr><td>6</td><td>86</td><td>57</td></tr>
</table>
</td><td>2</td></tr>
</table>

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Question	Answer	Marks
3(b)(ii)	*any **two** from:* 1 lactose is the **selection pressure ;** 2 (*lac*$^{+}$), can metabolise / take up / AW, lactose (so survive) **or** *lac*$^{-}$, cannot metabolise / take up / AW, lactose (so die) **;** 3 AVP **;** e.g. *ref.* glucose has run out	**2**

Question	Answer	Marks
4(a)	1 mutation **;** *2* horizontal transmission / conjugation / transformation / transduction **;**	**2**
4(b)	*idea of* tracking, mutations / resistance genes / resistance alleles **or** identifies mechanisms of resistance **or** (informed) choice / production, of antibiotic **;**	**1**
4(c)	*any **three** from:* 1 streptomycin is selection pressure **;** 2 bacteria with, mutation / resistance, survive / reproduce / have a selective advantage **; ora** 3 allele / gene, for **resistance** passed on **;** 4 directional selection **;**	**3**

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Question	Answer	Marks
5(a)	*any **four** from:* *mark as pairs* *Name* 1 dNTPs / <u>DNA</u> nucleotides **;** *Explanation 1* to, anneal / bind, to **complementary** bases **;** *Name 2* Taq polymerase **;** *Explanation 2* to make, phosphodiester bonds / the sugar phosphate backbone / double-stranded DNA / a complementary strand of DNA **or** *ref. to* functioning at higher temperature / does not denature at the higher temperature / is thermostable **;** *Name 3* buffer **;** *Explanation 3* to provide, optimum / suitable / constant, pH for, polymerase / DNA **or** prevents, denaturation of polymerase / damage to DNA **;**	**4**
5(b)(i)	*any **two** from:* 1 (DNA ladder) compared to (other fragments) **;** 2 *ref. to* (estimate) length of (DNA) fragment / to identify the fragment number **;** 3 *ref. to* show electrophoresis worked correctly **;**	**2**

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Question	Answer	Marks
5(b)(ii)	*any **three** from:* 1 (PCR) amplifies / makes many copies of, DNA (fragments) ; 2 (PCR) *ref. to* selecting fragments, small enough / less than 1000 bp / not more than 916 bp (for sequencing) ; 3 (electrophoresis) separate the (DNA) fragments ; 4 (electrophoresis) confirms / identifies, fragment lengths / fragment number / PCR worked correctly ;	**3**
5(c)	(2^{35} =) 3.4×10^{10} ;	**1**
5(d)	*any **four** from:* 1 child may have disease when, neither parent has the disease / no family history ; 2 early, detection / treatment (for gene therapy to work) ; 3 improve, quality of life / life expectancy ; 4 *ref. to* informs family planning (for future pregnancies) ; 5 *idea that* it does not involve additional sampling ; 6 (screening is) expensive ; 7 treatment / gene therapy, expensive ; 8 test may not always be accurate ; 9 long-term effect of treatment, unknown / negative ;	**4**

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Question	Answer	Marks
6(a)	*any **four** from :* 1 less / no, PKB, activated / stimulated ; 2 fewer / no, vesicles, move to / fuse with, cell surface membrane ; 3 fewer / no, GLUT4 (transport proteins) added to (cell surface) membrane **or** (cell surface) membrane, less / not, permeable to glucose ; 4 less / no, glucose taken up by facilitated diffusion (into muscle cells) ; 5 **blood** glucose concentration, (remains) high(er) / does not decrease ;	**4**
6(b)	*any **seven** from :* 1 (biosensor has) glucose oxidase (immobilised on recognition layer) ; 2 blood sample added ; 3 glucose (in blood) passes through, partially / selectively, permeable membrane ; 4 glucose oxidase, oxidises glucose / converts glucose / catalyses glucose reaction ; 5 gluconic acid and hydrogen peroxide formed ; 6 reaction converted to a current (by transducer) ; 7 current is amplified ; 8 digital / numerical / quantitative, reading ; 9 size of current is proportional to glucose concentration ; 10 instant result / accurate ;	**7**

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Question	Answer	Marks
7(a)(i)	*any **one** from :* soil contains few (named mineral) ions **;** located in, shaded areas / areas of low light intensity **;**	**1**
7(a)(ii)	to attract insects **;**	**1**
7(a)(iii)	energy / ATP, not wasted (responding to a non-edible object) **;**	**1**
7(a)(iv)	(time) for, digestion / enzyme action / absorption / assimilation **;**	**1**
7(b)	*any **three** from :* 1 impulses / action potentials, are discrete events / AW **;** 2 impulses / action potentials, are unidirectional **;** 3 determines / limits, the frequency of, impulses / action potentials **;** 4 AVP **;** e.g. 200-300 action potentials per second	**3**

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Question	Answer	Marks
8(a)	*any **four** from :* 1 (named) protected reserves ; 2 **limit** palm oil plantations / *ref. to* sustainable palm oil production ; 3 restoring lost habitat / reforestation / reduce deforestation ; 4 captive breeding programs ; 5 release into wild ; 6 ban, hunting / trade; 7 raise awareness / education ; 8 *ref. to* research ;	**4**
8(b)	1 ecosystem / habitat (diversity) ; 2 species (diversity / richness) ; 3 genetic (diversity) ;	**3**
8(c)(i)	0.2034 ; 0.3072 ; *allow **ecf** for mp2 if both incorrect* *allow **ecf** for mp2 if figure correct in both but not to 4dp*	**2**
8(c)(ii)	0.6928 / 0.693 ; *allow **ecf** for 1 minus their answer to **8ci***	**1**

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Question	Answer	Marks
8(c)(iii)	(*D*) close(r) to 1 / higher than 0.5 **;** (so) high(er) (bio)diversity **;**	**2**

Question	Answer	Marks
9(a)(i)	*absorption spectrum* absorption of **different** wavelengths (of light) by (named) pigment(s) **;** *action spectrum* **rate** of photosynthesis at different wavelengths (of light) **;**	**2**
9(a)(ii)	*any **three** from :* 1 chlorophyll b / carotenoids / accessory pigments (are present) **;** 2 (these other pigments) absorb light (energy), between 450 and 550 nm / of wavelengths that chlorophyll a does not absorb **;** 3 energy passed on to, reaction centre / chlorophyll a / primary pigment **;** 4 for, light-dependent reactions / photophosphorylation / photolysis (of water) / photoactivation **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(b)(i)</td><td>
any four from :

1 increase then decrease ;

2 optimum temperature at 29 °C ;

3 data quote – two temperatures and two rates with units ;

<table>
<tr><th>temperature / °C
±0.5</th><th>rate of photosynthesis / mg g^{-1} h^{-1}
±0.05</th></tr>
<tr><td>2.5</td><td>0.75</td></tr>
<tr><td>5</td><td>1.1</td></tr>
<tr><td>10</td><td>1.8</td></tr>
<tr><td>20</td><td>2.95</td></tr>
<tr><td>29</td><td>3.5</td></tr>
<tr><td>30</td><td>3.45</td></tr>
<tr><td>40</td><td>2.65</td></tr>
<tr><td>45</td><td>1.5</td></tr>
<tr><td>48</td><td>0.5</td></tr>
</table>
increase / before 29 °C
4 more kinetic energy for, enzyme (activity) / AW ;

5 temperature is the limiting factor ;

decrease / after 29 °C
6 denaturation of, rubisco / enzymes / oxygen-evolving complex ;

7 AVP ; e.g. photorespiration limiting the rate at above 25 °C
</td><td>4</td></tr>
</table>

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Question	Answer	Marks
9(b)(ii)	3.525 to 3.675 **;** mg g^{-1} h^{-1} **;**	**2**

Question	Answer	Marks
10(a)	*any **three** from :* 1 myelin **sheath** / Schwann cells, acts as an insulator / prevents movement of ions **;** 2 depolarisation / action potential, **only** occurs at the nodes **; I** impulses 3 action potentials jump from node to node / saltatory conduction **; I** impulses 4 long(er) local circuits **;** 5 AVP **;** e.g. wide axon diameter	**3**
10(b)	*any **four** from :* 1 ACh binds to receptors on <u>sarcolemma</u> **;** 2 (ligand-gated) Na^+ channels open **or** Na^+ enters, muscle cell / sarcoplasm **;** 3 <u>sarcolemma</u> depolarised **;** 4 depolarisation / action potential, spreads, to / down, T-tubules **;** 5 **voltage-gated** Ca^{2+} channels open **;** 6 Ca^{2+}, diffuse / move, out of sarcoplasmic reticulum (and bind to troponin) **;**	**4**

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Question	Answer	Marks
10(c)	*any **three** from :* 1 (decreased rate of respiration so), no / less, ATP produced **;** 2 no / less, Ca^{2+} pumped back into sarcoplasmic reticulum **;** 3 no / less, release of myosin heads from actin / cross bridges broken **or** no / less, hydrolysis of ATP by myosin head / return of myosin head to original position **;** AW 4 sarcomere, permanently contracted / cannot relax **;** **A** paralysis 5 slower sarcomere contraction / less sarcomere shortening / weaker power stroke **;**	**3**

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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **October/November 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 October/November 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	<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.

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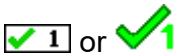
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	used to highlight part of an extended response
	used to highlight part of an extended response
	allow or accept
	benefit of the doubt given

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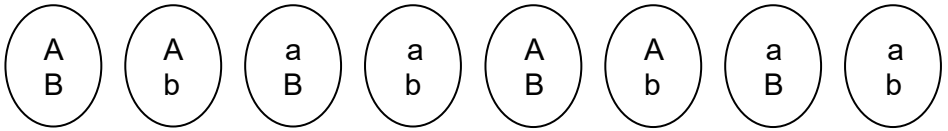
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<tr><td>1(a)(i)</td><td>AABB AABb AaBB AaBb ; ;</td><td>2</td></tr>
<tr><td>1(a)(ii)</td><td>long chocolate ;</td><td>1</td></tr>
<tr><td>1(b)</td><td>


;
<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>Ab</th></tr>
<tr><td>AB</td><td>AABB</td><td>AABb</td><td>AaBB</td><td>AaBb</td></tr>
<tr><td>Ab</td><td>AABb</td><td>AAbb</td><td>AaBb</td><td>Aabb</td></tr>
<tr><td>aB</td><td>AaBB</td><td>AaBb</td><td>aaBB</td><td>aaBb</td></tr>
<tr><td>Ab</td><td>AaBb</td><td>Aabb</td><td>aaBb</td><td>aabb ;</td></tr>
</table>
F2 offspring phenotype number ratio:
9 : 3 : 3 : 1 ;

short black short chocolate long black long chocolate ;

Mp 4 need phenotypes linked to genotypes by colour, symbol or initials
</td><td>4</td></tr>
<tr><td>1(c)</td><td>1 structural gene codes for, (named) structural / functional, protein / polypeptide ;
2 regulatory gene codes for, transcription factor / repressor protein
or
regulatory gene, controls / helps / restricts, expression of (other) genes ;</td><td>2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>
<table>
<tr><td></td><td>E. turcicum</td><td>Z. mays</td></tr>
<tr><td>1
structural
difference</td><td>chitin cell wall
or
no chloroplasts
or
hyphae / cells long and branching
or
syncytial / multinucleate / several nuclei per cell</td><td>cellulose cell wall
or
chloroplasts
or
no hyphae / cells not long and branching
or
one nucleus per cell ;</td></tr>
<tr><td>2
functional
difference</td><td>heterotroph(ic) / parasitic / obtain food from host / do not photosynthesise</td><td>autotroph(ic) / phototrophic / photosynthesis(e) ;</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>2(a)(ii)</td><td>any four from:

1 large groups divide into smaller groups ;
2 common / similar / shared, features within a group ;
3 ref. three of: kingdom – phylum – class – order – family ;
4 genus and species = binomial / Linnaean / Latin / scientific, name ;
5 (both in domain) Eukarya ;
6 different kingdoms / Fungi and Plantae ;</td><td>4</td></tr>
<tr><td>2(b)(i)</td><td>any two from:

1 low percentage leaf damage means high resistance (to infection) ;
2 SKV50 = 22% <u>and</u> CML153 = 58% ;
3 SKV50 shows greater resistance (to infection) ;</td><td>2</td></tr>
<tr><td>2(b)(ii)</td><td>continuous ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(b)(iii)	*any **four** from:* **1** many / different / several / multiple, genes **;** **2** affect, same trait / (percentage) area of leaf damage / resistance **;** **3** <u>alleles</u> of, one / each, gene have a small effect **;** **4** (different) <u>genes</u> have, additive / combined / interactive, effects **;** **5** mathematical treatment to illustrate additive effect **;**	**4**

Question	Answer	Marks
3(a)(i)	0.95 (no units) **; ;**	**2**
3(a)(ii)	*any **two** from:* **1** **B**, run for less time / stopped early **;** **2** chlorophyll, converted / changed, to phaeophytin **;** **3** AVP **;**	**2**
3(a)(iii)	*any **one** from*: **1** different solvents **;** **2** different, TLC plate / chromatogram / stationary phase (material) **;** **3** different temperatures **;**	**1**

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Question	Answer	Marks
3(b)	*any **four** from*: *similarities* **1** both absorb, blue / between 400 and 475 nm **;** **2** both absorb, little / no, light between 525 and, 600 / 630, nm **or** both absorb, little / no, green / yellow, light **;** **3** AVP **;** *max three differences* **4** chlorophyll *a* absorbs, at more / a larger range of, wavelengths **;** **5** chlorophyll *a* absorbs, more / better, between 400 and 445 nm **;** **6** carotenoids absorb, more / better, between 445 and 525 nm **;** **7** chlorophyll *a* absorbs between, 600 / 640, and, 680 / 690 nm, <u>and</u> carotenoids do not **;** **8** chlorophyll *a* (blue absorption) peak / highest, at 425 / 430 nm <u>and</u> carotenoids (blue absorption) peak / highest, at 460 / 465 nm **;** **9** chlorophyll *a* has blue peak and red peak but carotenoids have two blue peaks and no red peak **or** chlorophyll *a* has two peaks but carotenoids have three peaks **;**	**4**
3(c)	*any **four** from*: **1** gibberellin, moves to / acts on / stimulates, <u>aleurone</u> layer **;** **2** binds to, (gibberellin) receptor / GID(1) **;** **3** breaks down <u>DELLA</u> (protein) **;** **4** releases, PIF / transcription factor **;** **5** switches on <u>gene</u> for, amylase / maltase / protease **;** **6** amylase, breaks down / hydrolyses, starch to maltose **;** **7** sugars / glucose, for, respiration / growth, of embryo **;**	**4**

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Question	Answer	Marks
4(a)	**1** diploid **;** **2** allele **;** **3** dominant (allele) **;**	**3**
4(b)	*any **four** from:* **1** CDV acts as a selection pressure **;** **2** DNA / allele, for black (coat) gives resistance to CDV **or** DNA / allele, for black (coat), gives (selective) advantage / is selected for, if / when, CDV is common / dogs are common **;** *in the south (context must be established at least once):* **3** more CDV (infection) in wolves **;** **4** black wolves, more likely to survive / have selective advantage / are selected for **; ORA** greys **5** black wolves more likely to, breed / reproduce **; ORA** greys **6** pass on / increase the frequency of, allele for black coat **; ORA** grey	**4**
4(c)	**1** positive (linear) correlation / positive relationship / direct relationship / directly proportional **or** as % with (anti-CDV) antibodies increases the % of black wolvesincreases **;** *plus any **three** from:* **2** wolves that survive CDV will, later / as a result, have antibodies **;** **3** high % of antibodies show population with high level of CDV **;** **4** in population with high % antibodies, grey wolves have died / more black wolves are left **;** **5** gene / DNA / allele / protein, that gives black coat, helps survival / gives resistance to CDV / defends against CDV **;** **6** AVP **;**	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>feature</th><th>ADH</th><th>glucagon</th><th>insulin</th><th></th></tr>
<tr><td>binds to receptors on cell surface membranes</td><td>✓</td><td>✓</td><td>✓</td><td>;</td></tr>
<tr><td>results in molecules moving from cells into the blood</td><td>✓</td><td>✓</td><td>×</td><td>;</td></tr>
<tr><td>is secreted as a result of detection by osmoreceptors</td><td>✓</td><td>×</td><td>×</td><td>;</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>5(b)</td><td>any four from:

1 impulses / action potentials / neurotransmitters, in nervous system <u>and</u> hormones in endocrine system ;
2 electrical in nervous system <u>and</u> chemical in endocrine system ;
3 neurones / nerve cells, in nervous system <u>and</u> blood in endocrine system ;
4 effects are / target is, specific / localised, in nervous system <u>and</u> (can be) widespread in endocrine system ;
5 effect / response, happens quickly in nervous system and slowly in endocrine system ;
6 effect / response, lasts a short time in nervous system <u>and</u> long time in endocrine system ;
7 AVP ;</td><td>4</td></tr>
<tr><td>5(c)(i)</td><td>C ;</td><td>1</td></tr>
<tr><td>5(c)(ii)</td><td>B ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
5(c)(iii)	**1** (**D** / it), shortens / contracts / decreases ; *and any **three** from:* **2** calcium ions / Ca^{2+}, bind to troponin ; **3** tropomyosin, moves / shifts position / exposes binding sites on actin ; **4** myosin (head) binds to actin / myosin-actin cross-bridges form ; **5** power stroke / myosin head, pulls actin ; **6** more actin, enters / overlaps with, A band / **B** **or** more overlap between actin and myosin ;	**4**

Question	Answer	Marks
6(a)(i)	*any **three** from:* **1** identify / protect / prioritise, species most at risk ; **2** provide data to / advise, governments / scientists / zoos / industry ; **3** so action can be taken to protect a <u>species</u> ; **4** example of conservation action ; **5** AVP ;	**3**
6(a)(ii)	*in Europe / west **or** where, endangered / EN (context must be stated)* **1** *P. arion* less abundant (compared to, Asia / NT) ; **2** more threatened / higher risk of extinction ; **3** AVP ;	**2**
6(b)(i)	**1** <u>habitat</u>, degradation / change / loss ; **2** due to, (change in) farming / development ; **3** lack of, food plants / flowers for food ;	**2**

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Question	Answer	Marks
6(b)(ii)	*any **four** from:* **1** prevent extinction / allow survival (of species) ; **2** maintain / increase, biodiversity ; **3** aesthetic / recreational / wellbeing (reasons / benefits) ; **4** for, scientific interest / research / education ; **5** ethical / moral / stewardship (obligation) ; **6** local cultural significance / save local heritage / ecotourism ; **7** maintain / protect / restore / stability of, food chains / food webs ; **8** pollination / ecosystem, services ;	**4**

Question	Answer	Marks
7(a)	*any **three** from:* **1** breaks down / hydrolyses to / converted to, ADP / AMP, and Pi ; **2** releases energy / energy donor ; **3** reversible reaction / high turnover / can be regenerated ; **4** small / soluble, so can, diffuse / move (freely), in cell ; **5** AVP ;	**3**
7(b)	*any **six** from*: **1** ETC / electron flow, less / stops ; **2** no / less, energy, available / released / supplied (from electron flow) ; **3** no / fewer, H^+ ions / protons, pumped to intermembrane space ; **4** no / smaller, H^+ / proton, gradient ; **5** no / fewer, protons diffuse through ATP synthase ; **6** no / fewer, electrons reach, last carrier / end of chain ; **7** no / fewer, electrons can react with oxygen to form water ; **8** (oxidised) NAD not regenerated / lack of NAD ; **9** no / less, glycolysis / link reaction / Krebs cycle ; **10** AVP ;	**6**

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Question	Answer	Marks
8(a)	*any **four** from:* **1** (Liberty Link soybean / it, is) not harmed by / not killed by / resistant to, herbicide / glufosinate **;** **2** herbicide / glufosinate, kills, weeds / unwanted plants **;** **3** reduces / removes / less / no, <u>competition</u> (with, weeds / unwanted plants) **;** **4** *ref. to* (sun)light / water / (named) <u>soil</u> minerals **;** **5** higher yield **or** more crop, harvested / produced **;** **6** AVP **;**	**4**
8(b)(i)	restriction, enzyme / endonuclease **;**	**1**
8(b)(ii)	(DNA) ligase **;**	**1**
8(c)	*any **three** from:* *some / other / 21, countries:* **1** may, have, unsuitable / described problem in, climate / weather / soil **;** **2** no regulatory approval / may have banned (GM / Liberty Link) **;** **3** may have, (activist) groups / people, opposed to GM crops **;** **4** may not have land space available **;** **5** may have banned, herbicide / glufosinate **;** **6** AVP **;**	**3**

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Question	Answer	Marks
9(a)	(**X** =) (renal) pelvis **;** (**Y** =) medulla **;**	**2**
9(b)	*any **four** from*: **1** glucose oxidase (present / immobilised, in sensor / on strip) **;** **2** glucose → hydrogen peroxide **;** **3** hydrogen peroxide (oxidised) → oxygen / electrons **;** **4** (magnitude of) e– flow / current / voltage, (generated) is proportional to, hydrogen peroxide / glucose, concentration **;** **5** digital / numerical / quantitative, reading / result / value (on screen) **;** **6** AVP **;**	**4**

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Question	Answer	Marks
10	*marks from any two groups of mark points to max 6:* **1** mutant *TYR* gene codes for non-functioning tyrosinase **;** **2** albinism / albino, recessive (disorder / allele) **;** **3** lack of melanin / no melanin produced **;** **4** giving, pale / fair, skin / hair **or** giving, transparent / pink, iris **;** **5** mutant *HBB* gene codes for, abnormal (β) globin / haemoglobin S **;** **6** sickle cell, anaemia / disease, codominant (disorder / allele) **;** **7** less soluble / sticky / rod-forming, haemoglobin makes red blood cells sickle **;** **8** sickle cells, block capillaries / cause pain (in low O_2 conditions) **;** **9** mutant *F8* gene codes for non-functional factor VIII **;** **10** haemophilia, recessive **/** sex-linked / on X chromosome **;** **11** fibrinogen not changed to fibrin **;** **12** blood clotting problem / risk of excessive bleeding **;** **13** mutant *HTT* gene codes for abnormal huntingtin protein **;** **14** Huntington's disease dominant (disorder / allele) **;** **15** *ref. to* additional / number of, CAG repeats **;** **16** cognitive / movement, difficulty **;** *other human genetic conditions (max 2 conditions with 4 possible marks each)* **17** mutant named gene codes for abnormal named protein **; ;** **18** type of allele that causes named condition **; ;** **19** biochemical detail re. gene / protein / molecule **; ;** **20** physiological effect **; ;**	**6**

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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/44**

Paper 4 A Level Structured Questions **October/November 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 October/November 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	<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.

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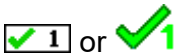
Annotations guidance for centres

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 standard isation 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
	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
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)	**1 A ;** **2 C ;** **3 F ;** **4 B ;**	**4**
1(b)	*any **four** from:* **1** no / less, Ca^{2+} / calcium ions, enter (synaptic knob / presynaptic neurone) **;** **2** no / less, vesicles of acetylcholine, move towards / fuse with / do exocytosis at, presynaptic membrane **;** **3** no / less, acetylcholine / ACh, binds to receptors (on postsynaptic membrane) **;** **4** no / less, Na^{+} / sodium ions, enter (postsynaptic neurone) **or** no / less, depolarisation of postsynaptic membrane **;** **5** no / fewer, actions potentials **;**	**4**

Question	Answer	Marks
2(a)	*anaphase:* **K** and **M** **;** *cells containing pairs of homologous chromosomes:* **J** and **K** **;** *crossing over:* **J** **;** *haploid cells:* **L** and **M** and **N** **;**	**4**
2(b)	*any **two** from:* **1** to prevent self-pollination / to ensure cross-pollination **;** **2** so, must cross with / other parent must be / pollen comes from, a, different / selected, plant / parent / individual / variety **;** **3** to make plant a female parent **;**	**2**

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Question	Answer	Marks
2(c)	*any **four** from:* *stage 1 – inbreeding to get two lines* **1** inbreeding / line breeding **;** **2** select for, disease resistance / rapid growth / high yield **;** **3** select, best / desirable, offspring <u>and</u> cross with each other repeatedly **;** **4** (results in) homozygous (loci) **;** *stage 2 – outcross to get uniform vigorous offspring* **5** hybridise / outcross / outbreed, with another, variety / type of maize **;** **6** with a different desired trait **;** **7** AVP **;**	**4**

Question	Answer	Marks
3(a)	*any **five** from:* **1** <u>restriction endonuclease</u> **;** **2** (RE) cuts, bacterial / herbicide-resistance, gene / DNA **;** **3** (RE) cuts a, plasmid / vector **;** **4** <u>DNA ligase</u> joins, new / bacterial / foreign, gene to, plasmid / vector **;** **5** *ref. to* joining / adding, of <u>promoter</u> **;** **6** (promoter / regulatory sequence) ensures expression of (new / bacterial / foreign / prokaryotic) gene **;**	**5**
3(b)	73 / 100 × 123.5 **or** 90.155 million **;** (90.155 × 2 =) 180.31 million **;**	**2**

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Question	Answer	Marks
3(c)	*any **four** from:* *positive implications:* **1** more food / higher yield (per hectare) **;** **2** (farmers) use less, insecticide / pesticide **;** **3** cheaper food prices for consumers **;** **4** less land needed to grow food leaves more for, biodiversity / conservation **;** **5** improved food nutritional value **;** *negative implications:* **6** food allergies ; **7** greater quantity of herbicide residue on food **;** **8** (evolution of) resistance in, insects / weeds / fungi / pests **;** **9** pollen drift to / cross-breeding with, organic / non-GM / conventional, crops **;** **10** GM crops may become invasive weeds **;** **11** consumer mistrust / GM food must be clearly labelled **;**	**4**

Question	Answer	Marks
4(a)(i)	0.3 **;**	**1**
4(a)(ii)	*any **four** from:* **1** genetic drift **;** **2** (drift as) frequency, fluctuates / decreases and increases / shows random changes / does not change markedly in just one direction **;** **3** <u>directional</u> selection **;** **4** from (generation) 2 to 7 / at first, **T** decreases as, **T** is selected against <u>and</u> from (generation) 7 to 13 / later, **T** increased as, **T** is selected for**;** **5** may be, stabilising selection / selection for heterozygotes **;** **6** (stabilising selection) keeps relative allele frequencies roughly the same **;**	**4**

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Question	Answer	Marks
4(b)	*any **three** from:* **1** small(er) population **;** **2** causes (genetic) bottleneck (effect) **;** **3** chance events, have greater relative effect on / cause larger fluctuations in, allele frequency **;** **4** more likely for one allele to, replace another / go extinct / become fixed **;** **5** by chance **T** organisms, did not mate / pass on **T** allele **or** by chance offspring with **T** died **;**	**3**
4(c)	Hardy-Weinberg **;**	**1**

Question	Answer	Marks
5(a)	*any **three** from:* **1** small so can keep, in small space / for low cost / with low maintenance **;** **2** can select parents for, mating / cross-breeding / particular crosses **;** **3** so get many, offspring / generations, in a short time **;** **4** can be used to research, cancer / (named) neurodegenerative diseases **;** **5** AVP **;**	**3**

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Question	Answer	Marks
5(b)	**1** *symbols*: **A** = grey body **a** = black body **B** = long wing **b** = short wing **;** *F1 phenotypes*: grey long x grey long **2** *F1 genotypes*: **AaBb** x (**AaBb**) **;**	**6**

	AB	**Ab**	**aB**	**ab** ;
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb ;

5 *F2 offspring phenotype number ratio:*
9 : 3 : 3 : 1 ;

6 grey long | grey short | black long | black short **;**

Question	Answer	Marks
5(c)	**1** carry out a test cross / cross with a double homozygous recessive fruit fly / cross with fly with black body and short wings **;** *plus any **two** from:* **2** if **some** offspring have black body then F2 fly is, heterozygous for the body colour (gene) / **Aa ;** **3** if **all** offspring have grey body then F2 fly is, homozygous dominant for body colour (gene) / **AA ;** **4** if **some** offspring have short wings then F2 fly is, heterozygous for wing length (gene) / **Bb ;** **5** if **all** offspring have long wings then F2 fly is, homozygous dominant for wing length (gene) / **BB ;**	**3**

Question	Answer	Marks
6(a)(i)	**1** <u>blood glucose concentration</u> increases until 30 minutes **;** **2** decreases to original value / returns to 5 mmol dm^{-3}, by 90 minutes **;**	**2**
6(a)(ii)	83.3 **; ;**	**2**
6(a)(iii)	*any **two** from:* **1** reduce intake of (named) carbohydrate **;** **2** physical exercise **;** **3** inject insulin **;** **4** AVP **;**	**2**

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Question	Answer	Marks
6(b)	*any **seven** from :* **1** glucagon is, cell-signalling molecule / ligand / first messenger ; **2** binds to receptor on liver cell (surface) membrane ; **3** G-protein activated ; **4** aden(yl)yl cyclase activated / formation of cAMP ; **5** *ref. to* second messenger ; **6** enzyme cascade / signal amplified ; **7** glycogenolysis / glycogen hydrolysed to glucose ; **8** gluconeogenesis / amino acids → glucose / triglycerides → glucose ; **9** glucose released into blood ; **10** AVP ;	**7**

Question	Answer	Marks
7(a)	**1** phylum ; **2** order ; **3** *Strigops* ;	**3**
7(b)	*any **three** from:* **1** no / few, humans ; **2** no / few, predators ; **3** sufficient, vegetation / food ; **4** places to hide during day ; **5** AVP ;	**3**
7(c)	*any **four** from:* **1** inbreeding depression **/** little hybrid vigour ; **2** low / decreased, genetic, diversity / variation **or** small gene pool ; **3** disadvantageous recessive alleles (more likely to be) expressed ; **4** infertility / low disease resistance / reduced fitness ; **5** low / decreased, ability to adapt **or** high / increased, risk of extinction ; **6** AVP ;	**4**

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Question	Answer	Marks
8(a)	*any **four** from:* **1** Ca^{2+} act as second messenger **;** **2** causes (K^+) channel proteins to open **;** **3** X = potassium ions / K^+ (that leave the cell) **;** **4** water potential of cell increases **/** water leaves cell by osmosis **;** **5** (guard) cell, becomes flaccid / loses turgidity **;**	**4**
8(b)	*any **four** from:* **1** (stomata) open to take up carbon dioxide for photosynthesis **;** **2** (stomata) close to prevent, transpiration / (excessive) water loss **;** **3** e.g. conditions when stomata close **;** **4** (water homeostasis needed to) maintain turgidity of cells / supply water for reactions **;** **5** *ref. to* daily rhythm **or** open during, day / light, and close, at night / at low light intensity / in the dark **;** **6** AVP **;**	**4**

Question	Answer	Marks
9(a)	**1** NAD **;** **2** <u>coenzyme A</u> **;**	**2**
9(b)	*any **three** from:* **1** enzyme activity decreases over time at both concentrations (of hydrogen peroxide) **;** **2** activity decreases, more / faster / at a greater rate, at high(er) H_2O_2 concentration **or** enzyme less active with, with high(er) H_2O_2 concentration **;** **3** paired data quote **;** **4** H_2O_2, acts as an inhibitor / inhibits enzyme activity **;**	**3**

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Question	Answer	Marks
9(c)	*any **four** from:* **1** energy is used to pump, protons / H^+, into intermembrane space **;** **2** proton gradient (formed) **;** **3** protons diffuse through ATP synthase **;** **4** ATP produced from ADP and Pi **;** **5** oxygen accepts electrons to form water **;** **6** *ref. to* chemiosmosis **;**	**4**
9(d)	*any **three** from:* **1** respiration in anaerobic conditions **;** **2** produces lactate **;** **3** need oxygen, to oxidise lactic acid to CO_2 and H_2O / for breakdown of lactic acid in Krebs cycle plus oxidative phosphorylation / (for ETC) to make extra ATP **;** **4** ATP used for lactate → glucose / glycogen **;** **5** *idea of* re-paying oxygen debt **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)</td><td>any three from:
<table>
<tr><th></th><th>cyclic</th><th></th><th>non-cyclic</th><th></th></tr>
<tr><td>1</td><td>photosystem I (only)</td><td>vs</td><td>photosystems I <u>and</u> II</td><td>;</td></tr>
<tr><td>2</td><td>electrons return to, same photosystem / PSI / P700</td><td>vs</td><td>electrons do not return to same photosystem</td><td>;</td></tr>
<tr><td>3</td><td>ATP made</td><td>vs</td><td>ATP and reduced NADP made</td><td>;</td></tr>
<tr><td>4</td><td>no photolysis</td><td>vs</td><td>photolysis</td><td>;</td></tr>
<tr><td>5</td><td>no oxygen produced</td><td>vs</td><td>oxygen produced</td><td>;</td></tr>
</table></td><td>3</td></tr>
<tr><td>10(b)</td><td>1 carbon dioxide ;
2 Rubisco ;
3 NADPH ;
4 glucose / hexose / starch / cellulose / glycerol / fatty acids / lipids / amino acids / proteins ;</td><td>4</td></tr>
</table>

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