CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

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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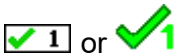
Annotations guidance for centres

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
	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

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Question	Answer	Marks
1(a)	*any **two** from:* glucose (phosphate) **;** fructose (phosphate / bisphosphate) **;** triose phosphate **;** (named) fatty acid / keto-acid **;** glycerol **;** amino acid **;**	**2**
1(b)	*any **four** from:* **1** breaks down / hydrolyses to, ADP / AMP, and Pi **;** **2** releases, energy / 30.5 kJ mol^{-1} **;** **3** reversible reaction / high turnover / can be regenerated **;** **4** small / soluble, so can, diffuse / move (freely), in cell **;** **5** AVP **;**	**4**
1(c)	substrate-linked / substrate-level (phosphorylation) **;**	**1**
1(d)(i)	oxygen **;**	**1**
1(d)(ii)	*presence of oxygen:* **1** (ATP yield) increases / is higher **;** *plus any **two** from:* **2** oxygen acts as final, electron / proton, acceptor **;** **3** oxidative phosphorylation / chemiosmosis (occurs) **;** **4** energy from, reduced NAD / reduced FAD / electron transport chain **;** **5** proton gradient / H^+ → into intermembrane space **;** **6** ATP made in Krebs cycle **;**	**3**

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Question	Answer	Marks
2(a)	*any **four** from:* **1** sodium hydroxide absorbs, carbon dioxide / CO_2, released by, woodlice / respiration **;** **2** oxygen / O_2, taken in reduces pressure (in boiling tube) **;** **3** drop of liquid moves towards, boiling tube / bung / woodlice / left **;** **4** measure, distance / length, moved by drop, in set time **;** **5** rate = distance divided by time **;** **6** detail of calculation of volume of O_2 used **;**	**4**
2(b)	*rate at 5 °C:* lower / slower and less / lower, kinetic energy **or** fewer enzyme-substrate, collisions / complexes **or** fewer, enzyme-catalysed / respiration / glycolysis / link reaction / Krebs cycle, reactions **;**	**1**

Question	Answer	Marks
3(a)	dominant **;** 3 / daughter, has disease but, 2 / father, does not **or** 3 / daughter, could not have the disease if allele were recessive **;**	**2**
3(b)	*any **three** from*: **1** founder effect **;** **2** allele / variegate porphyria, present in, migrants / settlers / founding population **;** **3** higher frequency than in, Dutch / Europeans / original population **;** **4** genetic drift has large effect in small, population / gene pool **;** **5** inbreeding / migrants married within their own population **;** **6** high frequency of allele maintained over, time / generations **;** **7** AVP **;**	**3**

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Question	Answer	Marks
3(c)	*any **four** from*: **1** use mRNA (from person's cells) to make, cDNA / ssDNA **;** **2** add fluorescent, label / tag / dye / chemical / marker, to (this ss) DNA **;** **3** cDNA / ssDNA, hybridises with / binds to / complementary base pairs with, probe(s) / microarray **;** **4** fluorescence shows, disease / mutant, gene / allele, expression / transcription **;** **5** AVP **;**	**4**
3(d)	*any **one** from:* **1** find out / diagnose, person's disease **;** **2** so can, choose / develop, right treatment **;** **3** global, research resource / access **;**	**1**
3(e)	*any **three** from:* **1** change from **T** to **C** **or** replacement / substitution, of **T**, with / by, **C** **or** substitution of **C** for **T ;** **2** functional / working / correct / normal, enzyme / protein, produced **;** **3** gRNA, is specific to / only finds / just alters, CEP /disease / mutant, allele / gene **or** gRNA does not bind to genes other than CEP **;** **4** AVP **;**	**3**

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Question	Answer	Marks
4(a)	*any **three** from:* *(both processes)* **1** use / require, carbon dioxide / CO_2 **;** **2** use / require, water / H_2O **;** **3** use / require, (sun) light energy / source of energy is light **;** **4** make an organic, molecule / product **;** **5** produce / release, oxygen / O_2 **;** **6** involve transduction of energy (from one form to another) **;** **7** involve electron flow **;**	**3**
4(b)	**A** starch, grain / granule **;** **B** thylakoid (membrane) / lamella / granum **;**	**2**
4(c)(i)	ATP and reduced NADP (and oxygen) **;**	**1**
4(c)(ii)	*any **four** from:* **1** electron carriers / electron transport chain / to carry electrons **;** **2** to release energy to, move / pump, protons (into, thylakoid space / lumen) **or** to release energy to generate proton gradient **;** **3** oxygen-evolving, complex / enzyme **;** **4** (to catalyse) splitting / photolysis, of water **;** **5** LHC / antenna complex / photosystem, proteins hold pigments **;** **6** ATP synth(et)ase to make ATP **;**	**4**
4(d)	triose phosphate **;**	**1**

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Question	Answer	Marks
4(e)	*any **two plus one** opposing arguments based on correct ref. to:* **1** percentage / amount, of sunlight, absorbed / used **;** **2** absorption / action, spectrum **or** wavelengths / colours of light, used **;** **3** respiration of organism **;** **4, 5** stage/transition, where, energy lost **; ;** **6, 7** (named) limiting factor(s) **; ;** **8** energy storage capability **or** night / dark, process **;** **9** quality / nutrition in / palatability, of food product **;** **10** proportion edible **;** **11,12** additional energy inputs **; ;** **13, 14** additional resources needed **; ;** **15** labour / maintenance, needed **;** **16** amount of space needed **;** **17** plant, hormones / coordination **;** **18** evolutionary adaptation **;**	**3**

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Question	Answer	Marks
5(a)(i)	directional (selection) ;	**1**
5(a)(ii)	curve with starting point (on *x*-axis), peak and end point (on *x*-axis) all to the right of the original positions ;	**1**
5(b)	*any **four** from*: **1** disruptive / diversifying (selection) ; **2** selection pressure is, seed / food (availability / size) ; **3** competition for, food / seeds ; **4** (birds with) intermediate bills cannot eat small and large seeds ; **5** extreme / small and large, phenotypes / bills, more likely to survive / have selective advantage / selected for ; **6** correct description of change in allele frequency ;	**4**
5(c)(i)	*r* / 0.930 / calculated value, is greater than critical value for n = 5 ; at (probability level) 0.05 ;	**2**
5(c)(ii)	*any **four** from*: *invasive alien species / they, may:* **1** change / disrupt, food, chains / webs ; **2** compete for food with / feed on same food as / occupy same niche as, native, species / organisms ; **3** prey on / graze / eat, native, species / organisms ; **4** introduce (new), disease / parasites ; **5** change / damage, the habitat ; **6** be toxic / threaten human health ; **7** damage, tourism / agriculture ;	**4**
5(c)(iii)	*any **two** from:* **1** climate change ; **2** hunting by humans ; **3** degradation / loss, of habitat ; **4** (named) pollution ; **5** disease ; **6** (named) natural disasters ;	**2**

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Question	Answer	Marks
6(a)(i)	**P:** selective reabsorption ; **Q:** osmoregulation ; **R:** ultrafiltration ;	**3**
6(a)(ii)	**P**: proximal convoluted tubule ; **Q**: collecting duct / distal convoluted tubule ; **R**: Bowman's capsule ;	**3**
6(b)	**1** **B** / interstitial fluid / tissue fluid / medulla, has more, salt / sodium chloride / Na^+ / Cl^-; *plus **one** from:* **2** salt gradient helps reabsorb water from collecting duct ; **3** AVP ;	**2**

Question	Answer	Marks
7(a)	*any **four** from:* **1** insulin / it, is a hormone ; **2** (described) stimulus causes insulin to be secreted from (named) endocrine, gland / tissue / cells ; **3** insulin travels in blood ; **4** binds to receptors on (named) target cells ; **5** to cause (described) response ; **6** AVP ;	**4**
7(b)(i)	*any **four** from:* **1** at 21 min, blood glucose concentration / it, rises to 110 mg 100 cm^{-3} ; **2** (high / increase in, blood glucose concentration) detected by pancreas / causes response in pancreas ; **3** insulin rises to 500 pmol dm^{-3} ; **4** (insulin) increase GLUT proteins in membrane / increases glucose uptake into cells / increases cell permeability to glucose **or** (insulin) increases rate of respiration of glucose ; **5** (insulin) causes / stimulates, glycogenesis / lipogenesis ; **6** (mean) blood glucose concentration / it, falls, to normal / within normal range / below starting point / to set point ;	**4**

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Question	Answer	Marks
7(b)(ii)	*any **three** from:* **1** blood glucose concentration falls as glucose is respired **;** **2** blood glucose concentration falls below, set point / normal **;** **3** insulin, secretion / release, stops **;** **4** glucagon (secreted / released / rises) **;** **5** glycogen, (in cells) converted to glucose **or** glycogenolysis **;** **6** (stored) protein / fat, converted to glucose **or** gluconeogenesis **or** (stored) protein / fat, used for respiration **;**	**3**

Question	Answer	Marks
8	*any **six** from:* **1** gibberellin binds to (gibberellin) receptor (-enzyme-complex) **;** **2** DELLA (protein) destroyed **;** **3** transcription factor / PIF, released / free / no longer bound to DELLA **;** **4** transcription factor / PIF / RNA polymerase, binds to, DNA / promoter **;** **5** growth / expansion / XET / xyloglucan endotransglucosylase, gene, switched on / expressed / transcribed **;** **6** loosens cell walls / breaks bonds between cellulose **;** **7** water enters (cells) by osmosis causing cell elongation **;** **8** AVP **;**	**6**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(a)</td><td>any three from:
1 (domains are) Archaea <u>and</u> Bacteria ;
2 membrane lipids ester-linked (Bacteria) vs. ether-linked / not ester-linked (Archaea) ;
3 single type of rRNA (Bacteria) vs. 3 types (Archaea)
or
Archaea, rRNA / ribosomal subunit, similar to eukaryotic ;
4 peptidoglycan (Bacteria) vs. not peptidoglycan / different (Archaea) ;
5 AVP ;</td><td>3</td></tr>
<tr><td>9(b)</td><td><table><tr><th>taxon</th><th>name</th></tr><tr><td>domain</td><td>Eukarya ;</td></tr><tr><td>kingdom</td><td>Animalia ;</td></tr><tr><td>phylum</td><td>Chordata</td></tr><tr><td>class</td><td>Mammalia</td></tr><tr><td>order</td><td>Carnivora</td></tr><tr><td>family</td><td>Felidae</td></tr><tr><td>genus</td><td>Panthera ;</td></tr></table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
10(a)	**causing X / –70 (mV)** *any **three** from:* **1** active transport / sodium-potassium pump **;** **2** moves three Na^+ out of and two K^+ in (to neurone) **;** **3** more K^+ diffuses out than Na^+ diffuses in **;** **4** makes outside of membrane (relatively) more positive **;** **5** maintaining / establishing, resting potential **;** **causing Y / +40 (mV)** *any **two** from:* **6** depolarisation **;** **7** Na^+ / sodium ion, channels open **;** **8** Na^+, moves / diffuses, in (to neurone) **;** **causing Z / –90 (mV)** *any **two** from:* **9** hyperpolarisation **;** **10** (voltage-gated) K^+ / potassium ion, channels open **;** **11** K^+, moves / diffuses, out (of neurone) **;**	**7**
10(b)	**1** local, circuit / current **;** **2** from, depolarised / positive, area to, resting / negative, area **;**	**2**
10(c)	*any **three** from:* **1** speeds up (nerve) impulse / impulse transmission faster **;** **2** (as) myelin sheath / Schwann cells, act(s) as an insulator **;** **3** (as) local circuits flow between, nodes of Ranvier / gaps in sheath **;** **4** saltatory conduction **;** **5** fast(er), (described) response / muscle contraction **;**	**3**

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