CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

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.

This document consists of **20** printed pages.

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.

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.

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.

Annotations guidance for centres

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

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

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

Annotations

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

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

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
AV	alternative valid point

Question	Answer	Marks
1(a)	**A** – GLUT / carrier **;** **I** channel **B** – glycolysis **;** **C** – intermembrane space **;** **A** intermembranal **R** inner membrane	**3**
1(b)	*any **four** from:* 1 (pyruvate) decarboxylation / decarboxylase / carbon dioxide released **;** 2 (pyruvate) dehydrogenation / dehydrogenase / oxidation **;** 3 formation of, acetyl group / acetate **;** 4 reduced NAD produced / described **;** 5 acetyl group / acetate, combines with coenzyme A **or** formation of acetyl CoA **;**	**4**
1(c)	*any **three** from:* 1 little / no, link reaction / Krebs cycle / oxidative phosphorylation **;** 2 ATP, mostly / only, produced by, glycolysis / process **B** / substrate-linked phosphorylation **;** 3 (so) less ATP produced **;** 4 anaerobic respiration / production of lactate **;**	**3**

Question	Answer	Marks
2(a)(i)	*any **four** from:* 1 antibiotic acts as selection pressure **;** 2 bacteria with antibiotic resistance (gene / allele) have selective advantage / selected for **; ora** 3 bacteria with antibiotic resistance (gene / allele), survive / reproduce **; ora** 4 pass on, gene / allele, (for antibiotic resistance) **or** increase in **allele** frequency (for antibiotic resistance) **;** 5 *ref. to* plasmids **;** 6 (horizontal gene transfer) by, transduction / transformation / conjugation **;** 7 (horizontal gene transfer) gives rapid increase of resistant bacteria **;**	**4**
2(a)(ii)	*any **two** from:* 1 drug prevents attachment of mRNA to ribosome **or** drug prevents attachment of tRNA to, amino acid / ribosome / mRNA **or** drug binds to ribosome **;** 2 protein (coded for by antibiotic resistance gene) not made **;** 3 so antibiotic able to work **;**	**2**

Question	Answer	Marks
2(b)(i)	*any **three** from:* accept **ora** throughout *natural selection* 1 environment as selection pressure **;** **ora** human acts as selection pressure 2 random mating **;** **ora** humans select organisms to breed 3 takes more generations for effects to be seen / slower process / AW **;** 4 organisms <u>not</u> selected for desirable phenotypes **;** **ora** humans select features 5 can result in speciation **;** 6 does <u>not</u> decrease, genetic diversity / hybrid vigor **;** 7 inbreeding less likely to occur **;** 8 greater heterozygosity **;**	**3**
2(b)(ii)	1 offspring (from F1) will not be genetically similar / AW **;** 2 offspring (from F1) will produce variation in next crop / will not be true-breeding plants**;**	**2**

Question	Answer	Marks
3(a)	1 enzymes produced when, allolactose / lactose / substrate, is present **or** enzymes only produced when required **;** 2 genes not, expressed / switched on / transcribed, continuously **or** genes, expressed / switched on / transcribed, when, allolactose / lactose / substrate, binds to repressor **;** **I** inducer	**2**
3(b)	*any **seven** from:* 1 lactose enters the bacterium **;** 2 lactose binds to the repressor **;** 3 causing a shape change **;** 4 the repressor detaches from the operator **;** 5 promoter unblocked / AW **;** 6 RNA polymerase binds to the promoter **;** 7 gene(s) transcribed **;** 8 β-galactosidase is made **;** 9 β-galactosidase breaks down lactose **;** *galactosidase activity levels off as:* 10 β-galactosidase activity at maximum / galactosidase active sites full **;**	**7**

Question	Answer	Marks
4(a)	*any **four** from:* 1 geographical, isolation / barrier (caused by the, river / canyon walls) **;** 2 no gene flow between (isolated ancestral) populations **;** 3 different, selection pressures / environment **;** 4 different / random / independent, mutations (in each population) **;** 5 different changes in allele frequencies / different gene pools / different alleles selected for **;** 6 populations have different, morphological / physiological / behavioral, features **;** 7 leads to, reproductive isolation / inability to interbreed (to produce fertile offspring) **;** 8 allopatric speciation **;**	**4**
4(b)	*any **three** from:* *DNA sequencing **ora** for fossils* 1 provides more information (about the whole organism) **;** 2 more precise / more accurate **;** 3 only a small sample of DNA is needed **;** 4 can give estimate of when species diverged/how closely related two organisms are / molecular clock can estimate time of divergence **;** 5 quantitative **;** 6 AVP **;** e.g. *idea of.* avoids convergent evolution problems	**3**

Question	Answer	Marks
4(c)	*any **one** from:* not enough fossils ; small sample sizes ; DNA degrades over time ; this depends on an estimated mutation rate ;	**1**

Question	Answer	Marks
5(a)	*any **three** from:* 1 cDNA has, no introns / only exons **or** genomic DNA has introns (and exons) ; 2 introns are non-coding sequences / exons are coding sequences ; 3 bacteria cannot, remove introns / carry out splicing ; 4 with cDNA, functional mRNA is made / translation occurs **or** with genomic DNA, functional mRNA is not made / translation does not occur ;	**3**
5(b)(i)	bond together / anneal, with hydrogen bonds ; formation of phosphodiester bonds / joins sugar phosphate backbone ;	**2**
5(b)(ii)	1 so RNA polymerase can bind ; 2 so, transcription / gene expression, occurs ;	**2**

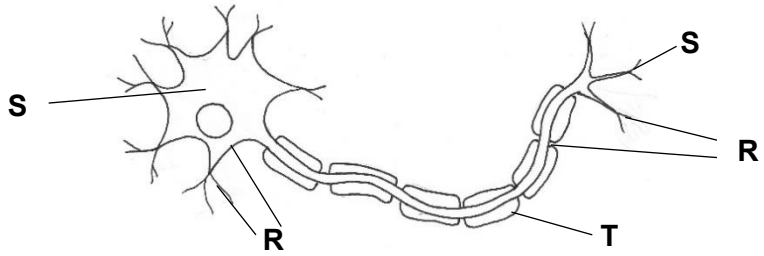
Question	Answer	Marks
5(c)	*any **three** from:* 1 marker gene is added to plasmid **;** 2 positioned downstream of promoter **;** 3 positioned alongside, GOI / insulin gene**;** 4 when marker gene is expressed fluorescent proteins are made **;** 5 *ref. to* (fluorescent proteins) fluoresce / glow, with exposure to, UV / blue, light **;** 6 shows which, bacteria / cells, are transformed / AW **;**	**3**
5(d)	*any **two** from:* *advantages of using yeast:* 1 easier / cheaper, to culture yeast cells **;** 2 more productive / higher productivity **;** 3 easier, to extract / processing / to purify, (insulin) **;** 4 yeast cell similar to β-cells / named example **;** e.g. have Golgi apparatus	**2**

Question	Answer	Marks
6(a)(i)	urea **;**	**1**
6(a)(ii)	deamination **/** ornithine cycle / urea cycle / converts ammonia (to urea) **;**	**1**
6(a)(iii)	liver **;**	**1**

Question	Answer	Marks
6(b)	*any **seven** from:* 1 blood enters glomerulus via afferent arteriole **;** 2 afferent arteriole (lumen) diameter larger than efferent **;** 3 (so) high, blood / hydrostatic, pressure **;** 4 blood / hydrostatic, pressure greater than water potential gradient (between Bowman's capsule and glomerulus) **;** 5 fluid forced through pores / fenestrations in (blood vessel) endothelium **;** 6 basement membrane acts as a filter **;** 7 stops, large proteins / blood cells / molecules larger than 68 000–70 000 RMM **;** 8 water / glucose / amino acids / urea / mineral ions, pass through **;** 9 slit pores between podocytes **;** 10 AVP **;** e.g. GFR 125 cm^{-3} min^{-1}	**7**
6(c)	*any **two** from:* 1 collecting duct in medulla **;** 2 thicker medulla has lower water potential **;** 3 (so) more water reabsorbed **;** 4 AVP **;** e.g. *ref. to* loop of Henle	**2**

Question	Answer	Marks
7(a)(i)	DNA **;** ribosome **;**	**2**
7(a)(ii)	thylakoid space **;**	**1**
7(b)	xanthophyll **;** 3.4 **;** 0.92 **;**	**3**
7(c)	*any **four** from:* 1 absorbs light between 400 and 500 nm **/** peak at 450 nm **;** 2 accessory pigment **;** 3 absorbs light wavelengths <u>not</u> absorbed by, reaction centre / primary pigment / chlorophyll a **; A** harvest 4 so extends the range of wavelengths absorbed **;** 5 pass <u>energy</u> to, reaction centre / primary pigment / chlorophyll a **;** 6 *idea* improves efficiency of light-dependent stage **;**	**4**

Question	Answer	Marks
8(a)	1 prevents illegal, trading / poaching / hunting ; 2 trading requires permits / trading is regulated ; 3 *ref. to* awareness / education ;	**3**
8(b)	*any **four** from:* 1 multicellular ; 2 eukaryote / eukaryotic / (cells), contain a nucleus ; 3 specialised cells / tissues / organs ; 4 heterotrophic (nutrition) / described ; 5 nervous system ; 6 (some cells have) cilia / flagella ; 7 mobile / motile / locomotion ;	**4**

Question	Answer	Marks
9(a)	*any **four** from:* 1 use (named) sense organs to detect prey **;** 2 faster transmission of, impulses / signals **;** 3 (so) faster reaction to stimuli **;** 4 *ref. to* control centre / brain / CNS (decision making) **;** 5 faster response **or** ref. reflexes **;** 6 (by) muscles **;**	**4**
9(b)	*(if a letter is used more than once, all must be correct)* *correct position of label and letter for:* **R ;** **S ;** **T ;**  	**3**

Question	Answer	Marks
9(c)(i)	*any **three** from:* *increase in curve* 1 cross bridges form / myosin heads bind to actin **;** 2 power stroke / actin filaments slide over myosin filaments **;** 3 bands get, smaller / shorter **or** decrease in width of sarcomere **;** *decrease in curve* 4 breaking of cross bridges / detachment of myosin heads from actin **;** 5 bands get, bigger / longer **or** increases width of sarcomere **;**	**3**
9(c)(ii)	*increase* 1 calcium ions / Ca^{2+}, released by sarcoplasmic reticulum **;** 2 calcium ions / Ca^{2+}, bound to troponin **;** *decrease* 3 calcium ions / Ca^{2+}, pumped back into sarcoplasmic reticulum **;**	**3**

Question	Answer	Marks
10(a)	*any **three** from:* 1 self-contained unit **;** 2 community of organisms **; A** idea of several species 3 biotic and abiotic factors / named **;** 4 *ref. to* interaction **;** 5 AVP **;** e.g. flow of energy and cycling of minerals / nutrients	**3**
10(b)(i)	*any **three** from:* 1 (frogs are) mobile ; 2 marking, not harmful / cannot be removed **;** 3 (sufficient time for) marked individuals to mix with rest of population **;** 4 no, births / deaths **or** no, immigration / emigration / migration **or** constant population size **;**	**3**
10(b)(ii)	69 **;;** *must be a whole number, one mark only if not whole number* $\frac{27 \times 33}{13}$ *credit working if wrong answer*	**2**