CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

Paper 2 AS Level Structured Questions **May/June 2025**

MARK SCHEME

Maximum Mark: 60

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.

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
	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
CON	contradiction in response, mark not awarded
ECF	error carried forward applied
I	incorrect or insufficient point ignored while marking the rest of the response
IRRL	irrelevant material that does not answer the question
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
PAG	point already given
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
AVP	alternative valid point

Question	Answer	Marks
1(a)(i)	**A** = endodermal (cell) **;** **B** = xylem vessel element **;** **A** vessel elements **A** xylem elements **I** xylem	**2**
1(a)(ii)	(has cells that can) divide continuously by mitosis **;** *idea that* forms cells that can, differentiate / AW, into cells in, vascular tissue / xylem (tissue) / phloem (tissue) **;** (for) repair / growth, of, vascular tissue / xylem / phloem **;** divide to maintain pool of procambial cells **;**	**1**

Question	Answer	Marks
1(b)	*mark as pairs (adaptation A + explanation E), max two pairs* **A** thick (waxy) cuticle **;** **E** increased / long, diffusion distance for water <u>vapour</u> **or** *idea of* (greater) impermeability to, water <u>vapour</u> **;** **A** needle-shaped / narrow / AW, leaves **;** **E** low surface area to volume ratio, qualified **;** e.g. less transpiration / AW *allow **ecf** if adaptation is spines* **A** multilayered epidermis / hypodermis **;** **E** increased diffusion distance for water <u>vapour</u> **;** **A** low stomatal density **; A** few(er) stomata (per unit area) **A** small(er) stomata **E** less, transpiration / diffusion of water vapour out of the plant (because most water loss is via stomata) **; I** evaporation **A** sunken stomata **; A** other examples e.g. stomata in, grooves / crypts / chambers **A** trichomes / (stomatal) hairs**;** **A** rolled / curled, leaves **;** *for above three mps* **E** maintains humid air around stomata / reduced water potential gradient / (creates) still / non-moving, air **;** **I** concentration gradient AVP **;;** e.g. **A** midday closure of stomata **E** close at times when transpiration is highest / AW **A** close packing of mesophyll cells / fewer (intercellular) air spaces **E** reduces evaporation from mesophyll **A** stomata open at night **E** lowers transpiration as, higher humidity / lower temperature **A** lighter gray / pale coloured, leaves **E** reflect light to keep temperature cooler	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>4 / four ;</td><td>1</td></tr>
<tr><td>2(a)(ii)</td><td>COOH group bonded to the top carbon ;

NH_2 group bonded to the top carbon ;

A with or without lines indicating bonds within functional groups
R if atoms other than C and N are shown bonded to the carbon</td><td>2</td></tr>
<tr><td>2(b)</td><td><table><tr><th>description</th><th>level of protein structure</th></tr><tr><td>in some conditions, four melittin polypeptides can bind to each other</td><td>quaternary ;</td></tr><tr><td>a melittin polypeptide consists of a sequence of 26 amino acids</td><td>primary ;</td></tr><tr><td>alpha helices are formed at each end of a melittin polypeptide</td><td>secondary ;</td></tr></table></td><td>3</td></tr>
<tr><td>2(c)</td><td>produces a, pore / gap / channel / opening / AW, (in cell surface membrane) ;
A forms a channel protein

ref. to phospholipids / phospholipid bilayer ; e.g. displaces / disrupts / separates, phospholipids</td><td>2</td></tr>
</table>

Question	Answer	Marks
2(d)	*any **four** from*: **1** binding / attachment / joining / AW, of cell fragment to, (phagocyte cell surface) receptors / (phagocyte) membrane **;** *endocytosis / phagocytosis* **2** (cell surface) membrane, surrounds / AW, cell fragment **or** pseudopodia, surrounds / form round / AW, cell fragment **or** (phagocytic) cell, envelops / engulfs, cell fragment **;** **3** membrane fusion / (phagocytic), vacuole pinches off / AW **or** phagocytic vacuole formed **;** *allow vacuole if phagocytosis stated* **A** phagosome formed **A** vesicle for vacuole *break down cell fragments* **4** lysosome (containing enzymes), fuses / AW, with phagocytic vacuole **;** **A** phagolysosome formed **5** fragment broken down by, hydrolytic / digestive, enzymes **;** **R** lysosome digests **6** named enzyme and product **or** two named enzymes **;** AVP **;** *idea of* opsonisation of / antibody binding to, cell fragment	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>
<table>
<tr><th>feature</th><th>prokaryotic cell</th><th>eukaryotic cell</th></tr>
<tr><td>circular DNA</td><td>✓</td><td>✓</td></tr>
<tr><td>80S ribosomes</td><td>X</td><td>✓</td></tr>
<tr><td>a cell diameter of 20 μm</td><td>X</td><td>✓</td></tr>
</table>

one mark per correct row

if no marks gained, check correct column for 1 mark
</td><td>3</td></tr>
<tr><td>3(b)</td><td>allow enzyme for protein
any three from:
protease (produced by S. epidermidis) is, secreted / released ;
A protease is an extracellular enzyme

protease breaks down proteins (needed for survival) specific to S. aureus ; AW
explanation ; e.g. protease active site complementary to substrate (of S. aureus)
protease complementary to substrate and form enzyme-substrate complexes

protease breaks down, protein in biofilm / (biofilm) polymers ;
idea that without biofilm the S. aureus cannot remain attached to skin cells ;

other example of S. aureus protein broken down ;
e.g. cell membrane proteins / receptors / binding sites

AVP ; e.g. S. aureus cells need substances from biofilm for survival</td><td>3</td></tr>
</table>

Question	Answer	Marks
3(c)(i)	*allow, bacteria / pathogens / microorganisms, for S. aureus* secrete / produce / AW, mucus / mucin **;** mucus, traps *S. aureus* cells ***/*** acts as a barrier (to reach cells) **;** **R** virus	**2**
3(c)(ii)	ciliated epithelial cell **;** **A** ciliated epithelium cell **I** ciliated cell	**1**
3(d)(i)	*any **three** from*: prevent formation of crosslinks / cross bridges, (between peptidoglycan chains) **;** *if not gained, allow **ecf** for vancomycin difference* stop / prevent, synthesis / repair, of cell wall **;** *differences* penicillin, binds to / is an inhibitor of, enzyme(s) / transpeptidase(s) (that catalyse formation of cross links) **; ora** vancomycin, binds to / acts on / AW, peptidoglycan / cross link, components **;** **ora** *idea that* vancomyin, blocks access to peptidoglycan component / may prevent binding of enzyme that joins peptidoglycan subunits together **;** *if no marks gained because of incorrect knowledge of pencillin mechanism of action, allow one mark as **ecf** for an answer incorporating a feature of vancomycin mechanism of action shown on Fig. 3.2*	**3**

Question	Answer	Marks
3(d)(ii)	*any **three** from*: **1** prescribing / take, antibiotics only when (absolutely) necessary **;** **A** examples e.g**.** do not use for viral infections do not use as preventative medicine **2** make sure, correct / effective, antibiotic(s), prescribed / used **;** **A** only use antibiotic for the prescribed condition **3** complete course / follow instructions for use **;** **A** *ref. to* DOTS **4** use other antibacterials **or** develop new, drugs / antibiotics **;** **5** reduce / control, antibiotics in, agriculture / animals used for food **;** **6** *ref. to* break transmission cycle / described example **;** e.g. vaccines good hygiene in hospitals quarantine **7,8** AVP **; ;** e.g check / improve / AW, knowledge of, healthcare professionals / public, qualified report patterns of antibiotic resistance / AW *ref. to* monitor to check if antibiotic is effective **;** *ref. to* WHO Global Plan to End TB vary antibiotic treatment use a number of different antibiotics at the same time limit / prevent, antibiotics being sold *context is control by prescription*	**3**

Question	Answer	Marks
4(a)(i)	*any **one** from:* (membrane) fluidity will increase / AW **;** increase in (lateral) movement of phospholipids (in bilayer) **;** AVP **:** e.g. increase in passage of, polar molecules / ions, across membrane easier to fuse with other membranes	**1**
4(a)(ii)	*idea that* (greater membrane fluidity) makes it easier for lysosomes to fuse with, vacuoles / vesicles / phagosomes / endosomes / membranes (of other organelles) **;** *allow **ecf** on fluidity decreases in **Q4(a)(i)** e.g. makes more impermeable to prevent hydrolytic enzymes exiting*	**1**
4(b)(i)	K_m = 120 **;** unit = μmol dm^{-3} **;**	**2**
4(b)(ii)	*any **four** from*: *differences* **1** rate of reaction is lower at pH 4.5, throughout / at all substrate concentrations / AW **; ora** **2** V_{max} / plateau, is 2.8 (at pH 4.5) v 5.9 (at 5.9) pmol min^{-1} **;** **3** V_{max} is reached at a lower substrate concentration with pH 4.5 **; A ora** **A** data 330–400 μmol dm^{-3} compared with 700 μmol dm^{-3} *explanations to max 3* *at pH 4.5 / lower pH* **4** fewer enzyme-substrate complexes form **;** **5** tertiary structure of enzyme / shape of active site, changes / AW **;** **6** (at pH 4.5) active site shape becomes less complementary to substrate **;** **7** detail **;** e.g. increased presence of hydrogen ions has an effect on, R-group interactions / ability to lower activation energy / ability to bind substrate **8** suggestion that pH 5.9, is / is closer to, the optimum pH **; ora**	**4**

Question	Answer	Marks
5(a)	*any **three** from*: allows DNA replication to, occur many times / AW **;** allows (some) cells to carry out, many / continuous / repeated, mitoses / cell cycles / cell divisions **;** **I** cell replication prevents the loss of, genes / genetic information (from ends of chromosomes) **;** **ora** **A** prevents loss of coding sequences **I** prevents loss of, DNA / genetic material AVP **;** e.g. prevents fusion of chromosome ends prevents ends of chromosomes being recognised as damaged	**3**
5(b)(i)	U U A G G G **;**	**1**
5(b)(ii)	leucine **;** glycine **;** **ecf** on asparagine and proline	**2**
5(b)(iii)	*any **one** from*: increase in number of different proteins produced **;** **A** increase in number of different enzymes produced **A** increase in the number of different mRNA molecules in the cell *ref. to* ability of cell to, become differentiated / become specialised / take on particular function **;** increase in growth of cell (in preparation for mitosis) **;** production of cell organelles (in preparation for mitosis) **;** AVP **:**	**1**

Question	Answer	Marks
6(a)	*any **five** from*: **1** inject (non-self / foreign / specific) antigen into small mammal **;** **A** named e.g. mouse **2** *ref. to* leave time for immune response to occur (over several weeks) **;** **A** immune response described **3** remove splenocytes from the spleen (of mice) **;** **A** plasma cells / B-lymphocytes / B-cells, *for splenocytes* **4** fuse, splenocytes / AW, and, myeloma / tumour / cancer, cells **;** **5** screen and select hybridoma cells **;** **6** clone selected hybridoma cells **;** **7** AVP **;** e.g. use of fusogen / polyethylene glycol separate hybridoma cells into separate wells *ref. to* HAT medium *ref. to* humanising monoclonal antibody	**5**
6(b)	**T** / **S** **;** **Q** **;** **R** **;**	**3**
6(c)	right atrium **;** Purkyne , tissue / fibres **;** **A** Purkinje, tissue / fibres **A** Bundle of His ventricular systole **;**	**3**