CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

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.

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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
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

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
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
I	ignore

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Question	Answer	Marks
1(a)	*macromolecule* (both are) large / AW, molecules / size / (molecular) mass **;** **A** composed of, many / AW, atoms **I** composed of more than one molecule *polymer* composed of, many / three or more / more than two / repeated / repeating, subunits / units / monomers / residues / alpha glucose **;** **A** many of the same / similar / chain of … *for repeated* **I** molecules	**2**
1(b)(i)	**1** α- / alpha-, glucose molecule on left with –OH on C1 facing downwards **;** **2** α- / alpha-, glucose molecule on right with –OH on C4 facing downwards **;** **ecf** if a single same mistake is made in both, e.g. no –H on C5 **3** involvement of water **;** must be above or alongside arrow **R** if below	**3**
1(b)(ii)	glycosidic **;** **A** glucosidic **I** incorrect detail of the bond, e.g. β- / beta- / α- / alpha-,1, 6	**1**
1(b)(iii)	hydrolysis **;**	**1**

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Question	Answer	Marks
2(a)	*any **two** from:* *cilia* (composed of) microtubules / not composed of microfilaments / not composed of actin (fibres) **;** **R** if microvilli have microtubules 9+2, arrangement / pattern / structure (in horizontal section) **;** AVP **;** e.g. *ref. to* component proteins – e.g. tubulin / dynein (cilia) extend from / attach to, a basal body / basal body at base **R** centrioles	**2**
2(b)	number of microvilli (over the surface of the cell) **;** **I** amount / quantity	**1**
2(c)	mitochondrion **;** synthesises / makes / produces / provides, ATP for, active transport / active uptake / endocytosis / exocytosis **;** **I** absorption **A** provides energy *if no ATP* **A** any other suitable function of an epithelial cell in the small intestine e.g. synthesis of, enzymes / carrier proteins / mucus **or** movement of organelles within cell	**2**
2(d)	*no ora for this question* *organisation for one mark* linear, chromosome / DNA **A** straight **or** DNA associated with, histones / histone proteins / basic proteins **;** **A** *ref. to* chromatin *distribution for one mark* DNA, contained in nucleus / surrounded by nuclear envelope / surrounded by nuclear membranes **;** **A** *ref. to* DNA in nucleolus	**2**

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Question	Answer	Marks
3(a)(i)	**1** change in, absorbance / rate of reaction, <u>and</u> (then), reaches a time when there is no further change / reaches a plateau / reaction stops / absorbance becomes constant **;** **A** *for change* absorbance increases, in Fig. 3.2 / for dopa oxidase, and decreases, in Fig. 3.3 / for neutrase **A** decrease in rate of reaction **R** if rate of reaction increases **2** due to change in (intensity / shade, of) colour (of reaction mixture) **;** **3** due to, collisions between substrate and enzyme / enzyme-substrate complexes form(ing) / product being made **;** **4** *idea that, no / little, change in absorbance* because, all / most, of the substrate is used up / AW **;** **A** substrate is limiting factor **I** reactants are used up	**3**
3(a)(ii)	*any **two** from:* **1** can take, quantitative / numerical, readings / results **;** **2** *idea that* can use values from the colorimeter to plot graph(s) **;** **3** can take readings continuously/do not have to take samples **;** **I** continuous data **4** results are not subjective/no judgements made by eye/no bias in the results/AW **;** **A** results are objective/more accurate **I** precise **5** can determine / AW, <u>rates</u> of reactions **;** **6** AVP **;** e.g. *ref. to* use of, standards / calibration curve, to obtain actual concentrations e.g. can detect, small differences in, colour / cloudiness / AW	**2**
3(b)(i)	V_{max} = 80 (μmol mg^{-1} min^{-1}) <u>and</u> half V_{max} = 40 (μmol mg^{-1} min^{-1}) **;** **A** 80 and 40 / horizontal lines shown at 80 and 40 on Fig. 3.4 K_m = 0.014 mmol dm^{-3} / 14 μmol dm^{-3} **;** *unit must be given on answer line or in working* **A** in range 0.012 to 0.016 mmol dm^{-3}	**2**
3(b)(ii)	*any **two** from:* lower concentration of substrate to reach (½) V_{max} / AW **;** **A** faster rate at, the same concentration / lower concentration VpSP37 has a higher <u>affinity</u> for its substrate (than the other enzymes) **; ora** explained **;** e.g. better fit between substrate and active site / AW **;** **I** ESCs formed more efficiently / any *ref. to* cost, etc.	**2**

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Question	Answer	Marks
4(a)(i)	RNA polymerase **;**	**1**
4(a)(ii)	*any **two** from:* *accept for either cap or poly(A) tail or both* **1** protects mRNA from being, broken down / degraded / damaged, by enzymes **;** **A** protects mRNA from enzyme action **2** prevents mRNA molecules joining together **;** **A** prevents ends of a mRNA molecule joining **3** helps to, direct / move, mRNA, through nuclear pores / to ribosome(s) / to leave nucleus / to cytoplasm **;** **4** required to start, translation / assembly of amino acids at ribosome **;** **A** helps / allows / AW, (mRNA) attachment to ribosome(s) **R** refs to start and stop codons **5**, **6** AVP **;;** e.g. makes sure 5' end enters ribosome first / AW	**2**
4(a)(iii)	*any **three** from:* **1** gene / RNA, splicing **;** **A** primary transcript splicing **R** DNA splicing / mRNA splicing / genetic splicing **2** introns removed **;** **3** exons, attached together / joined up **;** **R** extrons **4** shortens / AW, the RNA molecule **;** **5** removal of non-coding sequences / only keeping the coding sequences **;** **A** non-coding regions / AW **A** non-coding introns **R** non-coding / coding, genes **6** AVP **;** e.g. rearranging exons / alternative splicing **I** annealing *ref. to* phosphodiester bonds forming between RNA nucleotides / AW *ref to* spliceosome	**3**
4(b)(i)	(at the) ends / AW **;** **A** at the ends of, DNA / chromatids **I** sides / edges	**1**

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Question	Answer	Marks
4(b)(ii)	*any **three** from:* **1** allows DNA replication to, occur many times **;** **2** allows (some) cells to carry out, many / continuous / repeated, mitoses / cell cycles / cell divisions **;** **I** cell replication **3** prevents the loss of, genes / genetic information **;** **A** prevents loss of coding sequences **I** loss of DNA **I** prevents loss of genetic material **4** AVP **;** e.g. prevents fusion of chromosome ends prevents ends of chromosomes being recognised as damaged	**3**
4(c)	*any **four** from:* **1** mutation in a gene **;** **2** *leads to* uncontrolled / unregulated, mitosis / cell division **;** **3** proto-oncogene to oncogene **;** **A** *ref. to* oncogene in correct context (without the proto-) **4** *ref. to* tumour suppressor gene(s) **;** **A** in context of 'switched off' **5** *idea that* normal (named) checkpoints do not function **;** **A** not checked during (named) stage of cell cycle **A** bypass checkpoints / checkpoints not used **6** mass of, abnormal / non-functional / damaged, cells formed **;** **A** irregular / abnormal, mass of cells **I** undifferentiated **7** AVP **;** e.g. supplied with blood vessels cells do not carry out, apoptosis / programmed cell death cancer cells ignore stop signals from other cells / have no contact inhibition	**4**

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Question	Answer	Marks
4(d)	*any **five** from:* *melanoma cell releases cytokines* **1** cytokines stimulate, clonal expansion / division (by mitosis), of, T-lymphocytes / B-lymphocytes **;** **A** T-cells / B-cells **A** T-helper cells / T-killer cells **2** cytokines stimulate (action of), macrophages / phagocytes **;** **A** form angry macrophages **3** cytokines act as cell-signalling molecules **;** *melanoma cell releases antigens* **4** antigens stimulate, clonal selection of (specific) B-lymphocytes / T-lymphocytes **;** **A** B- / T-, lymphocytes (with receptors / immunoglobulins / antibody) that are complementary to antigen **A** T-cells / B-cells **A** T-helper cells / T-killer cells **5** antigens, stimulate / AW, B-lymphocytes to divide (by mitosis) to form plasma cells **;** **A** clonal expansion of B-lymphocytes to form plasma cells **A** if cytokines stated instead of antigens **6** plasma cells, secrete / release / produce, antibodies **;** **7** antibodies mark cancer cells for destruction by, T-killer cells / macrophages / phagocytosis **;** **8** killer cells, release / AW, perforin / granzymes / toxins / hydrogen peroxide / hydrolytic enzymes, to kill / destroy, (cancer) cells **;** **A** description of how cell is killed e.g. breaks open / makes holes, in cell surface membrane **9** AVP **;** e.g. proteins released from melanoma cell act as <u>non-self antigens</u>	**5**

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Question	Answer	Marks
5(a)	*any **two** from:* **1** most water (in xylem) goes to the leaves taking (dissolved) phosphate ions with it **;** **2** xylem tissue does not extend into, growing points / shoot tips / root tips **;** **3** higher demand for phosphate ions in leaves (for photosynthesis) **;** **4** water and phosphate ions are transported upwards in the xylem (not down to root tips) **;** **5** phosphate ions are absorbed in area above root tips (so don't go down) **;** **A** transport to root tips involves movement in phloem **6**, **7** AVP **;;** e.g. correct ref to blockage by, endodermis / Casparian strip / suberin (apoplast pathway) not all phosphate ions cross cell (surface) membrane of endodermal cells (symplast pathway) phosphates may be stored in (vacuoles of cells in), roots / stems phosphate ions are used in the root for making, ATP / nucleotides / AW	**2**
5(b)	*any **four** from:* **1** phosphate ions transported in the phloem move, out of the leaf / into stem **;** **2** (group B data suggests that) phloem transports (some of) phosphate ions downwards **;** **3** phosphate ions can move from phloem to xylem **;** **4** waxed paper prevents movement (between phloem and xylem) **; ora** **5** data in support of difference between waxed and unwaxed in the same sample area **;** e.g. in S1 1% in xylem in A as opposed to 5% in xylem in B / <u>percentage</u> in xylem always higher in group B **6** some phosphate ions may transfer to surrounding cells in the stem **;** **7** much of the phosphate may not have left the leaf / much of the phosphate has been transported away from the leaf in the hour **;** **8** AVP **;** e.g. some may travel upwards in the phloem but no data not clear that results show phosphate ions transported upwards in xylem *ref. to* anomalous results / results not conclusive not all phosphate ions injected are accounted for	**4**

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Question	Answer	Marks
6(a)(i)	haem (group) **;** **I** Fe^2 **I** prosthetic group	**1**
6(a)(ii)	(iron in haem group) combines / binds, with (one) oxygen (molecule) **;** **A** carries / transports / attaches, oxygen **A** 'bonds with' if stated as iron ion / Fe^{2+} / ferrous ion **R** oxygen atom / 2 or more oxygens **R** carbon dioxide binds	**1**
6(a)(iii)	more than one <u>polypeptide</u> (chain) **;** **A** 2 or more **R** more than 2 / many / multiple **A** haemoglobin has four <u>polypeptides</u> **I** amino acid chain	**1**
6(b)(i)	accept values within the range 10–14 <u>kPa</u> **;** **A** as a range or as a single figure	**1**
6(b)(ii)	accept any <u>range</u> between 1–6 <u>kPa</u> **;** **A** within range 0–6 kPa **R** a single figure *ref. to* (steep) decrease in percentage saturation of haemoglobin as pO_2 decreases **;** **R** increasing saturation **A (**oxy)haemoglobin, dissociates / releases its oxygen **A** haemoglobin has a low affinity for oxygen	**2**

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Question	Answer	Marks
6(b)(iii)	*units – kPa and % – must each be used once* **1** (dissociation) curve shifts to the right **;** **I** curve shifts downwards / graph if given for curve **2** (percentage) saturation (of haemoglobin) decreases (as pCO_2 increases) **;** **A** decrease affinity of Hb for O_2 **3** comparative data quote giving percentage saturation at the same pO_2 and at two different values of pCO_2 **;** **A** percentage of oxygen released **4** *any ref. to* difference between position of curves, e.g. large difference in percentage saturation in middle of the range / little difference at high pO_2 **;**	**3**
6(b)(iv)	Bohr, shift / effect **;**	**1**
6(b)(v)	*any **two** from:* supplies more oxygen (to respiring tissues) **;** **A** more oxygen is released / AW **I** quicker / faster **I** haemoglobin releases oxygen more readily *idea that* allows oxygen to be supplied to, (named) tissues / cells, to meet demand / as demand increases **;** (maintains) aerobic respiration **;**	**2**

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