CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

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)	**X** = (large / permanent) vacuole **;** **Y** = tonoplast **; A** vacuolar membrane **Z** = nucleus **;**	**3**
1(b)	*if correct named cells are given, allow as a tissue if plural, otherwise ignore e.g.* ***I** cortex cell* ***A** cortex cells* **I** root hair cell *at start* and, xylem / vascular bundle / stele, *at end* **I** cell structures epidermal (tissue) / epidermis cortical (tissue) / cortex **A** parenchyma endodermal (tissue) / endodermis pericycle any three in correct sequence **;;** *if incorrect tissue(s) included with a correct full sequence of three, max 1 mark* *only two tissues stated but are in correct sequence allow one mark* *three tissues stated but not in correct sequence, and no incorrect tissues, allow one mark*	**2**
1(c)	*any **three** from*: cellulose, (molecules / fibres), hydrophilic / allow adhesion of water (molecules) **;** *idea that* arrangement of cellulose (fibres) gives spaces (for water flow) **;** AW e.g. many gaps freely permeable / not impermeable, (to water) **;** **A** *idea of* few obstacles to, water, movement / flow e.g. (cell walls) not selective / allow continuous movement of water / allow water to move at a high rate / allow all water to pass through / (offer) path of least resistance *ref. to* hydrogen bonding **;** *in correct context* e.g. cellulose molecules form hydrogen bonds with water molecules **I** hydrogen bonds between cellulose molecules hemicellulose / pectin, hydrophilic **;**	**3**

Question	Answer	Marks
1(d)(i)	rough ER site of, protein / enzyme, synthesis and smooth ER site of, lipid / sorgoleone, synthesis **;** **A** protein modification **A** lipid storage (barley plant), higher proportion of rough ER / lower proportion of smooth ER **or** (sorghum plant), higher proportion of smooth ER / lower proportion of rough ER **;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(d)(ii)</td><td>
student X to max 3
(mechanism could be) exocytosis ;
R diffusion / facilitated diffusion see ecf below

plus max two details from:
for, bulk transport / larger quantities ;
idea that may be too large to exit cell (by other mechanisms) ; A are large molecules
presence of, (small) Golgi bodies ; A presence of Golgi body
ref. to vesicles as, Golgi / secretory, vesicles ; A description e.g. packaging into vesicles
vesicles, move to / fuse with, cell (surface) membrane ;

ecf if, diffusion / facilitated diffusion, stated as the mechanism:
move down a. concentration / diffusion, gradient ;
A move from high to low concentration

student Y to max 3 check one of three different options (A enzymes for acid phosphatases and vice versa)
option 1
enzymes, facilitated diffusion <u>and</u> sorgoleone, (simple / passive) diffusion ;

plus two marks for all information in table correct ;;
<table>
<tr><td>enzymes</td><td>sorgoleone</td></tr>
<tr><td>hydrophilic / are not hydrophobic / polar / AW</td><td>hydrophobic / not hydrophilic / non-polar / AW</td></tr>
<tr><td>pass through, transport / membrane / carrier, proteins AW
A channel protein</td><td>cross hydrophobic core / between fatty acid tails / phospholipid bilayer AW</td></tr>
</table>
if two marks not gained, one mark for a correct row or correct column
</td><td>4</td></tr>
</table>

Question	Answer	Marks
1(d)(ii)	***option 2*** sorgoleone exocytosis and enzyme facilitated diffusion **;** *plus* one additional point about exocytosis **;** detail from enzyme column (shaded dark grey) **;** ***option 3*** enzymes exocytosis and sorgoleone diffusion **;** *plus* one additional point about exocytosis **;** sorgoleone column (shaded light grey) **;**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>any two from:
amino acids with hydrophilic R groups to, exterior / outside, (of molecule)
A facing, watery / aqueous, environment / cytosol / cytoplasm
or
amino acids with hydrophobic R groups to, interior / centre / AW, (of molecule) ;
A hydrophilic / hydrophobic, amino acids
must see amino acids somewhere in text to allow hydrophobic / hydrophilic ideas soluble (in water / cytoplasm / cytosol) ;
A forms colloidal suspension physiological / metabolic / dynamic, (role) ;
I functional unless qualified e.g. functional, for example haemoglobin carries oxygen has a functional role / functional, not structural
AVP ; e.g. non-repetitive / irregular, sequence(s) of amino acids

ref. to two or more bond types holding (3D) shape / tertiary structure / quaternary structure in place, but
R if peptide bonds listed</td><td>2</td></tr>
<tr><td>2(b)</td><td><table>
<tr><td>chloride ion / Cl^-;
I glucose</td></tr>
<tr><td>carbaminohaemoglobin ;</td></tr>
<tr><td>hydrogencarbonate (ion) ;
A HCO_3^-</td></tr>
<tr><td>oxyhaemoglobin ;</td></tr>
<tr><td>hydrogen ion(s) ;
A H^+ / proton</td></tr>
</table></td><td>5</td></tr>
</table>

Question	Answer	Marks
3(a)	positions of H and OH for C1 and C4 are other way round / AW **;** can award from a diagram **A** H should be up on C1 and C4 **A** OH should be down on CI and C4	**1**
3(b)	*conclusion 1 there are non-reducing and reducing sugars in the carrots* (all have) fructose/galactose/glucose, which, is / are, reducing (sugar(s)) **and** sucrose, which is non-reducing (sugar) **;** **A** sucrose is non-reducing and all the others are reducing (sugars) **A** fructose / galactose / glucose, reacts with Benedict's solution **and** sucrose does not **R** if another sugar in addition to sucrose is stated as non-reducing *conclusion 2 there are monosaccharide and disaccharide sugars in the carrots* (all have) fructose / galactose / glucose, which, is / are, monosaccharide(s) and sucrose, which is a disaccharide **;** **R** if another sugar in addition to sucrose is stated as disaccharide *conclusion 3 the carrots have the same patterns of results* (yes) all have order of content as (highest) fructose, glucose, sucrose and galactose **;** **A** all have fructose as highest content and galactose as lowest content **I** data quotes	**3**
3(c)	starch / amylose / amylopectin / cellulose / hemicellulose / pectin / inulin **;**	**1**

Question	Answer	Marks
3(d)	*allow other AW for assimilates e.g. sugars / sucrose / other named sugars / amino acids / organic compounds* *allow named locations for growing areas e.g. developing shoots / developing leaves / buds / seeds* *ignore 'nutrients' as AW for assimilates but allow ecf* acts as source (only), after dormant period/in second year of growth and is a sink in the first year of growth **;** **I** during dormant period one detail of source **;** e.g. *idea that* assimilates are mobilised for transfer e.g. starch to sugars for transport assimilates, loaded / AW, into phloem (tissue) source is starting area of, translocation / transport of assimilates source, provides assimilates for growing areas one detail of sink **;** e.g. of, growth / development storage e.g. energy store / assimilates converted for storage / storage of substances receives assimilates transported, in phloem sap / in phloem tissue / photosynthates receives assimilates from, source / leaves / sites of synthesis / photosynthetic tissue	**3**
3(e)	*any **two** from:* has RNA (as genetic material), not DNA / so does not need transcribing / so transcription does not occur **;** (viral) RNA, acts as mRNA / is sequence of mRNA codons **;** AW (viral) RNA can be used (directly) for translation **;** **A** description of translation e.g. to form, amino acid chain / polypeptide **I** for synthesis of proteins attach to ribosomes and make, polypeptide / protein *ref. to single– / double–, stranded is neutral*	**2**

Question	Answer	Marks
4(a)	*Mycobacterium tuberculosis* **;** *must be spelled correctly*	**1**
4(b)	1 (infected), person, coughs / breathes (out) / talks / sneezes / AW, and (uninfected) person, inhales / inspires / breathes in **;** 2 aerosol infection / aerosol transmission / droplet infection / droplet transmission *must be a term* **or** organism / pathogen / bacteria / *M. tuberculosis*, in, airborne droplets / droplets in air **;** **A** contaminated airborne droplets / contaminated droplets in air **A** *ref. to* airborne droplets from an infected person transmits the pathogen **I** infected droplets / infected airborne droplets / droplets of air / air droplets *max 1 if another mode of transmission also given as a choice* *max 1 if correct description of Mycobacterium bovis given e.g. drinking contaminated (unpasteurised) milk* ***or*** *eating contaminated meat (from cattle)*	**2**
4(c)	antibiotic **;** **I** examples **I** antibacterial	**1**
4(d)	label line and label to: bronchus **;** bronchiole **;** blood vessel **;** **R** if blood vessel is stated as a capillary	**3**

Question	Answer	Marks
4(e)	*any **five** from:* *gas exchange and overall health to max 4* 1 fewer, bronchioles / alveoli / alveolar capillaries **or** granuloma / described, causes, damage / lesions / airway lumen to decrease / AW **;** **A** takes up lung space **I** blocks airways 2 consequence **;** e.g. less air enters alveoli / reduced surface area (for gas exchange) *context is fewer alveoli (fewer capillaries)* fewer red blood cells / less haemoglobin, to take up oxygen *(granuloma)* causes (partial) air blockage / prevents alveolar function / AW suggestion that cells in the granuloma take up oxygen 3 many immune system cells / dead cells / debris / AW, hinders gas exchange **;** *this is not the same as mp8* 4 less oxygen, reaches tissues / to the (rest of) body (in circulation) **;** 5 consequence **;** e.g. tiredness / fatigue / less mobile increases blood pressure / strain on heart rapid breathing / causes breathlessness **A** difficulty breathing **I** affects breathing *prevent development TB elsewhere in body to max 4* 6 infected (lung) cells / pathogen, prevented from entering, circulation / bloodstream **;** 7 granuloma acts to, confine / localise / isolate, pathogen **;** **A** description of cells within granuloma acting as the barrier 8 many / surrounded by / AW, cells of the immune system / named **;** **I** white blood cells e.g. lymphocytes / plasma cells / phagocytes / macrophages / neutrophils / multinucleated giant cells *note: many macrophages in a giant cell is not mp7* 9 other detail of immune response stimulated **;** e.g. antigen presentation antibody formation (against *M. tuberculosis*) phagocytosis of, infected cells / pathogen cytokine release 10 AVP **;** e.g multinucleated giant cells, more effective as a large cell / increase chance of detecting pathogen result of immune response prevents, population increase / bacteria reproducing / AW another detail of immune response	**5**

Question	Answer	Marks
5(a)	antigen(s) **;** **I** self– / non-self	**1**
5(b)	*any **three** from: using bone marrow stem cells* 1 (origin from bone marrow so) haematopoietic/results (only) in production of blood cell types **;** **I** multipotent **A** specialise / differentiate, into red blood cells 2 able to produce genetically identical cells **;** 3 (retain ability to) divide (continuously) / carry out mitosis / go through cell cycles **;** **I** reproduce / replicate 4 (so) large numbers (of red blood cells) can be produced **;** **A** can, produce stem cells / self-renew **R** can differentiate into stem cells 5 can avoid passing on diseases / AW **;** *from the blood sample* 6 less invasive than extraction from bone marrow **;** AW **ora** 7 immobilisation method used to collect the stem cells is, only possible if in blood / easy / easier (than extraction from bone marrow) **; ora** 8 AVP **;** e.g. can replace blood taken as a sample by a transfusion easily genetically modified can be modified to avoid rejection	**3**

Question	Answer	Marks
5(c)	*any **three** from:* 1 no toxic effects (in recipient) **;** 2 should not stimulate an, allergic/immune, response (in the recipient) **;** **A** not rejected 3 does not carry any pathogens / AW **;** **A** no risk of infection / named example **A** screening (of blood product) not required *allow* safe to use *if mp1, 2 or 3 not gained* 4 long shelf life / long-lasting **;** **A** easy to store 5 can transport oxygen **;** **A** idea of improved ability to carry / transport / deliver, oxygen 6 soluble, in blood **or** idea of able to circulate easily in blood **;** 7 used for all blood types / specific to particular blood types **;** 8,9 AVP **;;** e.g. can carry out other functions of blood fast production / large quantities / mass production acceptable to be used by people because of, ethical / cultural / religious, reasons AW	**3**

Question	Answer	Marks
6(a)	curve drawn to the right of original, same shape and lower maximum rate of reaction, passing through plot of 0.055 to 0.06 mmol dm^{-3} on x-axis **;** *must start branching away before third plot point at 2au* **R** S-shaped / sigmoid curve K_m = 0.055 to 0.06 mmol dm^{-3} **;** *allow ecf if no curve drawn and printed curve used* *incorrect K_m but standard curve for non-competitive inhibition drawn, allow 2 marks if their K_m is correct* *if competitive curve drawn and K_m is correct from their curve allow* ecf *1 mark*	**2**
6(b)	*start codon* triplet of / three, (RNA / DNA) bases / nucleotides (begins translation), qualified e.g. coding for, methionine / first amino acid first codon attaching to ribosome **or** (codon to begin translation is) AUG (for RNA) **or** TAC (for DNA transcribed strand) **or** ATG (for DNA non-transcribed strand) **;** *stop codon* triplet of / three, (RNA / DNA) bases / nucleotides, (ending translation), qualified **;** *codon meaning only needed once* e.g. does not code for amino acid stops, chain elongation / addition of amino acids allows / AW, polypeptide to detach (from ribosome) recognised by releasing factors **or** (codon to end translation) UAG UAA / UGA (for RNA) **or** ATC / ATT / ACT (for DNA transcribed strand) **or** TAG / TAA / TGA for DNA non-transcribed strand) *if more than one codon given, all must be correct*	**2**

Question	Answer	Marks
6(c)(i)	(each) detection antibody attached to a (different) toxin **;** *allow one antibody attached to two toxins (astride)* **A** at least one detection antibody attached **R** if one detection antibody attached directly to immobilised antibody **R** if unattached detection antibody shown	**1**
6(c)(ii)	*any **one** from:* bind, to different, locations / sites / AW, on toxin **;** AW **A** bind different, epitopes / antigenic determinants detection antibody has, HRP / enzyme (attached) **; ora** *ignore similarity of both bind toxin to award if stated detection antibody has enzyme* capture antibody is immobilised **; ora**	1

Question	Answer	Marks
6(c)(iii)	*allow enzyme for HRP* *allow 'lighter' for 'paler'* *assume ref. to colour is blue-green* *any **four** from;* 1 colorimeter measures, absorption of light (by reaction mixture) **;** **A** transmission of light (through reaction mixture) 2 low(er) intensity of / pale(r), colour gives low(er), (colorimeter) reading / measurement / absorbance **;** **ora** for transmission **A** ***or*** *idea that* different intensities of colour, gives different absorbances *allow example* 3 low(er), intensity of colour / absorbances, indicates low concentration **;** **A** *idea that* different, intensities of colour / absorbances, indicate different concentrations *allow example* 4 will get different absorbance readings for low toxin positive result compared with negative result **;** AW **A** would get same reading as blank if negative result (positive does not give same reading as blank) **A** not relying on by-eye judgement (between colourless and very pale blue-green) **A** colorimeter not subjective **A** by-eye judgment may not detect a slight colour change (colourless to very pale blue-green) ***no** ora for statement colorimeter detects a slight colour change (must compare with by-eye)* 5,6 AVP **;;** e.g. *ref. to* use of, standards / calibration curve, to obtain actual concentrations *ref. to* use of, stop / acid, so only initial rate of reaction occurs low concentration of HRP so low quantity of, TMB / substrate, oxidised **A** less products formed **ora** low quantity of, oxidised TMB gives a, light(er) (blue-green) colour / minimal colour change **ora** low concentration of toxin results in, a low quantity of detection antibody binding / most detection antibody washed away	**4**