CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 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 October/November 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	<u>'List rule' guidance</u> 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
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)	*any **two** from:* *allow **oras*** **1** cilium composed of microtubules **or** microvillus, composed of microfilaments / contains actin (filaments) **;** **2** cilium 9+2 (microtubule) arrangement **;** **3** cilium has basal body **; A** has centrioles at the base **4** cilium shows synchronous, rhythm / movement **; A** whip-like / rhythmic, movement **5** cilium, moves / wafts, mucus **or** microvillus increases, surface area / SA, for, absorption / uptake / secretion **;** **A** increases SA to locate transport proteins AW **6** AVP **;** e.g. cilium has dynein (arms) cilium is, longer (10 μm) / wider (0.2 μm) **or** microvillus is, shorter (1 μm) / narrower (90 nm)	**2**
1(b)	*any **one** from*: protects (intestinal), epithelium / cells / lining **;** **A** examples of protection e.g. damage from stomach acid / digestion by enzymes **A** less likely for epithelial cells to be damaged / AW **A** traps, pathogens **or** (harmful), bacteria / microbes / microorganisms **I** dust **A** prevents, pathogens / AW, from reaching cells eases / reduces friction for, movement of, gut contents / substances (through digestive system) **;** habitat / nutrient source, for gut, microorganisms / flora **;** AW AVP **;** e.g. location for immune system cells **R** if stated as being in the gas exchange system	**1**
1(c)(i)	arteriole **; A** (small) artery	**1**

Question	Answer	Marks
1(c)(ii)	*any **two** from:* (at arteriole end of capillary) high, <u>hydrostatic</u> / <u>blood</u>, pressure **;** **A** *ref. to* hydrostatic pressure gradient (ultra)filtration / described **;** e.g. fluid / plasma / water <u>and</u> solutes, forced / comes out of, capillaries / blood glucose / amino acids / ions, leave (blood) **or** (large / plasma) proteins remain (in blood) **;** **R** if stated, red blood cells / platelets, leave through, fenestrations / fenestrae / endothelial pores **or** pores / gaps / spaces, in, capillary wall / endothelium / between cells **;**	**2**
1(d)	*any **three** from*: *after, secreted / released, by enteroendocrine cells* transport of, peptide / GLP-1 / ligand, in, blood / circulation **;** to, <u>target cells</u> (which are cells of the, stomach / pancreas) **;** binding of, peptide / GLP-1 / ligand, to receptor **;** *context can be cell surface membrane or intracellular* *ref. to*, specificity / complementary **;** *must be in correct context of GLP-1 binding to receptor* (binding) triggers / sets off / AW, events within (target) cell (leading to the response) **;** **A** examples e.g. signal transduction / triggers enzyme cascade	**3**
1(e)(i)	prophase metaphase anaphase telophase } **;** **R** if interphase or cytokinesis stated	**1**

Question	Answer	Marks
1(e)(ii)	*any **three** from*: *ref. to nucleus / nucleolus, is neutral* presence of, vesicles / vacuoles, qualified **;** e.g. many / secretory / Golgi **A** storage vesicles correct *ref. to* exocytosis **;** **A** fusion of, vesicle / vacuole, with cell surface membrane much / high proportion of / a lot of / AW, rough endoplasmic reticulum **;** **I** ER / RER / rough ER **A** many ribosomes rough endoplasmic reticulum / ribosomes, site of, peptide / polypeptide / protein / enzyme, synthesis **;** **ecf** *for abbreviating rough endoplasmic reticulum previously* AVP **;** e.g. presence of mitochondria to provide, ATP / energy, for, protein synthesis / movement of vesicle to cell surface membrane / exocytosis *mp2 can also be awarded here **only** if ref. has been made within response to vesicles / vacuoles*	**3**
1(e)(iii)	Paneth cell is, differentiated / specialised (for, secretion / its function) **or** stem cells are, undifferentiated / not differentiation / not specialised **;**	**1**
2(a)	*Vibrio cholerae* **;** *must be spelled correctly*	**1**

Question	Answer	Marks
2(b)	*any **four** from*: *within general response, in correct context* **1** *ref. to*, contamination / contaminated **;** **A** presence of, pathogen / *V. cholerae* / bacterium *in correct context (can look for **ora**)* **2** *ref. to* breaking the transmission cycle **;** *providing access to safe drinking water* **3** cholera is transmitted by faecal-oral route **;** **A** described e.g. *ref. to* (contaminated) faeces and ref. to, food washed in contaminated water **or** drinking (contaminated) water **or** eating (contaminated) food *practise personal hygiene* **4** *ref. to* using method to make sure faeces do not enter drinking water **;** e.g. use of, toilets / latrines **A** do not defaecate in or near, rivers / reservoirs / lakes AW *accept* urinate **I** non-scientific terms for, defaecation / urination **5** washing hands **;** **6** detail **;** e.g. use, soap / antibacterial gel / AW after, urination / defaecation **A** after going to the toilet before handling foods*context is preparation or eating a meal* scrub under fingernails cafes, restaurants / AW, provide places for washing hands do not share towels / use disposable towels / AW **7** AVP **;** e.g. water, is / should be, chlorinated / boiled / bottled / filtered to remove pathogens / UV-treated / other water, is / should be, kept separate from sewage / piped direct from water treatment plant keep fingernails short safe disposal of vomit	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(c)(i)</td><td>

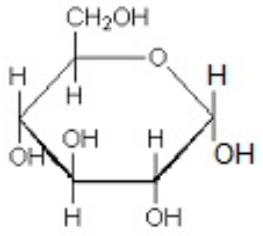
antigen is a standalone mark then move to rows 3,4,5

if no marks gained from rows 3,4,5, check for correct answers in these rows going <u>down</u> the column to award 1 mark

<table>
<tr><th>row</th><th>feature</th><th>oral cholera vaccine</th><th>passive immunisation for cholera</th></tr>
<tr><td>1</td><td>component causing the desired response</td><td><u>antigen(s)</u> ; I weak / weakened / toxin
A toxoid / inactivated toxin
R dead antigen
A weakened / attenuated / dead, pathogen / V. cholerae</td><td>antibody</td></tr>
<tr><td>2</td><td>type of immunity gained</td><td>artificial active</td><td>artificial passive</td></tr>
<tr><td>3</td><td>stimulates production of memory lymphocytes</td><td>(yes) / no</td><td>yes / (no);</td></tr>
<tr><td>4</td><td>length of time needed to have an effect</td><td>shorter
same
(longer)</td><td>longer
same
(shorter);</td></tr>
<tr><td>5</td><td>duration of immunity</td><td>shorter
same
(longer)</td><td>longer
same
(shorter);</td></tr>
</table>

</td><td>4</td></tr>
</table>

Question	Answer	Marks
2(c)(ii)	B-lymphocyte / plasma cell / splenocyte, <u>and</u>, myeloma / tumour, cell **;** **A** B-cell *for B-lymphocyte* **A** cancer cell *for myeloma cell* *plus **two** from:* (B-lymphocyte) synthesises (specific / desired) / AW, antibody **;** **I** has the antibody (B-lymphocyte) cannot survive (for long) / dies, in culture **;** (myeloma cell) can divide / can carry out mitosis / long-lived **;** **I** rapidly / fast **A** <u>plasma cell</u> cannot divide **R** (hybridoma cell) divides uncontrollably	**3**

Question	Answer	Marks
3(a)	*any **three** from:* different sequence of, (DNA) nucleotides / bases **;R** RNA nucleotides code for / result in, different, polypeptides / proteins **;** **A** result in different sequences of amino acids **A** *LCT*, codes for / AW, lactase / enzyme, and, *MCM6*, codes for a different protein / involved in regulation have different numbers of, introns / exons **;** different, lengths / number of nucleotides / number of bases **;** *context is DNA* AVP **;** e.g. one may be continually expressed, the other switched on and off *MCM6* associated with different regulatory sequences	**3**
3(b)	statement showing relationship between transcribed strand and primary transcript **;** e.g. (transcribed strand is the) DNA (strand) / template (strand), used to form the primary transcript primary transcript is RNA (molecule first) formed from transcription of transcribed strand primary transcript is a complementary copy of the transcribed strand (but uracil replaces thymine) statement showing relationship between primary transcript and mRNA **;** e.g. primary transcript undergoes, gene / RNA, splicing, to form mRNA primary transcript undergoes modification to produce mRNA mRNA formed by removal of introns from primary transcript mRNA formed only from exons of primary transcript *one mark for a response that has correct ideas but does not show a direct relationship*	**2**
3(c)	base substitution / substitution (mutation) **;** **I** missense	**1**
3(d)	 *all correct for one mark – if deciding to leave out the H, then this must be for all C1 to C5 hydrogens – leaving out only the C5 H is zero marks*	**1**

Question	Answer	Marks
3(e)(i)	*any **two** from:* *idea of* can, detect increase in / distinguish between, the intensity of colour (as products form) **;** can obtain quantitative results (for coloured product of ONPG) **;** **A** can provide numerical, values / readings / results / measurements **R** if stated that the results are wavelengths *ref. to* not subjective / AW **;** *idea of* not by-eye judgments / difficulty in describing different colour shades can obtain accurate, results / readings / values **;** **A** *idea of* greater accuracy in obtaining results *vague references to accuracy should be considered for ideas linked to 'not subjective'* can construct numerical graphs of results to compare curves of each (lactase) concentration **;** AW AVP **;** e.g. more sensitive to small colour changes at the beginning of the experiment not able to see initial reaction proceeding by eye *ref. to* use of a (prepared) calibration, curve / graph (to compare rates / product concentrations)	**2**

Question	Answer	Marks
3(e)(ii)	*any **four** from:* *accept activity for percentage of maximum activity* **1** immobilised (overall) greater, productivity / yield / hydrolysis (of lactose in milk) **; I** activity **2** (process / immobilised) more tolerant to, temperature / pH, fluctuations / changes **;** AW **A** *idea that* can be used in processes covering a wide range of, temperature / pH **3** detail immobilised vs free lactase from Fig. 3.2 **;** e.g. (at temperatures) above optimum / higher than 38 / 39 °C, (immobilised) has a higher activity AW above optimum / higher than 38 / 39 °C, (partial / extent of) denaturation (for immobilised) is less at each temperature AW **A** higher than 40 °C *if accompanying context is correct* **R** if optimum stated as 35 °C **4** data from Fig. 3.2 to support **;** *any one comparison (units only for temperature required)* **5** detail immobilised vs free lactase from Fig. 3.3 **;** e.g. higher activity at all pHs except pH 6.5 and pH 7.0 higher activity, below pH 6.5 / above pH 7.0 free not active at pH 5.5 but immobilised active, at all pHs / for a wider pH range **6** data From Fig. 3.3 to support **;** **7** AVP **;;** e.g. can use a lower temperature / cheaper, for same quantity of product **8** more, heat stable / thermostable / stable at high temperatures **I** longer shelf-life **R** thermostatic better in alkaline pHs	**4**

Question	Answer	Marks
4(a)	*any **three** from:* *max 2 for similarities, max 2 for differences* *similarities, both have* phospholipids **;** channel / transport, protein **; A** intrinsic / integral / transmembrane, protein **R** carrier / pump, protein a bilayer / two layers **;** *differences* *do not need to have 'outer membrane' 'bacterial' if context is clear* (bacterial outer membrane) has lipopolysaccharides **; ora** (cell surface membrane / eukaryote) has, phospholipid bilayer / both layers with phospholipids **; ora** *if ora also given (bacterial) only has outer layer of (outer) membrane with phospholipids, can also award mp1* AVP **;;** e.g. cell surface membrane has, glycocalyx / glycolipids / glycoproteins cell surface membrane has cholesterol outer membrane does not have extrinsic proteins	**3**
4(b)(i)	*any **one** from:* *formation of O-IMV* involves a more complex process **;** e.g. greater variety of, contents / cell structures **R** organelles *ref. to* needing to make a vesicle with two 'membranes' / AW **A** 'layers' peptidoglycan, chains / layer / bonds, need to be broken **; A** peptidoglycan wall needs to be broken causes, (temporary) weakness in cell wall / risk of lysis **;** *idea that* more resources required to form vesicle **or** too great a loss of important cell, components / structures *ref. to* take more time to produce **;** uses (more) energy to, break wall / repair wall / make the vesicle **;I** *ref. to* organelles AVP **;** e.g. suggestion that periplasmic proteins need to be released in greater numbers so more OMVs formed	**1**
4(b)(ii)	*any **one** suggestion that:* *must be in context of a fully formed O-IMV* function of O-IMVs require, energy / ATP **;** **A** suggested function e.g. DNA transcription / metabolic reactions / for active transport **I** cell processes O-IMV (formation) has cytoplasm, which contains ATP **;** OMVs formed only from periplasm, which has no ATP **;** **A** no ATP in outer membrane space AVP **;** e.g. no / few, ATP transporters / transport proteins, for exit of ATP into periplasm (in area where OMV forms)	**1**

Question	Answer	Marks
4(b)(iii)	*ref. to* DNA in O-IMVs being passed on to other bacteria **;** e.g. O-IMVs may, fuse with / be taken up by / AW, plasmids / DNA, in (degraded) O-IMVs may enter other bacteria qualified *ref. to* O-IMV DNA and antibiotic resistance **;** e.g. O-IMVs have, alleles / genes / plasmid, that, give / confer / AW, antibiotic resistance DNA may mutate to give (a, gene / allele, for) antibiotic resistance DNA, codes for / expresses / AW, a protein involved in antibiotic resistance example of gene conferring resistance e.g. enzyme to breakdown antibiotic change to ribosome structure (to prevent antibiotic attachment) efflux pump for / membrane protein to pump out, antibiotic	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>A = (waxy) cuticle ;
B = spongy mesophyll (layer / tissue) ; R spongy mesophyll cell I parenchyma</td><td>2</td></tr>
<tr><td>5(b)</td><td>one mark each correct row <u>and</u> each example must be different
<table>
<tr><th>structural feature in Fig. 5.1</th><th>one example of xerophytic adaptation</th></tr>
<tr><td>structure A</td><td>thick / thicker, (waxy cuticle) ;
A reflective layer / AW</td></tr>
<tr><td>upper epidermis</td><td>multi-layered / more than one cell layer / hypodermis
or
thick walled / thick cell walls / sclerenchyma
or
presence of, trichomes ;</td></tr>
<tr><td>lower epidermis</td><td>sunken stomata
or
stomata in, pits / grooves / crypts / chambers
or
presence of, trichomes
or
thick / thicker, (waxy) cuticle
or
few(er) stomata (per unit area) R no / fewer
or
stoma / stomata, with smaller, aperture / pore ;</td></tr>
</table></td><td>3</td></tr>
</table>

Question	Answer	Marks
6(a)	• *consider <u>all</u> mps to award if response clearly addresses events in the left side* ○ *mps 1,2,6,7,8 must be in the context of the left side of the heart* • *otherwise allow mp 3, 4, and 5 to max 3 – these mark points are inset to the right* *any **five** from:* **1** blood enters (heart) via / in, pulmonary vein(s) **;** **2** blood exits heart to aorta **;** **R** arota **3** blood flows from atrium to ventricle **;** **4** atrial, systole / contraction, then, ventricular, systole / contraction **;** **A** atrium contracts then ventricle contracts **5** pressure in ventricle, increases / gets higher **;** **I** high pressure unclear attempts / mixed right and left sides **6** bicuspid / (left) atrioventricular valve closes **; A** mitral valve **R** *if in context of events in the atrium* **7** semilunar / aortic, valve opens **; ecf** *from arota in mp 2* **R** *if in context of events in the atrium* **8** bicuspid / (left) atrioventricular, valve closes when (blood) pressure in ventricle higher than atrium **or** semilunar / aortic, valve opens when (blood) pressure in ventricle higher than aorta **; A** aortic valve	**5**

Question	Answer	Marks
6(b)(i)	*if no marks gained allow one mark for four, polypeptides / polypeptide chains* two, (identical) alpha / α, chains / globins, and two, (identical) beta / β, chains / globins **;** **A** subunits / polypeptides, for chains **R** beta-pleated sheets / globulin *plus **one** from;* each, chain / globin / polypeptide, incorporates / contains / AW, a haem (group) **;** **A** four haem groups **A** molecule for polypeptide if mp1 gained **A** ferrous ion / Fe^{2+} / iron (ion / atom), within porphyrin (ring) for haem group **A** prosthetic group with, ferrous ion / Fe^{2+} / iron (ion / atom) hydrogen bonds / hydrophobic interactions / ionic bonds, between, chains / polypeptides / globins **;** *context is interactions between chains* **R** if disulfide bond also stated	**2**
6(b)(ii)	oxygen binds to, iron ion / ferrous ion / Fe^{2+} **;** **A** oxygen bonds / oxygen forms a bond, *only if*, iron ion / ferrous ion / Fe^{2+} stated **A** oxygen binds to, iron / iron atom / haem (group) **R** if more than one oxygen molecule binds to one iron ion detail of saturated **;** e.g. total of 4 oxygen molecules / 8 oxygen atoms (bind per haemoglobin molecule) each, chain / globin / polypeptide, binds one oxygen molecule **R** bonds *ref. to* cooperative binding / allostery **A** description *ref. to* (fully saturated molecule is) in, high partial pressures of oxygen / high concentration of oxygen **;** *ref. to* T / tense, state to, R / relaxed, state	**2**