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CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/23**

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.

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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	<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.

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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
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
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

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Question	Answer	Marks
1(a)	*letter **A**: example of substance* = carbon dioxide / oxygen **;** *letter **D**: type of movement* = active transport **;** *letter **D**: part of membrane involved* = carrier / pump, protein and *example of a substance* = sodium ions **;** **R** sodium-potassium pump **A** potassium ions / chloride / amino acids **A** sodium pump (if sodium is example) **A** glucose *if not given for letter **C*** *letter **C**:example of a substance* = glucose **;** **A** amino acids / chloride (ions) / potassium ions / sodium ions *part of membrane involved*: *for **B*** = channel protein and *for **C*** = carrier protein **;**	**5**
1(b)	*any **two** from* *viruses travel through* symplast pathway **;** **I** apoplast pathway *if described correctly* **R** symplast and apoplast pathways *if no further detail of apoplast given* plasmodesmata / cytoplasmic connections between cells **;** **A** strands of cytoplasm because viruses are small enough (to pass through plasmodesmata) **;** AVP **;** **A** any *ref. to* actual size (width of plasmodesmata ~ 50 nm, width of Tobacco Mosaic Virus 18 nm)	**2**

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Question	Answer	Marks
2(a)(i)	*any **two** from* each polypeptide is a (left-handed), helix / helical shape **;** **R** alpha helix (three) polypeptides are tightly, coiled / wound (around each other) / AW **;** (three polypeptides form a) triple helix **;** **I** bonding	**2**
2(a)(ii)	*any **three** from* *collagen molecules arranged* **1** in parallel **;** **2** staggered / ends are not aligned / AW **;** *molecules held together by – max 2* **3** covalent, bonds / links **; I** hydrogen bonds **R** if part of a list that includes other bonds in proteins **4** between R-groups of amino acids on different molecules **; A** side chains **5** AVP **;** e.g. covalent bonds between lysine / hydroxylysine (residues)	**3**
2(b)(i)	provides (high tensile) strength to, help keep trachea open / support trachea **;** **A** provides strength to prevent trachea collapsing allows flexibility for, breathing / change of diameter of trachea / bending of trachea / AW **;**	**2**
2(b)(ii)	*any **one** from:* (inhalation) allow, stretching / expansion, without, rupture / AW **; A** prevent overstretching elastic fibres recoil to help, expel air / exhalation / expiration **; R** to empty	**1**
2(c)(i)	(gly)-pro-met-gly-pro-arg-gly-pro-pro-gly ;	**1**

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Question	Answer	Marks
2(c)(ii)	*any **three** from:* *allow gly for glycine* **1** glycine is every third amino acid **;** **2** glycine, allows tight folding for the polypeptides / makes it easy for polypeptides to fit closely together / AW **;** **A** compactness **A** glycine allows the turning points (of the polypeptide) **3** glycine has smallest R-group **;** **A** glycine is the smallest (amino acid) / glycine has H as R-group *or* side chain **4** NH in glycine can form hydrogen bonds (with carboxyl group on another amino acid residue) **5** (so) allows many hydrogen bonds between polypeptide**s ;** **6** AVP **;** ala / pro, also has a small R-group / AW	**3**
2(c)(iii)	**P** *deletion of first nucleotide pair* changes the, sequence / order, of amino acids (in primary structure) **; I** shorter **A** (GTC CAA TGG GTC CCC GAG GTC CCC CAG GT_) val gln trp val pro glu val pro gln (val) **Q** *substitution in first triplet* (GGT to TGT in non-transcribed strand) cys (instead of gly) is first amino acid, and no change to the rest (of, sequence / order, of amino acids) **;** **A** only first amino acid is different	**2**

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Question	Answer	Marks
3(a)	*any **three** from:* *to award MPs 2, 3 and 6 there must be reference to shape or conformation at least once in the answer* *if no reference to shape or conformation in the answer mark to max 2* *if lock and key described mark to max 2 from MP4 onwards* **1** *idea that* active site (of inactive enzyme) and substrate are, (only) partially / not, complementary **;** **2** as substrate enters active site there is a, change in shape / conformational change, (of active site / enzyme) **;** **A** active site moulds around substrate **R** substrate changes shape / substrate active site **3** so shape of active site becomes complementary to substrate **;** **A** *idea that* there is a good fit between active site and substrate **4** enzyme-substrate complex forms **;** **5** lowers activation energy **;** **6** product(s) leave and, enzyme / active site, returns to original, shape / conformation **;** **7** AVP **;** e.g. catalytic sites move to be in correct position e.g. detail of lowering activation energy – putting strain on substrate / stress on bonds	**3**
3(b)(i)	*allow enzyme or subtilisin for immobilised subtilisin A* *allow attachment for attachment of larvae* **I** comparisons between controls *any **four** from:* **1** effective because (much) lower percentage attachment with, the enzyme / AW, compared with the control(s) / AW **;** **ora** for (both) controls **2** any comparison between 24 and 48 hrs in the same experimental tank (1 to 4) **;** e.g. tank 2 only one showing decrease at 48 hours **3** any comparison between any two different tanks (1 to 4 or any experimental with control) at either 24 or 48 hours **;** e.g. less attachment in tank 2 than in the others at 48 hours **4** 48 hours is a short period of time / may not be effective after a few days **;** **5** not 100% effective **;** **6** (generally) becomes less effective at 48 hours (with exception of tank 2) **;** **7** immobilised enzyme, not stable / detached from surface **;** **8** *ref. to* no trend with increasing subtilisin concentration **;** **9** no repeats so data may not be valid / AW **;** **10** AVP **;**	**4**

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Question	Answer	Marks
3(b)(ii)	***I*** *ref. to cost* *any* ***two*** *from:* **1** density / concentration of, enzyme / subtilisin A / polymer **;** **A** way of attaching enzyme to polymer **2** type of polymer **;** **3** check that all organisms are removed from ships before applying, enzyme / polymer **;** **4** way to fix polymer to surfaces of ships / material used to make surface of ships **;** **5** number of larvae put into tanks / experiment carried out at time of year when larvae are in sea water **;** **A** *idea that* different places have different numbers of larvae **6** length of time before taking measurements **;** **7** length of time, enzyme / anti-fouling agent, remains active **;** **A** *ref. to* stability of immobilised enzyme **8** *idea of* any interaction with other, fouling / marine, organisms **; A** 'affect' as an interaction e.g. that could, graze / decompose, subtilisin A / polymer that could compete with *A. amphitrite* for attachment sites effectiveness against fouling organisms other than, *A. amphitrite* / barnacles subtilisin A / product of enzyme, may be, toxic / harmful, to marine organisms **9** effect of immersion in sea water on, enzyme / polymer (not in artificial sea water) **;** **10** effect of different types of sea water, e.g. salt content / mineral content / roughness **;** **A** different, concentrations of sea water / salinities **11** effect of marine pollutants / something in sea water, as enzyme inhibitors **;** **12** AVP **;** e.g. *ref. to* surface area of ship exposed to sea water types of antifouling agents present in the seawater	**2**

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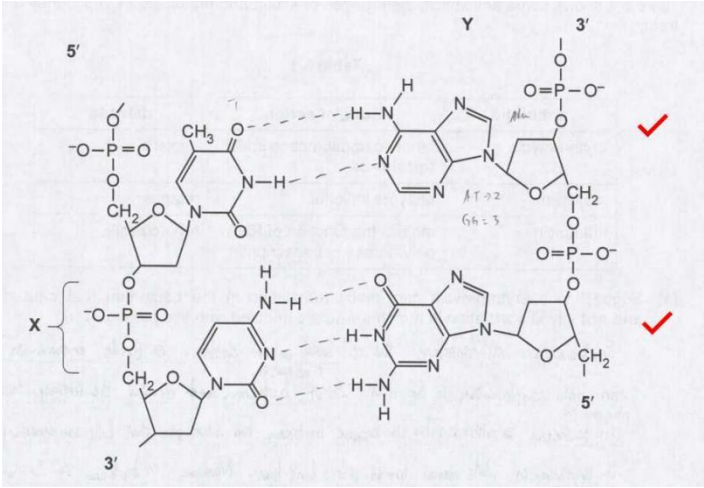
Question	Answer	Marks
4(a)(i)	repeating, units / sub-units / molecules / nucleotides (used to make a, polymer / polynucleotide / strand (of DNA)) ;	1
4(a)(ii)	*any **one** from:* (pentose / sugar is) ribose (not deoxyribose) ; C2 on the, pentose / sugar, is -OH not -H ;	1
4(a)(iii)	respiration ;	1
4(b)(i)	two hydrogen bonds drawn correctly between A and T ; three hydrogen bonds drawn correctly between C and G ; *for positioning of H bonds on C-G, **A** from either H on amine group on C to link with oxygen on G*  *if no marks gained but A-T has two lines and C-G has three lines between bases award 1 mark*	2
4(b)(ii)	phosphodiester ;	1

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Question	Answer	Marks
5(a)	*any **two** from:* **1** bacteria, have 70S ribosomes and humans have 80S ribosomes / only have 70S ribosomes **;** **2** antibiotic, cannot bind to 80S / human ribosomes **or** can only bind to 70S / bacterial ribosomes **;** **3** antibiotic, binding site / target site, not present on 80S ribosomes / only present on 70S ribosomes **;** **A** *ref. to* complementary / specfic – alternative to second part of the MP **4** antibiotic cannot enter mitochondria to reach 70S ribosomes (in humans) **;** **5** AVP **;** different combinations of proteins in ribosomes / different rRNAs in ribosomes	**2**
5(b)	*any **one** from:* **1** penicillin acts on cell walls and human cells have no, peptidoglycans / cell walls / enzyme(s) that make cell walls**;** **A** murein *penicillin* **2** prevents formation of peptide / cross, bridges / linkages, (between peptidoglycans) in (bacterial) cell wall **;** **3** prevents repair of, gaps / holes / AW, in (bacterial) cell walls caused by autolysins **;** **I** *ref. to* penicillinase	**1**
5(c)	*any **one** from:* *rifampicin* **1** blocks / fits into / binds to / competes for, the active site of, RNA polymerase / enzyme **;** **2** binds, to allosteric site / site away from active site, to, change shape of active site / prevent it forming phosphodiester bonds **;** **3** attaches to DNA template blocking RNA polymerase moving along it **;** **4** can be incorporated into RNA but no nucleotide can be added to it **;** **5** AVP **;** e.g. attaches to the promoter to stop RNA polymerase, binding to DNA / moving along DNA / AW	**1**

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Question	Answer	Marks
6(a)	*any **two** of these pairs, feature and explanation* **1** thick wall of (left) ventricle **; R** if right **2** pumps blood at high pressure to, reach (all of) systemic circulation / overcome resistance in systemic circulation / over a long distance / AW **;** **A** if thick wall unqualified **A** generate high force **R** 'withstands high pressure' **3** thin wall of (left) atrium **;** **4** pumps blood at low pressure, into ventricle / over a short distance **;** **either** **5** (named) valves **; R** tricuspid / pulmonary **6** prevent, backflow of blood / maintains one-way flow of blood (through heart) **;** **ecf** if right atrioventricular / tricuspid **or** **5** (left) atrioventricular / mitral / bicuspid, valve **; R** right **6** prevents, backflow of blood / blood flowing from ventricle to atrium **;** **A** maintains one-way flow of blood (through heart) **or** **5** (left) semi-lunar, valve **;** **6** prevents, backflow of blood / blood flowing from, aorta / artery, to ventricle **;** **A** maintains one-way flow of blood (through heart) **7** chordae tendinae / tendons / tendinous cords / AW **; I** ligaments **8** hold the valve in position, during systole / when ventricle contracts / AW **;** **A** prevents blowback / turning inside out **I** high tensile strength unqualified **9**,**10** AVP **;;** e.g papillary muscle **;** contracts to hold, tendons / valve, when heart contracts / during systole **; ora**	**4**

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Question	Answer	Marks
6(b)	*any **four** from:* *if AVN used penalise once and then use ECF* **1** sinoatrial node releases, waves of excitation / waves of depolarisation / (electrical) impulses / action potential(s) **;** AW **2** impulses / AW, stimulate, (both) atria to contract / atrial systole **;** **3** impulses / AW, prevented from reaching ventricles by, fibrous ring / non-conducting tissue / insulating tissue / (between atria and ventricles) **;** **A** annulus fibrosus **4** atrioventricular node, delays impulse (by 0.1 s) **;** **5** atrioventricular node, sends impulse to, Purkyne tissue (in septum) **;** **A** bundle of His *allow **ecf** for abbreviating AVN* **6** Purkyne tissue conducts impulse to, base of ventricles / apex of heart, so they contract **;**	**4**
6(c)(i)	*any **two** from: if transport is used in MP2 to MP8, penalise once and mark to a max of 1 for those MPs* *provides, aqueous / watery, (external) environment / surroundings, for cells* **1** to maintain correct water potential to prevent, cell dehydration / excessive water loss from cells **;** *idea that provides medium for exchange of substances* **2** supply of oxygen / oxygen diffuses from blood into tissue fluid **;** **3** removal of carbon dioxide / carbon dioxide diffuses from tissue fluid into blood **;** **A** exchange of (respiratory) gases as alternative to MP2 and MP3 **4** supply of named nutrient e.g. glucose, amino acids, (named) ion(s) **;** **5** removal of, metabolic / toxic, waste **or** urea **;** **6** location / movement, of (tissue) macrophages / neutrophils / phagocytes (for defence) **;** **I** white blood cell **7** allows movement of / medium for passage of, (named) cell signalling molecules / hormones / ligands **;** **A** *ref. to* cells signalling nearby cells / paracrine signalling **8** AVP **;** e.g. contributes to formation of lymph / contains antibodies e.g. allows movement of lymphocytes into lymph	**2**

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Question	Answer	Marks
6(c)(ii)	*any **three** from:* **1** (at arteriole end of capillary) high, hydrostatic / blood, pressure **;** **2** (ultra)filtration / described **;** e.g. fluid / plasma / water and solutes, forced / comes, out of, capillaries / blood **3** glucose / amino acids / ions, leave blood **R** if stated, red blood cells / platelets, leave ***or*** (large) plasma proteins remain in blood **;** **4** through, fenestrations / fenestrae / endothelial pores **or** through, pores / gaps / spaces, in, capillary wall / endothelium / between cells **;** **5** AVP **;** e.g. *ref. to* hydrostatic pressure gradient hydrostatic pressure of blood is greater than hydrostatic pressure of tissue fluid	**3**
6(d)(i)	**I** pathogen **A** epitope for antigen *any **two** from:* some (T-lymphocyte) have (T-cell) receptors, specific / complementary, to a particular antigen **; ora** antigen (in vaccine) binds to these T-lymphocytes **;** *idea that* only these T-lymphocytes are, activated / stimulated / selected **; I** respond AVP **;** e.g. some T-lymphocytes do not become exposed to limited quantity of antigen in vaccine	**2**

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Question	Answer	Marks
6(d)(ii)	*max four if no correct ref. within response to, memory cells / immunological memory* *any **five** from:* *context of primary immune response* **1** antigen presentation by macrophages **;** **2** (T- / B-) lymphocyte, binding / recognition / clonal selection / activation / described in terms of receptor **;** **3** clonal expansion / cell divides by mitosis many times (to produce a clone) / AW **;** **4** cytokines released by T-helper, cells / lymphocytes **;** **5** (stimulate) formation of memory, (T- / B-) lymphocytes / cells **;** **6** (memory cells) remain in, circulation / body, for a long time / AW **;** **A** remain in lymph nodes **or** memory cells are long-lived **;** *context of secondary immune response* **7** large numbers of (specific), memory cells / lymphocytes **; I** more memory cells **A** memory cells have a higher chance of encountering antigen	**5**

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