CAMBRIDGE
International Education

Cambridge IGCSE™

BIOLOGY **0610/42**

Paper 4 Theory (Extended) **May/June 2025**

MARK SCHEME

Maximum Mark: 80

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	<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
	incorrect point or mark not awarded
	information missing or insufficient for credit
	allow or accept
	incorrect or insufficient point ignored while marking the rest of the response
	contradiction in response, mark not awarded
	benefit of the doubt given
	error carried forward applied
	benefit of doubt was considered, but the response was decided to not be sufficiently close for benefit of doubt to be applied.
	point has been noted, but no credit has been given or blank page seen

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Annotation	Meaning
	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.
	pages are linked together
	used to highlight part of the response
	used to highlight parts of an extended response
	used to highlight parts of an extended response
	Point already given
	Maximum mark reached
	Key point attempted / working towards marking point / incomplete answer / response seen but not credited / blank page seen
	Maximum number of marks for a marking point has been awarded.

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Mark Scheme Abbreviations:	
;	separates marking points
/	alternative responses for the same marking point
R	reject the response
A	accept the response
I	ignore the response
ecf	error carried forward
AVP	any valid point
ora	or reverse argument
AW	alternative wording
underline	actual word given must be used by candidate (grammatical variants excepted)
( )	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks that can be given
MP	marking point

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Question	Answer	Marks	Guidance
1(a)(i)	**A** trachea **;** **B** bronchus / bronchi **;** **C** bronchiole(s) **;**	**3**	
1(a)(ii)	to keep the airway open / prevents collapse (of airway) **;**	**1**	
1(a)(iii)	*any four from:* 1 diaphragm, contracts / flattens / lowers **;** 2 external intercostal muscles contract (and internal intercostal muscles relax) **;** 3 ribs / ribcage, lifted / AW, up / out / forwards **;** 4 increase the volume, in the thorax / lungs / chest **;** 5 decreasing the pressure, in the thorax / lungs / chest **;** 6 air is drawn in to equalise the pressure (between atmosphere and lungs) **;**	**4**	**A** air pressure lower than atmospheric pressure / air moves in down a pressure gradient
1(b)(i)	1 *any **two** named cells from:* • goblet (cells) • ciliated (cells) • lymphocytes • phagocytes *plus any two from:* 2 goblet cells, secrete / produce, mucus to trap, particles / pathogens / AW **;** 3 cilia on ciliated cell, move / AW, mucus, up / out / away / AW **;** 4 lymphocyte produces antibodies **;** 5 phagocyte carry out phagocytosis **OR** engulf, pathogens / particles / AW **;**	**3**	

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Question	Answer	Marks	Guidance
1(b)(ii)	*any four from:* 1 blockage / narrowing of, airways / lumen / AW **;** 2 reduced, diffusion / surface area (for gas exchange) **;** 3 *ref. to* less / slower, (delivery of) oxygen / (removal of) carbon dioxide / gas exchange **;** 4 into, blood / muscle **;** 5 less (aerobic) respiration / (more) anaerobic respiration **; ora** 6 less energy (released) / ATP (produced) **; ora** 7 for muscle contraction **;**	**4**	**A** increased diffusion distance
1(c)	1 *correct parental genotypes:* Ff and Ff **;** 2 *correct gametes:* F, f and F, f **;** 3 *correct offspring genotypes:* FF, Ff, (Ff), ff **;** 4 *correct offspring phenotypes:* no cystic fibrosis and no cystic fibrosis (no cystic fibrosis) and cystic fibrosis **;** 5 *probability:* 0.25 / 25(%) / 1 out of 4 / 1:3 **;**	**5**	**A** genotypes in any order MP4 offspring phenotypes must be in the same order as offspring genotypes **ecf** from previous step

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2(a)</td><td>
<table>
<tr><th>component of blood</th><th>letter from Fig. 2.1</th><th>function</th></tr>
<tr><td>red blood cell</td><td>F</td><td>transport / carry / AW, oxygen</td></tr>
<tr><td>lymphocyte</td><td>G</td><td>production of antibodies</td></tr>
<tr><td>plasma</td><td>H</td><td>transport / carries / contains / holds / AW, (blood) cells / ions / nutrients / hormones / proteins / antibodies / carbon dioxide / urea / waste / heat
A solvent OR maintain, blood pressure / pH / osmotic balance</td></tr>
<tr><td>phagocyte</td><td>E</td><td>phagocytosis</td></tr>
<tr><td>platelet</td><td>J</td><td>(description of blood) clotting / prevent blood loss / release fibrin</td></tr>
</table>
;;;;;</td><td>5</td><td>one mark per correct row</td></tr>
<tr><td>2(b)(i)</td><td>HIV / human immunodeficiency (virus) / AVP ;</td><td>1</td><td></td></tr>
<tr><td>2(b)(ii)</td><td>any two from:
(contaminated) surfaces / objects ;
food ;
water ;
faeces / sewage ;
soil ;
air ;
(named) animals / vector ;</td><td>2</td><td></td></tr>
</table>

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Question	Answer	Marks	Guidance
2(c)	*any three from:* 1 ref. to specificity **OR** antibodies have complementary (shape) to, antigen / pathogen **;** 2 fit / bind, to (specific) antigens **;** 3 mark / clump / immobilise / neutralise / inactivate, pathogens / toxins **;** 4 (for) destruction of pathogens / phagocytosis / described **;** 5 AVP **;**	**3**	e.g. prevents pathogens entering a cell
2(d)	*any three from:* *active immunity:* **1** (gained) as a result of infection / vaccination **;** **2** antibodies are produced (by the body / lymphocytes / memory cells) **;** **3** produces memory cells / ref to secondary immune response **;** **4** long-term / permanent **;** **5** slower response **;**	**3**	**A ora** throughout for passive immunity MP1 **A** passive immunity (gained from) antibodies, in breast milk / through placenta / by injection MP2 **A** in passive immunity antibodies are not acquired from their own immune system
3(a)	310 (%) **;;;**	**3**	MP1 correct readings from graph (80 **and** 325±2) MP2 correct calculation to any number of significant figures e.g. 306.25% MP3 correct rounding to two significant figures from their calculation **ecf** from previous step
3(b)(i)	DNA **;**	**1**	

Question	Answer	Marks	Guidance
3(b)(ii)	*any two from:* 1 to check (that the GM crops) inherit / have / express, gene / allele (to produce insect resistance) **;** 2 to check (that the GM crops) have the same / a high enough yield / good (described) quality product / AW **;** 3 to check (that the GM crops) can grow in, intended / different environments / AW **;** 4 to check the gene / allele / GM / crop / plant, does not cause any unexpected / unwanted, effects / AW **;** 5 *idea of* building up a large quantity of, seed / plants / crops (to sell to farmers) **;**	**2**	MP1 **A** all offspring show the gene in the phenotype
3(b)(iii)	*any six from:* 1 section of DNA / gene / allele, is isolated / cut / AW(from one organism's chromosome / DNA) **;** 2 restriction enzymes used (to cut / isolate, gene / DNA / plasmid) **;** 3 bacterial plasmid DNA and section of (one organism's) DNA / gene, cut with the same (restriction) enzyme **;** 4 sticky ends formed (when restriction enzymes are used) **;** 5 (sticky) ends / base pairs (of bacterial plasmid DNA and other organism DNA) are complementary **;** 6 section of (one organism's) DNA / gene / allele, is inserted into (bacterial) plasmid (DNA) **;** 7 (DNA) ligase used (to insert, gene / DNA, into plasmid) **;** 8 recombinant, plasmid / DNA, is formed (when, gene / DNA, and plasmid are joined) **;** 9 (recombinant / plasmid, DNA) inserted into, bacteria / another cell / organism **;** 10 AVP**;** multiplication / reproduction / division / growth, of (GM) bacteria **OR** use of a fermenter for (GM) (for multiplication of bacteria) **OR** protein from (one organism's) gene / allele, made / expressed, in (GM) bacteria	**6**	

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Question	Answer	Marks	Guidance
3(c)(i)	*any one from:* 1 isolate / separate, (GM) crops and wild plants **;** 2 grow (GM) crops in glasshouses **;** 3 cover flowers (of GM crop) **;** 4 remove, stamens / anthers / pollen (of GM crop) **;** 5 plant another species around the (GM) crop **;**	**1**	MP4 **A** use sterile GM crops
3(c)(ii)	*any two from:* 1,2 confer resistance to, herbicides / pesticides / disease / salinity / cold / hot / drought / wind (e.g. thicker stems) / heavy metals **;;** 3 provide additional, nutrients / AW (to humans) **;** 4 improved, yield / shelf life (of product) / flavour / quantity / appearance / AW **;** 5 reduced pollution **OR** less / no, use of, fertiliser / pesticides **;**	**2**	MP4 **A** improved taste / grow faster

Question	Answer	Marks	Guidance
4(a)	inherited **;** survive (and) reproduce / breed / produce offspring **;**	**2**	either order
4(b)	*any two from:* curled / rolled, leaf **;** inner surface is folded **;** hairs / AW **;** few / sunken, stomata **OR** stomata in, pits / AW **;** thick cuticle **;**	**2**	
4(c)(i)	0.001276 / 1.276×10^{-3} (mm) **;**	**1**	
4(c)(ii)	cellulose **;**	**1**	

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Question	Answer	Marks	Guidance
4(c)(iii)	*any one from:* swollen / thick (stem) **OR** water storage / succulent **;** chloroplasts / site of photosynthesis **;** thick (waxy) cuticle **;** AVP **;**	**1**	**A** wide stem
4(d)	*any three from:* *species 1:* 1 roots, shallow / close to the surface **OR** spread, out(wards) / over a wide area (of the soil surface) **;** 2 to absorb water immediately after rainfall / from the (soil) surface **;** *species 2:* 3 deep / long (vertically), root **;** 4 to absorb, ground / deep, water (in the soil) **;**	**3**	

Question	Answer	Marks	Guidance
5(a)(i)	*any four from:* 1 <u>active transport</u> **;** 2 (movement of particles / nitrate ions) from a low concentration to a high concentration / against **OR** up the concentration gradient **OR** there are more (nitrate) ions in the cell / root hair than the soil **;** 3 pass, through / across, cell / partially permeable, membrane **;** 4 using protein, carriers / molecules **;** 5 using energy (from respiration) **;**	**4**	MP3 **A** root hair has a large surface area
5(a)(ii)	lightning **and** (nitrogen fixing) bacteria **;**	**1**	
5(b)	osmosis **;**	**1**	

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Question	Answer	Marks	Guidance
5(c)	*total of five from:* *differences to max 3:* *root hair cells have:* 1 nucleus / nuclear membrane **;** 2 mitochondria **;** 3 (large permanent) vacuole **;** 4 <u>cellulose</u> cell wall / cell wall made of a different substance **;** 5 <u>linear</u> DNA **;** 6 <u>no</u> plasmids **;** 7 AVP **;** *similarities to max 3:* 8 cell wall **;** 9 cell membrane **;** 10 cytoplasm **;** 11 DNA / genetic material **;** 12 ribosomes **;** 13 AVP **;**	**5**	**ora** for the differences relating in context of bacteria MP2 **A** (correct named) membrane-bound organelles MP5 **A** circular / loop of, DNA

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Question	Answer	Marks	Guidance
6(a)	*any five from:* 1 enzyme activity reaches, peaks / increases and decreases (for **L** / **M**) **;** 2 maximum (area digested) / peaks, is pH 2 for **L** and pH 10 for **M ;** 3 **L** has steepest increase in activity between pH 1 and 2 / **M** has most gradual increase from pH 3 to pH 10 / as pH increases / AW **;** 4 **L** has higher activity than **M** at their optimum pHs / AW **;** ora 5 **L** and **M** are active, between pH 3 and pH 5 **;** 6 **L** has no activity, from / at pH 5 (and onwards) OR **M** has no activity, before / at, pH 3 **;** 7 **M** is active for a wider pH range (in this investigation than **L**) **;** ora 8 no change in activity between pH 7 and 8 for **M ;** 9 data quote with correct units that includes ref to pH and area where the enzyme is active **;**	**5**	MP6 **A** denatured for no enzyme activity MP9 examples: • at pH 2 **L** digests 160 mm^2 of jelly • at pH 10 **M** digests 140 mm^2 of jelly • at pH, 7 / 8 **M** digests 80 mm^2 of jelly
6(b)	*any three from:* no jelly is broken down / enzyme has no activity **;** enzyme / **M** / active site, is <u>denatured</u> **;** enzyme / **M** / active site, has changed shape **;** <u>active site</u>, does not fit / does not bind / is not complementary to, the substrate / protein in jelly **;**	**3**	
6(c)	*enzyme **L***: pepsin **;** *location:* stomach **;**	**2**	

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