CAMBRIDGE
International Education

# Cambridge International AS & A Level

**BIOLOGY** **9700/23**

Paper 2 AS Level Structured Questions **October/November 2024**

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 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.



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**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.

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| |
|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• 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.<br>• 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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**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)(i) | B **and** C **; Accept** A, B **and** C<br>*if any other letters do not award the mark, ignore names* | **1** |
| 1(a)(ii) | *any **two** from:*<br><br>keeps the (named) airway(s) open / prevents collapse of airways **;** AW **R** bronchiole / alveoli<br>e.g. to allow free flow of air into and out of, airways / lungs<br>e.g. provides support (for the named airway(s)) **I** 'provides strength'<br><br>allows flexibility **; A** described e.g. bending neck, swallowing food<br><br>AVP **;** e.g. (C-shaped incomplete) rings (in, **B** / trachea) allow, lengthening / widening, during breathing in / inspiration / inhalation | **2** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(iii)</td><td>
region<br>
one mark for each letter – for 1.3 allow two or three letters if all are correct – ignore names<br><br>
one mark for feature matched with function – feature and relationship to function must match<br>
if find a correct feature and its function in the last column – accept<br>
feature must be visible in Fig. 1.2 and Fig. 1.3<br>
if gas (as in gas exchange) is not used, then answer must refer to oxygen and carbon dioxide<br><br>
<table>
<tr><th>Fig.</th><th>region of the gas exchange system (A, B, C, D, E, F, G)</th><th>one visible feature</th><th>one way in which the feature relates to its function</th></tr>
<tr><td>1.2</td><td>G ;</td><td>air spaces<br><br>walls are, thin / one cell thick<br>A squamous epithelium<br>R cell wall<br><br>good blood supply / capillaries<br>A capillary / red blood cells<br><br>arteriole / venule<br>R artery / vein</td><td>large surface area for, diffusion / gas exchange ;<br><br>short distance for, diffusion / gas exchange ;<br><br>for, diffusion / gas exchange<br>or<br>maintains steep concentration gradients<br>or<br>absorption / transport, of oxygen ;<br><br>supply blood to capillaries / carry blood away from capillaries ;</td></tr>
<tr><td>1.3</td><td>B ; Accept C / A</td><td>goblet cells<br><br>(many) cilia / ciliated epithelial cells / ciliated epithelium / ciliated cells<br><br>ciliated epithelium</td><td>secrete / produce / make, mucus ;<br><br>(cilia) move / AW, mucus (towards back of throat / AW) ;<br><br>provides barrier to pathogens ;</td></tr>
</table>
</td><td>4</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 1(b) | *any **five** from:*<br><br>**1** sinoatrial node, releases / generates / produces, impulses / waves of excitation / waves of depolarisation / AW **;**<br>***I*** 'signals' **A** SAN / SA node / pacemaker **R** nervous impulses<br><br>**2** impulses / AW, spreads to / across, walls / muscle of, (right) atrium **; A** atria<br><br>**3** right atrium contracts **; A** atrial systole if right atrium is given in answer, **A** pumps for contracts<br><br>**4** tricuspid / (right) atrioventricular, valve opens to allow blood to flow (from right atrium) into right ventricle **;**<br>**R** bicuspid valve / left atrioventricular valve<br><br>**5** atrioventricular node sends impulses down, septum / Purkyne tissue **; A** to apex of heart / down Bundle of His<br>**A** AVN / AV node<br><br>**6** atrioventricular node is responsible for / AW, a time delay **;**<br>**A** AVN / AV node<br><br>**7** right ventricle contracts **; A** ventricular systole if right ventricle is given in answer, **A** pumps for contracts<br><br>**8** semi-lunar valve opens **and** blood flows into pulmonary artery / arteries **; A** pulmonary valve<br>**R** aorta<br><br>**9** AVP **;** e.g. tricuspid / (right) atrioventricular, valve closes to stop, backflow / blood entering right atrium<br>(only in correct context) | **5** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | *any **two** from:* **I** repair cells<br><br>**1** to, replace (old / worn-out / dead / short-lived) cells / repair (damaged) tissue **;**<br><br>**2** stem cells divide and, differentiate / become specialised **; A** form different types of cells<br><br>**3** *idea of* self-renewal e.g. stem cells divide to maintain the, pool / number, of stem cells **;**<br>**I** increase in number of stem cells<br><br>**4** AVP **;** *ref. to* movement of food through intestine / presence of pathogens, increases chance of damage<br>cells (produced by stem cells) are genetically identical so the function of, the intestine / organs / tissues, can continue / AW<br>*idea that* allows growth (of small intestine) during development / AW **R** growth of cells | **2** |
| 2(a)(ii) | anaphase **;** | **1** |
| 2(a)(iii) | cytokinesis **;** | **1** |
| 2(b) | *any **two** from*<br><br>**1** (two) sister / identical, <u>chromatids</u> attached together **; R** 'sister chromosomes'<br>**A** holds the chromatids together after, replication / S phase<br><br>**2** attach (chromatids / chromosomes) to spindle (fibres) **;** *in context of mitosis* **R** if stated in interphase<br>**A** kinetochore *or* spindle microtubules for spindle (fibres)<br><br>**3** (centromeres) divide / separate, (at the start) in anaphase **; A** end of metaphase<br><br>**4** *so* daughter chromosomes can be moved to opposite poles **; A** sister / identical, chromatids<br>*do not award MP4 unless MP3 already given* | **2** |

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

*look for function in explanation if not on first line*
*for each cell – one mark for the function and one mark for the explanation*
*mark each cell straight through to max 2*

<table>
<tr><th>cell</th><th>function</th><th>explanation</th></tr>
<tr><td rowspan="5">P</td><td rowspan="2">absorption / uptake / movement in, of, (named) substances / nutrients<br><br>diffusion of, (named) substances / nutrients<br><br>active uptake / active transport, of (named) substances / of nutrients</td><td>microvilli, to give a large surface area / increase surface area / increase number of transport proteins (for uptake of digested food)<br><br>I cilia have large surface area A large surface area:volume ratio for microvilli</td></tr>
<tr><td>mitochondria to provide, ATP / energy, for, active transport / active uptake<br>R produce / make, energy R energy for cilia</td></tr>
<tr><td>breakdown of food molecules</td><td>large surface of membrane for enzymes for digestion</td></tr>
<tr><td>production / secretion, of enzymes</td><td>microvilli for membrane enzymes / RER for making enzymes / Golgi for packaging enzymes or modification of enzymes</td></tr>
<tr><td rowspan="3">Q</td><td rowspan="3">secretion / release / exocytosis / AW, of mucin / mucus<br>I produce and provide<br><br>if Q is secreting protein / unnamed substance allow ECF for explanation</td><td>rough endoplasmic reticulum for making protein (part of mucin / mucus)</td></tr>
<tr><td>Golgi body for, packaging / glycosylating / modification / AW, mucin<br>A mucus AW = adding carbohydrate / sugars</td></tr>
<tr><td>(large) vesicles / vacuoles, for storage / for containing / for transport, of mucin<br>A mucus</td></tr>
<tr><td rowspan="3">R</td><td rowspan="3">secretion / release / exocytosis / move ment out / AW, of (named) protein(s)<br>I produce and provide<br>A hormones / peptides / enzymes</td><td>(large quantity of) RER for, making proteins / making enzymes / translation / AW</td></tr>
<tr><td>Golgi body for packaging / modification / AW, proteins</td></tr>
<tr><td>vacuoles / vesicles, for transport to cell surface membrane / release by exocytosis / fusion with cell surface membrane</td></tr>
</table>

</td><td>6</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | pyrimidine **;** *accept phonetic or close spellings, e.g.* pyramidine / pyrimadine / pirimadine / primidine | **1** |
| 3(a)(ii) | *any **one** from:*<br><br>each nucleic acid has 4 (types of) base **; A** has 4 bases<br>DNA has A, T, C and G **and** RNA has A, U, C and G **;**<br>**A** full names even if misspelt unless another molecule (e.g. thiamine)<br>*idea that* in RNA U replaces T / DNA has T but RNA has U **;** | **1** |
| 3(b) | *any **four** from: max 2 if answer is about transcription and mRNA*<br>*penalise polypeptide once*<br><br>**1** (triphosphate) activated / free, nucleotide (with thymine) **;**<br>**2** thymine / T, pairs with, adenine / A **; I** complementary base pairing unqualified<br>**3** adenine / A, on <u>template</u> strand **;**<br>**4** formation of two hydrogen bonds between T and A **; I** H bonds between C and G<br>**5** *ref to* DNA polymerase in correct context (e.g. correct base pairing / bond formation / proof reading) **;**<br>**6** forms phosphodiester bond (between -OH of deoxyribose and phosphate of nucleotide) **; R** if DNA ligase<br>**7** release of, pyrophosphate / P-P / two phosphates **;**<br>**8** nucleotide added to the 3′ end of, newly-synthesised strand / leading strand / daughter strand (of DNA) **;**<br>**A** extension is in the 5′ to 3′ direction | **4** |
| 3(c) | **1** strands (are parallel and) run in <u>opposite</u> directions / one strand in 5′ to 3′ direction and other strand in 3′ to 5′ direction **;**<br><br>*any **two** from:*<br><br>**2** elongation / synthesis / extension / AW, of strand is, in 5′ to 3′ direction / not in 3′ to 5′ direction **;**<br>**3** DNA polymerase, moves in the 5′ to 3′ direction / can only add nucleotides to the 3′ end **;**<br>**4** *idea that* phosphate of each nucleotide is added to C3 of last nucleotide of growing strand **;**<br>**5** leading strand is made continuously / lagging strand is made up of Okazaki fragments **;**<br>**6** Okazaki fragments are attached together by DNA ligase **;** | **3** |

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| Question | Answer | Marks |
|---|---|---|
| 4(a) | *any **four** from:* **I** 'find optimum conditions for the enzyme mixture' **A** 'enzymes' for enzyme mixture<br><br>**1** (find) suitable, raw material / crop wastes / substrate **;**<br><br>*using Table 4.1*<br>**2** (find) crop waste that has high concentration of substrate for enzyme **M ; ORA**<br><br>*assume answer is about solution or mixture unless told about individual enzymes (**M**, **N** and **O**)*<br>**3** (find), optimum pH / optimum temperature **; A** reference to, pH / temperature, for maximum activity<br>**I** find optimum pH / temperature of each enzyme<br>**4** (find) appropriate <u>concentrations</u> of the enzymes in the mixture **; I** 'proportions'<br>**5** *idea of* ratio of enzyme mixture to, raw material / substrate / crop waste **;**<br>**6** (find) the best pre-treatment of the, raw material / substrate / crop waste **;**<br>**7** (find) if any, inhibitors / cofactors, are <u>present in the solution</u> **;**<br>**8** (find) if any products are toxic **;**<br>**9** identify the sugars produced **;**<br>**10** (find) how long it takes to produce sugars / (find) rate of sugar production **;**<br>**11** *ref to* enzyme immobilisation **;** | **4** |
| 4(b) | *any **four** from:*<br><br>**1** cellulose and, (named) protein / polypeptides, were present (in cell wall) **;** e.g. expansins **R** if collagen<br>**2** cellulose is broken down (fully) to β-glucose / β-glucose is the monomer of cellulose **; A** 'made of'<br>**3** protein / polypeptide / peptide, is broken down (fully) to amino acids **; A** 'made of'<br>**4** *idea that* partial hydrolysis has occurred to form, peptides / short chains of β-glucose **;**<br>**5** enzymes include cellulase and protease **;**<br>**6** breakage of glycosidic and peptide bonds **; A** glucosidic<br>**7** AVP **;** e.g. beta 1-4 glycosidic linkage / exopeptidases producing amino acids / endopeptidases producing peptides | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | U4 – T-helper (lymphocyte / cell)<br>**AND**<br>V4 – T-killer / T-cytotoxic (lymphocyte / cell) **;**<br>**A** 'helper and killer' **I** helping and killing | **1** |
| 5(a)(ii) | *any **four** from:*<br><br>*U4 / helper*<br>**1** secretes / produces / releases, cytokines / interleukins **; I** cell signalling molecules / cytokinins<br>**2** to stimulate, B-lymphocytes / B cells, to, divide / develop into plasma cells **;**<br>**A** stimulates humoral response / clonal expansion / development of memory cells<br>**3** stimulate macrophages to, be active / carry out phagocytosis / respond (to presence of pathogens) / be 'angry' **;**<br>**I** endocytosis<br><br>*V4 / killer*<br>**4** produces / secretes / releases, chemicals, to kill / break down, infected cells **; A** (auto)lysis / apoptosis<br>**5** e.g. perforin / hydrogen peroxide / granzymes / proteases **; A** hydrolytic enzymes / toxins<br>**6** detail of action of named chemical (see below) **;**<br>**7** AVP **;** e.g. correct ref to CD4 receptors (on U4 / T-helper) / CD8 receptors on (V4 / T-killer)<br><br>perforin – makes pores in cell surface membrane of infected cell for delivery of granzymes<br>hydrogen peroxide – oxidises cell components / stimulates apoptosis<br>granzymes / proteases – break down proteins (granzymes are serine proteases) | **4** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(b)</td><td>

*any **four** from:*

**1** make vaccine free **;** **I** cheap<br>
**2** make vaccine <u>available</u>, globally / to whole population (urban and rural) **;** **I** vaccinating people<br>
**3** *ref to* herd immunity / described **;** e.g. vaccinate a high proportion of the population<br>
**4** vaccinate children as early as possible **;**<br>
**5** *ref to* provide boosters / use effective vaccine so boosters are not necessary **;** e.g. live / attenuated, virus<br>
**6** accurate record keeping of those vaccinated / find those who have not been vaccinated **;**<br>
**7** surveillance / *ref to* contact tracing / described **;** e.g. look out for any cases of the disease<br>
**8** start vaccination immediately cases are found / *ref to* ring immunity / benefits of ring immunity **;**<br>
**9** education about, effects of the disease / benefits of having the vaccine / transmission of the disease **;**<br>
**A** counter, misinformation / antivaxers **A** importance of vaccination<br>
**10** make sure there is a sufficient supply of the vaccine **;**<br>
**11** provide funding for vaccine, production / distribution / delivery **;** **A** provide, cheap / easy to produce, vaccine<br>
**12** provide trained personnel **;**<br>
**13** AVP **;** e.g. quarantining people with the disease<br>
evaluate or monitor success of vaccination programme<br>
maintain cold chain (to ensure vaccine is effective)<br>
use a thermostable vaccine<br>
provide different types of the vaccine (e.g. Sabin (oral) and Salk (injected); different manufacturers for Covid)

**I** develop new vaccines in response to new, strains / variants / AW, of pathogen

</td><td>**4**</td></tr>
<tr><td>6(a)</td><td>

<table>
<tr><th>feature</th><th>plant cell</th><th>prokaryotic cell</th><th>virus</th></tr>
<tr><td>external structure</td><td>cell wall composed of cellulose</td><td>cell wall composed of peptidoglycan / murein **;**</td><td>capsid composed of protein / polypeptides **;**<br>**A** capsomeres</td></tr>
<tr><td>size of ribosomes</td><td>80S and 70S</td><td>70S **;**</td><td>no ribosomes</td></tr>
<tr><td>nucleic acids</td><td>DNA and RNA</td><td>DNA and RNA</td><td>DNA **or** RNA **;**<br>**R** DNA and RNA</td></tr>
</table>

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

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| Question | Answer | Marks |
|---|---|---|
| 6(b)(i) | *any **one** from:*<br><br>untreated / raw, sewage **; A** poor sewage treatment / poor sewer system<br>contaminated drinking water **;**<br>contaminated food / crops fertilised by raw sewage / seafood contaminated by raw sewage **;**<br>AVP **;** e.g. newly arrived people infected with, *Vibrio cholerae* / cholera pathogen (e.g. UN troops in Haiti in 2010) | **1** |
| 6(b)(ii) | choleragen is composed of more than one polypeptide **; A** 6 / 7, polypeptides **A** amino acid chain<br>**A** composed of, multiple / several, polypeptides | **1** |
| 6(b)(iii) | glycolipid / glycoprotein **;** | **1** |
| 6(b)(iv) | ATP / adenosine triphosphate **; I** adenine triphosphate | **1** |
| 6(b)(v) | chloride ions decrease the <u>water potential</u> of, intestine lumen / outside of cells / AW **; A** low<u>er</u> water potential<br>**A** loss of chloride ions makes the, cytoplasm / the cells, have a less negative / higher, water potential<br>(so water, leaves cell / enters lumen) by osmosis / down water potential gradient / from high to low water potential **;** | **2** |

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