Cambridge Assessment International Education

# Cambridge International AS & A Level

**BIOLOGY** **9700/21**

Paper 2 AS Level Structured Questions **October/November 2023**

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 2023 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 descriptors 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:<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. |

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.

**Examples of how to apply the list rule**
State **three** reasons… [3]

| | | | | |
|---|---|---|---|---|
| **A** | 1 | Correct | ✓ | **2** |
| | 2 | Correct | ✓ | |
| | 3 | Wrong | × | |

| | | | | |
|---|---|---|---|---|
| **B** | 1 | Correct, Correct | ✓, ✓ | **3** |
| **(4 responses)** | 2 | Correct | ✓ | |
| | 3 | Wrong | ignore | |

| | | | | |
|---|---|---|---|---|
| **C** | 1 | Correct | ✓ | **2** |
| **(4 responses)** | 2 | Correct, Wrong | ✓, × | |
| | 3 | Correct | ignore | |

| | | | | |
|---|---|---|---|---|
| **D** | 1 | Correct | ✓ | **2** |
| **(4 responses)** | 2 | Correct,<br>CON (of 2.) | ×, (discount 2) | |
| | 3 | Correct | ✓ | |

| | | | | |
|---|---|---|---|---|
| **E** | 1 | Correct | ✓ | **3** |
| **(4 responses)** | 2 | Correct | ✓ | |
| | 3 | Correct, Wrong | ✓ | |

| | | | | |
|---|---|---|---|---|
| **F** | 1 | Correct | ✓ | **2** |
| **(4 responses)** | 2 | Correct | ✓ | |
| | 3 | Correct<br>CON (of 3.) | ×<br>(discount 3) | |

| | | | | |
|---|---|---|---|---|
| **G** | 1 | Correct | ✓ | **3** |
| **(5 responses)** | 2 | Correct | ✓ | |
| | 3 | Correct<br>Correct<br>CON (of 4.) | ✓<br>ignore<br>ignore | |

| | | | | |
|---|---|---|---|---|
| **H** | 1 | Correct | ✓ | **2** |
| **(4 responses)** | 2 | Correct | × | |
| | 3 | CON (of 2.)<br>Correct | (discount 2)<br>✓ | |

| | | | | |
|---|---|---|---|---|
| **I** | 1 | Correct | ✓ | **2** |
| **(4 responses)** | 2 | Correct | × | |
| | 3 | Correct<br>CON (of 2.) | ✓<br>(discount 2) | |

**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)(i) | *any **three** from:*<br><br>active transport **; A** active uptake<br><br>against the concentration gradient **; A** use of values to support<br><br>using, energy / ATP **;**<br><br>conformational change / described (of protein carrier) **;**<br><br>*ref. to* specific binding site **;** | **3** |
| 1(a)(ii) | *similarity max 1*<br>*ref. to* diffusion / (movement) down concentration gradient **;**<br><br>passive<br>**or**<br>no, energy / ATP, required **;**<br><br>*difference max 1*<br>sodium ions enter by facilitated diffusion <u>and</u> oxygen molecules enter by (simple) diffusion **;**<br>**A** passive diffusion<br><br>sodium ions, use a carrier / channel / transport, protein **;**<br>**or**<br>sodium ions do not, pass through the phospholipid bilayer / cross the hydrophobic core (of the bilayer) **;**<br>**A** ora for oxygen | **2** |

| Question | Answer | Marks |
|---|---|---|
| 1(a)(iii) | *any **two** from:*<br><br>hydrogen carbonate ions move out of red blood cells (to be transported in plasma), so / and, chloride ions move in **;**<br><br>to maintain electrical neutrality (inside, cytoplasm / cell) **;**<br>**A** balance the charges (either side of membrane)<br>**A** to prevent build-up of negative charge (in cytoplasm)<br><br>AVP **;** e.g. maintain equilibrium to increase reaction between carbon dioxide and water | **2** |
| 1(b) | endocytosis / pinocytosis **;** **A** bulk transport | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | **X** (nucleolus) synthesis / AW of, ribosomal subunits / ribosomes **;**<br>**A** synthesis of organelles that are the sites of protein synthesis<br><br>**Y** (chromatin) contains gene(s), coding for the polypeptide(s) / AW **;**<br>**A** site, of transcription / for production of mRNA | **2** |
| 2(b)(i) | primary **;** | **1** |
| 2(b)(ii) | *any **one** from:*<br><br>carboxylic acid / carboxyl, group **;**<br>**A** both have C=O<br><br>contain carbon / hydrogen / oxygen **;** | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(b)(iii) | *any **three** from:*<br><br>*ref. to* role in / forms part of, overall 3D shape **;**<br>**A** tertiary / quaternary structure<br>**A** forms part of hydrophobic region of ghrelin<br><br>allows ghrelin to bind to receptor **;**<br><br>allows, ghrelin / part of ghrelin, to have a complementary shape / be complementary (to the receptor) **;**<br>**A** description<br><br>suggested detail **;** e.g. interacts with hydrophobic region of the receptor molecule (for binding)<br><br>AVP **;** e.g. help interaction with / embeds in, hydrophobic portion of the cell surface membrane *in context of bringing a complementary part of the molecule closer to receptor for binding*<br><br>suggestion that fatty acid chain allowed, incorporation into / attachment to, a transport molecule in plasma to reach target cell<br><br>*ref. to* effect of binding triggering reactions inside the cell **;** | **3** |
| 2(c)(i) | 1.8% **;**<br>working **;** $\frac{30 \times 3}{5000} \times 100$<br><br>*codons for 29 amino acids (including start met) and a stop codon*<br><br>*allow 1 mark if only 28 or 29 instead of 30, so 1.7% answer obtained* | **2** |

| Question | Answer | Marks |
|---|---|---|
| 2(c)(ii) | *any **two** from:*<br><br>introns / non-coding regions, removed / AW **;**<br><br>exons / coding regions, are joined together **;**<br><br>gene splicing / RNA splicing **; R** DNA splicing<br><br>AVP **;** e.g. guanine (cap) added (to 5′ end)<br>poly A tail / many As, added (to 3′ end) | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | (cell type **A**) phloem sieve tube element **;**<br><br>*plus any **two** from:*<br><br>connect the cytoplasm of the two cells / *ref. to* the symplast pathway **;**<br><br>*idea of* allow (rapid) diffusion of, sucrose / named molecules, from one cell to an adjacent cell / AW **;**<br><br>*idea of* efficiency of, loading into / unloading from, sieve tubes **;** | **3** |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)</td><td>
<table>
<tr><th>feature of polysaccharide</th><th>callose molecule</th><th>cellulose molecule</th></tr>
<tr><td>monosaccharide used to synthesise the polysaccharide</td><td></td><td>beta / β, glucose ;<br>R B glucose</td></tr>
<tr><td>bond connecting the monomers</td><td>1, 3 glycosidic bond ;</td><td></td></tr>
<tr><td>shape of molecule</td><td></td><td>straight / linear ;</td></tr>
<tr><td>orientation of monosaccharides in the molecule</td><td>adjacent glucose molecules same way up / AW ;</td><td></td></tr>
</table>
</td><td>4</td></tr>
<tr><td>3(c)</td><td>
any three from:<br><br>
(hydrogen bonding) gives adhesion between water molecules and, cellulose / hydrophilic parts of lignin (in xylem wall) ;<br><br>
(hydrogen bonding) gives cohesion between water molecules ;<br><br>
formation of continuous column / AW ;<br>
A adhesion, prevents column of water collapsing / AW<br><br>
transpiration pull ;<br>
A water, drawn up / pulled up by transpiration / pulled up by evaporation<br><br>
detail ; e.g. water evaporating from spongy mesophyll surfaces<br>
water vapour lost from, leaf / plant, during transpiration<br>
idea of creates tension<br><br>
AVP ;<br><br>
if mp 1 and mp 2 are not awarded, allow one mark for reference to cohesion <u>and</u> adhesion
</td><td>3</td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 3(d) | *any **two** from:*<br>hydrogen bonds between water molecules must break for water, to change state / evaporate / AW **;**<br>loss of, heat / energy for, evaporation / transpiration (will cool the, leaf / plant) **;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | human immunodeficiency virus **;** | **1** |
| 4(a)(ii) | *any **four** from:*<br>there is a decrease in the percentage infections in most regions / AW **;**<br>*ref. to* exceptions to this decreasing trend **;** e.g. **B** (Eastern Europe and Central Asia ) / **D** (Middle East and North Africa)<br>*allow no overall trend if mp 1 and mp 2 not awarded*<br>the biggest percentage decrease, in **E** (East and Southern Africa) **;**<br>the smallest percentage decrease, in **G** (Latin America) **;**<br>data quote to support described trend **;**<br>AVP **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 4(b) | *any **four** from:*<br><br>tuberculosis / TB, is an opportunistic, disease / infection **;**<br><br>weakened immune system **;**<br><br>(fewer T-helper cells so a ) less effective primary immune response **;**<br><br>(fewer helper T-cells so) less cytokine secreted **;**<br><br>less, phagocytosis of the pathogens / AW **; A** *ref. to* angry macrophages<br><br>fewer B-lymphocytes, stimulated / AW, to divide by mitosis and form plasma cells **;**<br><br>fewer antibodies secreted so fewer pathogens destroyed **;**<br><br>*ref. to* latent TB becoming activated **;**<br><br>AVP **;** e.g. 'weak' / no, response to (BCG) vaccine so, fewer / no, memory cells<br>TB is caused by, a bacterial pathogen / *Mycobacterium tuberculosis* / *Mycobacterium bovis* | **4** |

| Question | Answer | Marks |
|---|---|---|
| 4(c) | *any **four** from:*<br><br>1 *ref. to* compression on ventricles **;**<br>2 (so) volume of the ventricles reduces / ventricles cannot fully increase in size / AW **;**<br>3 less blood, filling / leaving, ventricles (each cardiac cycle) **;**<br>4 *idea that* ventricular, contraction / systole, less powerful / weaker / less forceful **;**<br>5 less blood pumped to the, pulmonary / systemic, circulation (per, contraction / cardiac cycle / unit time **;**<br>**A** lungs / rest of body<br><br>*faster breathing rate to compensate for*<br>6 consequence in, lungs / rest of body **;**<br>e.g. less oxygen, diffuses / AW, into the blood<br>less carbon dioxide, diffuses / AW, out of the blood<br>less oxygen delivered to the tissues / AW<br>7 faster breathing rate to (try and) increase quantity of oxygen, absorbed / AW (in the lungs) **;**<br>**A** increase quantity of carbon dioxide excreted<br>8 AVP **;** e.g. heart / cardiac muscle, does not receive enough, glucose / oxygen | **4** |

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | cartilage **;** | **1** |
| 5(a)(ii) | *any **two** from:*<br><br>(smooth muscle) contracts (and relaxes) / contractile **; R** bronchus contracts<br><br>changes diameter of the airway / controls size of the lumen **; A** *ref. to* constriction of bronchus<br><br>(may) help to regulate airflow, into / away from, gas exchange surfaces **;**<br><br>AVP **;** | **2** |
| 5(b)(i) | phospholipid with a head and two tails **;**<br><br>bilayer shown **;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 5(b)(ii) | *any **two** from:*<br>cholesterol regulates the fluidity of the membrane **;**<br>membrane less able to fuse with the lamellar body **;**<br>AVP **;** | **2** |
| 5(b)(iii) | *any **one** from:*<br>prevents too much surfactant building up in the lungs **;**<br>(digest surfactant to) recycle / reuse, molecules in surfactant **;**<br>engulf, pathogens / microbes / AW, trapped in surfactant **;**<br>macrophages use, protein / phospholipid / cholesterol, in surfactant **;**<br>AVP **;** | **1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | S phase / synthesis phase / interphase **;** | **1** |
| 6(a)(ii) | *any **two** from:*<br><br>does not have an OH group (on C3) so condensation reaction cannot occur **;**<br><br>phosphodiester bond cannot form between deoxyribose and phosphate of adjacent nucleotide **;**<br><br>is a different shape because it has H instead OH (on C3) **;**<br><br>shape not complementary to the active site of DNA polymerase<br>**or**<br>no, enzyme substrate complexes / ESCs, can form **;** | **2** |
| 6(b)(i) | *any **two** from:*<br><br>(both increase $K_m$, therefore both) reduce the affinity (of RNA polymerase for its substrate) **;**<br><br>(presence of) F52 reduces the affinity for the substrate more than F47 **;** ora for F47<br><br>AVP **;** e.g. manipulation of data to support described trend<br>correct link stated between $K_m$ values and affinity | **2** |

| Question | Answer | Marks |
|---|---|---|
| 6(b)(ii) | *any **three** from:*<br><br>*decreased, maximum rate of reactions / rate of transcription because*<br>$V_{max}$ lower, qualified **;**<br><br>binding (of the aptamer) changes, the tertiary structure / shape of, active site (of RNA polymerase) **;**<br>**A** binding changes shape of enzyme so active site less complementary to substrate<br><br>(so) substrate / (RNA) nucleotides, bind less easily to active site **;**<br>**A** fewer enzyme-substrate complexes form<br><br>binding of aptamer prevents, substrate / (RNA) nucleotide, binding to active site **;**<br><br>binding prevents RNA polymerase from binding to template strand **;**<br><br>binding prevents RNA polymerase from forming bond between RNA nucleotides **;**<br><br>AVP **;** | **3** |