Cambridge Assessment International Education

# Cambridge International AS & A Level

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

Paper 2 AS Level Structured Questions **May/June 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 May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.





**[Turn over**

## 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 (4 responses)**

| | | | |
|---|---|---|---|
| 1 | Correct, Correct | ✓, ✓ | **3** |
| 2 | Correct | ✓ | |
| 3 | Wrong | ignore | |

**C (4 responses)**

| | | | |
|---|---|---|---|
| 1 | Correct | ✓ | **2** |
| 2 | Correct, Wrong | ✓, × | |
| 3 | Correct | ignore | |

**D (4 responses)**

| | | | |
|---|---|---|---|
| 1 | Correct | ✓ | **2** |
| 2 | Correct, CON (of 2.) | ×, (discount 2) | |
| 3 | Correct | ✓ | |

**E (4 responses)**

| | | | |
|---|---|---|---|
| 1 | Correct | ✓ | **3** |
| 2 | Correct | ✓ | |
| 3 | Correct, Wrong | ✓ | |

**F (4 responses)**

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

**G (5 responses)**

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

**H (4 responses)**

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

**I (4 responses)**

| | | | |
|---|---|---|---|
| 1 | Correct | ✓ | **2** |
| 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 |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>any one from:<br><br><u>no chloroplasts</u> (present) ;<br><br>presence of (many) small vacuoles / no large vacuole / no central vacuole ;<br><br>central nucleus<br>or<br>nucleus not located at the, edge / periphery ;</td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>one mark per row ;;;;<br>If 0 marks, allow 1 mark if name of cell structure column completed correctly
<table>
<tr><th>function</th><th>name of cell structure</th><th>letter on Fig.1.1</th></tr>
<tr><td>gas exchange</td><td>cell <u>surface</u> membrane<br>I phospholipid bilayer<br><br>mitochondrial membrane(s)</td><td>A<br><br>E</td></tr>
<tr><td>production of subunits of ribosomes</td><td>nucleolus / nucleoli</td><td>C</td></tr>
<tr><td>active transport of ions</td><td>cell <u>surface</u> membrane<br>ecf for cell membrane<br>or<br>tonoplast / vacuolar membrane<br>or<br>mitochondrial membrane(s)<br>or<br>nuclear envelope<br>A nuclear membrane(s)</td><td>A<br><br>F<br><br>E<br><br>B</td></tr>
<tr><td>aerobic respiration</td><td>mitochondrion / mitochondria</td><td>E</td></tr>
</table></td><td>4</td></tr>
<tr><td>1(b)(i)</td><td>endocytosis / pinocytosis ; R phagocytosis</td><td>1</td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 1(b)(ii) | *any **three** from:*<br><br>**1** hydrolysis / use water to break bonds **;** **A** *ref. to* hydrolytic enzymes<br><br>**2** (action of) protease(s) / peptidases / proteolytic enzyme(s) **;**<br><br>**3** peptide bonds broken **;**<br>**R** if part of a list with other bonds not found in proteins, such as glycosidic, ester, phosphodiester<br><br>**4** to form, peptides / amino acids **;** | **3** |
| 1(c) | **1** formation of phagolysosomes / described **;**<br>**A** fusion with, phagosomes / phagocytic vesicle ***or*** vacuole<br><br>**2** breakdown / digestion, of, pathogen / bacteria / microorganisms / AW **;**<br>**A** kill / destroy, pathogen / bacteria / microorganisms / AW<br><br>*one from:*<br>**3** (by) two named enzymes **;**<br>e.g. lysozyme, protease, lipase, carbohydrase, nuclease<br><br>**4** any two named substrates that are hydrolysed **;**<br>e.g. polysaccharides, peptidoglycans, proteins, lipids, glycogen, nucleic acid(s)<br><br>**5** to form, harmless / useful / soluble / AW, products **;**<br><br>**I** *ref. to* breakdown of organelles | **2** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | *if only one molecule described, statement of difference must be in context of glycogen*<br><br>*any **three** from:*<br><br>*glycogen*<br>branched (v cellulose unbranched) **;**<br><br>monomer is / made of, alpha- / α-, glucose (v cellulose monomer is β-glucose) **;**<br><br>(1,4- and) 1, 6-. glycosidic bond(s) (v cellulose 1,4-glycosidic bond(s)) **;**<br><br>alternate, monomers / glucose residues / 1,4-(glycosidic) bonds, are not, rotated 180° / inverted / flipped / AW **; ora** | **3** |
| 2(b) | *any **three** from:*<br><br>**1** glycogen is a store of, energy / glucose **;**<br>**R** produces energy<br><br>**2** *idea that* many, branching points / 'ends' / terminals, for easy / faster, addition / release, of glucose **;**<br><br>**3** compact so stores much, glucose / energy (in cells / small space) **;**<br><br>**4** insoluble **;**<br><br>**5** does not, lower / change, water potential (of cell) **; A** no osmotic effect<br><br>**6** AVP **;** e.g. prevents loss of glucose from cell<br>(chemically) inactive so does not take part in cell metabolism / AW | **3** |

| Question | Answer | Marks |
|---|---|---|
| 2(c) | *any **three** from:*<br><br>**1** unbranched (polymer) / straight chain / linear **;**<br><br>**2** cellulose molecules are arranged in parallel **;**<br><br>**3** *idea that* large number of -OH groups (projecting in all directions) **;**<br><br>**4** allows, hydrogen bonds / H-bonds, to form with water<br>**or**<br>makes molecule hydrophilic **;**<br><br>**5** many hydrogen bonds between cellulose molecules / AW **;**<br><br>**6** cellulose molecules form <u>microfibrils</u> **; I** 'fibrils' / fibres<br><br>**7** hydrogen bonds give high tensile strength to microfibrils **A** cellulose fibres / cell wall<br>**or**<br>hydrogen bonds help cell walls to resist, turgor pressure / AW **;** | **3** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | polar / water soluble / hydrophilic, substances cannot pass through the, phospholipid bilayer / hydrophobic core (in cell surface membranes) **;**<br>**I** too large / active transport / facilitated diffusion / (hydrophobic) fatty acid 'tails' | **1** |
| 3(b)(i) | rate of uptake, becomes constant / reaches a plateau<br>**or**<br>at <u>high</u> concentrations / concentrations of > 150 $\mu$mol $dm^{-3}$, rate of uptake remains constant **; A** levels off<br><br>protein carriers / (hexose) transporters / VvHT1s, are working at their highest rate / are saturated **;**<br>**A** the number of protein carriers is limiting factor / AW<br>**A** $V_{max}$ is reached *in context of transporters* | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(b)(ii) | *any **two** from:*<br><br>**I** *size / quality of grapes / grapevines*<br><br>**1** grapes will, be sweeter / have improved taste **;**<br><br>**2** *idea that* concentration of sugars in grapes determines uptake of water by osmosis **;**<br><br>**3** *idea of* more energy for growth of the grapes **;**<br><br>**4** larger yield **;**<br><br>**5** increased, profit / income, for farmers **;**<br><br>**6** AVP **;** e.g. producing grapes in shorter time | **2** |
| 3(c)(i) | (foreign) protein / glycoprotein, that stimulates, an immune response / production of antibodies / activation of lymphocytes **;**<br>**A** polysaccharide / molecule / foreign substance / foreign antigen | **1** |

| Question | Answer | Marks |
|---|---|---|
| 3(c)(ii) | *any **four** from:*<br><br>*accept T-cells for T-lymphocytes*<br><br>**1** (group / clone of) T-lymphocytes have receptors complementary to an antigen **;**<br>**A** specific T-lymphocytes have receptors to an antigen<br><br>**2** (specific) T-lymphocytes, bind / AW, to antigen (on surface of antigen-presenting cell / macrophage) **;**<br><br>**3** (selected) T-lymphocytes, divide many times (by mitosis) / undergo clonal expansion **;**<br><br>**4** T-helper cells secrete, cytokines / interleukins / interferon **;**<br><br>**5** detail of effect of cytokine **;**<br>e.g. activation of B-lymphocytes / increased phagocytosis by macrophages / 'angry' macrophages<br><br>**6** T-killer cells, bind / attach, to infected cells and destroy them **;**<br><br>**7** detail of action of T-killer cells **;**<br>e.g. *ref. to*, perforin / granzyme / hydrogen peroxide / toxins<br><br>**8** production of memory cells (in context of T-lymphocytes / T-helper cells / T-killer cells) **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | sequence of, nucleotides / bases, that is part of DNA **; A** sequence of DNA nucleotides<br><br>(that) codes for a polypeptide **; A** protein / enzyme / amino acid chain | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(b)(i) | *must attempt both DNA polymerase and DNA ligase to gain max*<br><br>*any **five** from:*<br><br>*DNA polymerase*<br>**1** addition of, activated / phosphorylated, nucleotides **;**<br><br>**2** *ref. to* complementary, nucleotides / bases / strands **;**<br><br>**3** forms phosphodiester bonds **;**<br><br>**4** (between adjacent nucleotides and) elongating / growing, polynucleotide / strand / AW **;**<br><br>**5** *ref. to* proofreading ability of DNA polymerase **;**<br><br>*DNA ligase*<br>**6** joins / AW, Okazaki fragments **;**<br><br>**7** on lagging strand **;**<br><br>**8** forms phosphodiester bonds, between the fragments / to complete phosphate-sugar backbone **;** | **5** |
| 4(b)(ii) | S phase / synthesis phase **;**<br>**I** 1 as in S1 phase / S unqualified | **1** |

| Question | Answer | Marks |
|---|---|---|
| 4(c)(i) | **A** - centromere <u>and</u> **I** kinetochore<br>site of attachment of, chromatids / chromosome(s) to, spindle fibres / microtubules<br>**or**<br>holds, sister / identical, chromatids together **;** **R** daughter chromatids<br><br>**B** - spindle fibres / microtubules, <u>and</u><br>orientating chromosomes at the (spindle) equator<br>**or**<br>separating chromatids, at end of metaphase / at start of anaphase<br>**or**<br>movement of, chromatids / chromosomes, to (opposite) poles **;**<br><br>*allow 1 mark max if functions incorrect but **A** and **B** named correctly*<br>*allow 1 mark max if functions are correct but **A** named as kinetochore <u>and</u> **B** poorly misspelt attempt at microtubules* | **2** |
| 4(c)(ii) | <u>two</u> separate, chromatids / single-stranded chromosomes **;**<br><br>chromatids attached to spindle with fibres drawn to, poles / centrioles **;**<br><br>single chromatids drawn U-shaped or V-shaped pointing towards the poles **;**<br><br>centromeres drawn in both chromatids **;** | **3** |

| Question | Answer | Marks |
|---|---|---|
| 5(a) | *any **two** from:*<br><br>no nucleus **;**<br><br>no organelles / uniform appearance / homogenous cytoplasm **;**<br><br>(some are) biconcave shape / described **; A** cells have different shapes<br><br>same, width / size, as the lumen of the capillary **;**<br>**A** same width as capillary / diameter of cells is 6 - 7 μm<br>**R** colour / shading / AW | **2** |
| 5(b) | *any **three** from:*<br><br>**1** (wall is) thin / one cell thick / 1–2 μm in thickness **;**<br>**R** 'thin cell wall'<br>***I*** tunica intima<br><br>**2** *ref. to*, endothelial cells / endothelium **; *I*** squamous / epithelium<br><br>**3** short distance for diffusion **;**<br><br>**4** endothelial pores / fenestrations<br>**or**<br>pores / gaps, between / within, (endothelial) cells of the wall **;**<br><br>**5** for passage of, (named) small molecules / AW, from / to, plasma / blood / tissue fluid **;**<br>**A** phagocytes<br>**A** ultrafiltration<br><br>**6** AVP **;** *ref. to* pinocytosis across endothelial cells | **3** |

| Question | Answer | Marks |
|---|---|---|
| 5(c)(i) | *mark to max 3 if no ref. to 'more' at least once in the response*<br><br>*any **four** from:*<br><br>**1** more carbon dioxide diffuses into red blood cells **;**<br><br>**2** more carbonic acid is formed by carbonic anhydrase **;**<br><br>**3** formation of more hydrogen ions **; A** $H^+$<br><br>**4** haemoglobin has a high affinity for hydrogen ions **; A** $H^+$<br><br>**5** haemoglobin binds more hydrogen ions to form, haemoglobinic acid (HHb) **; A** $H^+$<br><br>**6** (formation of HHb) decreases affinity of haemoglobin for oxygen **;**<br><br>**7** haemoglobin releases more oxygen **;**<br><br>**8** carbon dioxide binds to $-NH_2$ / N terminal, of, globin / polypeptides / α chains and β chains **;**<br><br>**9** forms carbaminohaemoglobin **; R** carboxyhaemoglobin<br>*also lowers affinity*<br><br>**10** allosteric effect / change in tertiary structure / AW, in (oxy)haemoglobin (causes, release / AW, more oxygen) **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 5(c)(ii) | *any **two** from:*<br><br>**1** hydrogencarbonate ions / $HCO_3^-$ , pass out of red blood cells (into the plasma to increase concentration in deoxygenated blood) **;**<br><br>**2** chloride ions pass into red blood cells **;**<br><br>**3** to replace the, negatively-charged ions / anions / $HCO_3^-$ **;**<br>**A** to achieve electroneutrality / balance the electrical charge<br><br>**4** chloride shift **;**<br><br>**5** AVP **;** chloride ions pass through, channel proteins / anion exchangers / transport proteins / by facilitated diffusion | **2** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | plasmodesma **;** | **1** |
| 6(b) | Casparian strip **; I** suberin / endodermis | **1** |
| 6(c) | **R** if choice of terms given<br><br>osmosis **;**<br><br>transpiration pull / cohesion-tension **; I** mass flow / adhesion / down a water potential gradient<br><br>evaporation **;**<br><br>diffusion **;** | **4** |