Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/22**

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.

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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 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.

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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.

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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 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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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same marking point
R	reject
A	accept
I	ignore
AVP	any valid point
AW	alternative wording (where responses vary more than usual)
ecf	error carried forward
underline	actual word underlined must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument

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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, 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 CON (of 3)	× (discount 3)	

G	1 Correct	✓	**3**
(5 responses)	2 Correct	✓	
	3 Correct Correct CON (of 4)	✓ ignore ignore	

H	1 Correct	✓	**2**
(4 responses)	2 Correct	×	
	3 CON (of 2) Correct	(discount 2) ✓	

I	1 Correct	✓	**2**
(4 responses)	2 Correct	×	
	3 Correct CON (of 2)	✓ (discount 2)	

I

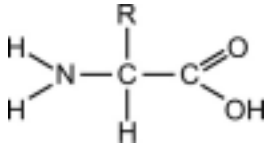
Question	Answer	Marks
1(a)	**3** = (atrial) systole (ventricular) diastole **5** = (atrial) diastole (ventricular) systole ; **7** = (atrial) diastole (ventricular) diastole ;	**2**
1(b)	*allow responses in context of both sides or one side of heart* *any **two** from:* atria and ventricles, do not contract / are not in systole, at the same time **;** AW ventricles, contract / are in systole, after atria **;** AW ora *idea that* allows atria to empty (completely) / allows ventricles to fill **;** **A** *idea that* (all) blood, pumped / AW, into ventricles (ready for systole)	**2**

Question	Answer	Marks
1(c)	*opening of tricuspid valve* pressure in (right) ventricle becomes lower than pressure in (right) atrium **or** pressure in (right) atrium becomes higher than pressure in (right) ventricle **;** *opening of pulmonary (semilunar) valve* pressure in (right) ventricle becomes higher than pressure in pulmonary artery **or** pressure in pulmonary artery becomes lower than pressure in (right) ventricle **;** *if mp1* ***and*** *2 have correct ideas but not referred to pressures on both 'sides' of the valve, allow one mark for idea of, increasing / high, pressure opening <u>each</u> of the valves* *help flow of blood through the heart* *any* ***two*** *from:* one-way flow of blood / prevents backflow of blood / directs blood in correct direction / blood flows in one direction / AW **;** **A** blood flows from atrium to ventricle to, pulmonary artery / lungs blood flows from (area of) higher pressure to (area of) lower pressure **;** *idea that* (blood) pressure changes aid coordination **;** e.g. semilunar valve is open (about same time) when tricuspid valve is shut	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>one mark each row to max 3
or = requires either root apical meristem or root cap cells statement
<table>
<tr><th>root apical meristem cells</th><th></th><th>root cap cells</th></tr>
<tr><td>(some) cells in, mitosis / different stages of cell cycle ;</td><td>or</td><td>no cells in mitosis / all cells in interphase ;
A no chromosomes visible / only chromatin visible</td></tr>
<tr><td>(some) cells in,
prophase / metaphase / telophase ;
A chromosomes visible (in some cells)</td><td></td><td>N/A</td></tr>
<tr><td>(generally) smaller (size) ;
A less cytoplasm</td><td>or</td><td>(generally) larger (size) ;
A more cytoplasm</td></tr>
<tr><td>larger nucleus in proportion to, size of cell / quantity of cytoplasm ;</td><td>or</td><td>smaller nucleus in proportion to, size of cell / quantity of cytoplasm ;</td></tr>
<tr><td>nucleoli / nucleolus, (more) visible / prominent / AW ;</td><td>or</td><td>nucleoli / nucleolus, not visible / not prominent / AW ;</td></tr>
<tr><td>(generally all) cuboidal / same shape ;
A rectangular / regular (shape)</td><td>or</td><td>variety of shapes / shape described ;
A irregular / circular</td></tr>
<tr><td>ref. arrangement of cells ; e.g.
rows / chains / tightly packed / compact / uniform / regular</td><td>or</td><td>ref. arrangement of cells ; e.g.
irregular / loosely packed / more intercellular spaces</td></tr>
<tr><td>AVP ; e.g.
all / more, cells have nuclei
cells not, sloughing off / detaching</td><td>or</td><td>AVP ; e.g.
some have no nucleus
some cells, sloughing off / detaching</td></tr>
</table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(b)	*any **three** from:* *max 1 mark (from mp1 / mp2) if response completely based on water movement within the plant* *mps 1-4: ref. to water molecules, needed once only / apply ecf* water molecules form hydrogen bonds **;** **A** H bonds / H bonding cohesion between water molecules (in spaces) **;** **A** cohesive force between water molecules cohesion to water molecules, adhering / AW, to soil, particles / clumps **;** adhesion of water molecules to, soil, surface / particles / clumps / mucilage / polysaccharides **;** **A** adhesive force of water molecules AVP **;** e.g. clumps provide, areas / (small) spaces / place, in which water collects *idea of* stable environment e.g. reduced movement of water, in / around clumps **I** keeps water around the, soil clumps / the root tip	**3**
2(c)	extracellular (enzymes) **;**	**1**
2(d)(i)	more than two / three or more / many / large number of / polymer of, monosaccharides / sugar monomers / sugar units / simple sugars / carbohydrate subunits / AW **;** **A** macromolecule *for large number of* **R** if includes incorrect example of a polysaccharide, e.g. sucrose *plus one from:* joined by / AW, glycosidic bonds **;** *idea of* repeating, subunits / units / monomers / AW **;**	**2**

Question	Answer	Marks
2(d)(ii)	*all correct (NH_2 or COOH groups on left or right)* **;** **A** H_2N  **A** COOH R-group / side chain, is variable **or** different amino acids have different, R-groups / side chains **;** AW *this can be annotated on the diagram*	**2**
2(d)(iii)	*any **three** from:* **I** *ref. to* concentration of water / solute concentration **A** ψ for water potential mineral ions / nutrients, are solutes / dissolve in water **;** (solutes) decrease / lower, water potential, within cell / in cytosol / in cytoplasm **;** **A** water potential becomes, more negative / low increases / steep(er) / presence of / AW, water potential gradient **;** **A** the difference in ψ between soil solution and cell increases **A** water moves from high to low water potential water follows osmotically / water enters by osmosis **;** *in context of, presence / uptake, of mineral ions*	**3**

Question	Answer	Marks
3(a)	*any **three** from:* stimulates an <u>immune response</u> **;** (usually) protein / glycoprotein / polysaccharides **; A** polypeptides **I** glycolipids recognised by / activates / stimulates, **and** named immune system cell **;** e.g. phagocyte / macrophage / neutrophil (B- / T-) lymphocyte **I** plasma cell **A** *idea of* leads to production of antigen-presenting cell *allow correct example of response by named cell* cause production of (specific) antibodies / bind to (specific) antibodies **;** **A** plasma cells releasing (specific) antibody **A** complementary shape to (antigen binding site on) antibody **A** complementary to receptors on lymphocytes example of location of non-self antigen **; I** whole cells as non-self antigens e.g. surface of / AW, pathogens / infected cells / tumour cells / non-body cells / foreign cells bacterial, cell wall / flagella viral, capsid / protein coat / envelope AVP **;** e.g. high molecular weight can be a toxin produced by a pathogen	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)</td><td>one mark each correct column = 4 marks
if 0 or 1 mark gained, check for correct row to max 2

In the whole table:
• if only ticks are used, assume blanks are crosses
• if only crosses are used, assume blanks are ticks

If there are ticks and crosses and blanks in the whole table, R the columns or rows with the blank(s)

<table>
<tr><th rowspan="2">description of cell</th><th colspan="4">cell of the immune system</th></tr>
<tr><th>B-lymphocyte</th><th>plasma cell</th><th>T-helper cell</th><th>T-killer cell</th></tr>
<tr><td>able to go through a number of cell cycles (clonal expansion)</td><td>✓</td><td>x</td><td>✓</td><td>✓</td></tr>
<tr><td>main role is to secrete cytokine during an immune response</td><td>x</td><td>x</td><td>✓</td><td>x</td></tr>
<tr><td>present during a primary immune response to a virus</td><td>✓ ;</td><td>✓ ;</td><td>✓ ;</td><td>✓ ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>3(c)</td><td>A = cytokinesis ; A division of the cytoplasm / cytoplasmic division

B = interphase ;

C = DNA replication ;
A semi-conservative replication / production of sister chromatid
A DNA, synthesis / AW
I chromatid duplication / chromatid replication</td><td>3</td></tr>
</table>

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Question	Answer	Marks
4(a)(i)	 label line to any part of nucleolus **;** *must touch an area of nucleolus*	**1**
4(a)(ii)	*any **two** from:* suggestion for structure as a flagellum **;** **R** microvillus **A** cilium / undulipodium presence of microtubules **;** presence of 9 + 2 (microtubule) arrangement / pattern, (in cross section) **;** AVP **;** e.g. *ref. to* location on outer part of cell (so can move) / AW circular cross section suggests tubular structure (hence flagellum) / AW e.g. looks cylindrical	**2**

Question	Answer	Marks
4(a)(iii)	*any **three** from:* *eukaryote because presence of* (true) nucleus / nuclear envelope / nuclear membrane<u>s</u> **;** mitochondrion **;** *if mp1 **and** 2 not gained, allow* double membrane-bound structures nucleolus **;** chromatin **;** (**X**) has 9+2 pattern of microtubules **; A** *ref. to* cytoskeleton / microtubules **X** / AW, covered by cell (surface) membrane **;** <u>endoplasmic reticulum</u> **;** **I** rough / smooth **I** ER / SER / RER **A** Golgi body *not prokaryote because* absence of cell wall **;** **I** does not have peptidoglycan cell wall (size) greater than 5 μm **;** **A** larger than (typical) prokaryote / bacterial cell **A** valid calculated size using scale bar *if stated as a prokaryote, read whole response and if all ideas refer correctly to eukaryotic structures, allow max 1*	**3**
4(b)(i)	pathogen **; I** parasite	**1**
4(b)(ii)	*falciparum* / *malariae* / *ovale* / *vivax* **; A** *knowlesi correct spelling*	**1**

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Question	Answer	Marks
4(c)	*any **three** from:* *similarities* vector, qualified **;** e.g. vector is, an insect / a fly both, are vector-borne / are carried by a vector both, need / involve, a vector (vector / carrier / insect) feeds / AW, on (human) blood **;** **A** both diseases transmitted through blood *differences* *malaria* (vector) is, a mosquito / *Anopheles* **; ora** (tsetse fly) not a mosquito **R** mosquito / Anopheles, versus insect (only) female (*mosquitos*), feed on blood / transmit disease / are vectors **;** *(information given for sleeping sickness is that male and female tsetse flies feed on blood)*	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
1 four DNA bases named correctly ; correct spellings
2 purine or pyrimidine column correct for A, C, G, T ;

3 final column correct ;
4 uracil (spelled correctly) <u>and</u> pyrimidine ;

if 0 or 1 mark gained, can increase to max 2:
• if 0 marks, can check for two correct rows
• only mp 1, 2 or 3 correct, check for one correct row
• only mp 4 correct, check for a correct A / C / G / T row

<table>
<tr><th>base</th><th>name of base</th><th>purine or pyrimidine</th><th>RNA or DNA or both</th></tr>
<tr><td>A</td><td>adenine</td><td>purine</td><td>both</td></tr>
<tr><td>C</td><td>cytosine</td><td>pyrimidine</td><td>both</td></tr>
<tr><td>G</td><td>guanine</td><td>purine</td><td>both</td></tr>
<tr><td>T</td><td>thymine</td><td>pyrimidine</td><td>DNA</td></tr>
<tr><td>U</td><td>uracil</td><td>pyrimidine</td><td>RNA</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>5(b)(i)</td><td>purine because it is a, double ring structure / has two rings ;
A purine because similar structure to, adenine / guanine</td><td>1</td></tr>
</table>

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Question	Answer	Marks
5(b)(ii)	*mp1 / 2 / 4 idea that carbovir triphosphate is more similar to the (activated) DNA nucleotides that are added to the elongating chain by DNA polymerase* *mp3 justifying why it is better to have a nucleotide analogue (carbovir triphosphate) by explaining the role of DNA nucleotides* *look for ora for abacavir* *any **two** from:* **1** carbovir triphosphate is (similar to / same as), an activated nucleotide / a nucleotide / not a nucleoside **;** **A** similar to, A / G, nucleotides **I** *ref. to* purine **2** carbovir triphosphate, has (three) phosphates / is activated / is phosphorylated **;** **3** detail of, (DNA) polymerase action / (activated DNA) nucleotides **;** e.g. (nucleotides are) added to the, growing / elongating, chain (nucleotides) form H bonds with, complementary base / AW (nucleotides are) substrates for DNA polymerase phosphodiester bonds form between nucleotides *allow mp3 in context of carbovir triphosphate (link to mp1)* **4** *ref. to* triangle / triangular cycloalkane, no longer present / not on DNA nucleotides **;** **5** AVP **;** e.g. carbovir triphosphate better fit to active site of enzyme / AW	**2**

Question	Answer	Marks
5(b)(iii)	*any **four** from:* *carbovir triphosphate can be inserted into a growing chain…* **1** prevents polymerase from adding DNA nucleotide to growing chain / AW **;** **A** *idea of* complete (viral) DNA not made if, chain does not elongate / no more nucleotides added **R** adding base **R** *if in context of stop codon / transcription* **I** *ref. to* complementary base pairing **2** similar <u>shape</u> to, substrate / (activated / phosphorylated) nucleotide **;** **A** complementary shape to active site of, DNA polymerase / enzyme **3** acts as an inhibitor **;** **4,5** further detail of how, inhibitor / carbovir triphosphate, may act **;;** *two from = 2 marks* e.g. may be irreversible fits into / binds to, active site of, enzyme / DNA polymerase competes with (DNA) nucleotide for active site **R** base fewer ES complexes form *in context of enzyme with DNA nucleotide* *idea of* fewer enzyme molecules available to bind to nucleotides may cause change in, shape / tertiary structure / 3D structure, of (DNA) polymerase / enzyme **I** *ref. to* complementary base pairing **6** (DNA polymerase) may not form phosphodiester bonds **;** **R** between, bases / complementary bases / complementary nucleotides **7** *ref. to* proofreading mechanism **;** e.g. error may cause breakdown of (newly synthesised) DNA may be too similar to be noticed as error and not repaired **8** AVP **;** e.g. (viral) DNA containing analogue may not be further replicated DNA polymerase cannot move along DNA template strand AW DNA polymerase may become detached from template strand *idea that* carbovir triphosphate, introduces a mutation / changes DNA formed / changes nucleotide sequence	**4**

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Question	Answer	Marks
6(a)	bronchi / left and right bronchus **;**	**1**
6(b)	*any **two** from:* diffusion distance too great / AW **;** **A** walls too thick for (efficient) diffusion **I** *ref. to* surface area time taken for diffusion (to occur) too long / diffusion rate too slow **;** further detail **;** e.g. many cell layers / a number of tissues, to pass across named tissue type(s) to cross e.g. presence of smooth muscle *ref. to* ciliated epithelium / not squamous epithelium *ref. to* layer of mucus on lining of gas exchange system *idea that*, ventilation / fast air flow, reduces time for (correct gradient to be established for) diffusion to occur **;** *idea that* blood supply is, not from pulmonary artery / not pulmonary circulation / from a branch of the aorta / part of the systemic circulation **;** **I** not enough, blood / blood vessels detail **;** e.g. (systemic) blood supply to the gas exchange organs is, already oxygenated / not deoxygenated low / no, concentration gradient for, oxygen / carbon dioxide in (systemic) blood supply to the gas exchange organs	**2**
6(c)(i)	as airway generation (number), increases / gets higher, airway diameter decreases **;** AW **A** in terms of named structures or numbers **A** inverse correlation	**1**

Question	Answer	Marks
6(c)(ii)	*any **three** from:* *yes, useful* compared to Weibel Lung model measurements, similar results / same trend / same relationship between airway generation and airway diameter **;** data to support **;** projection / multi-Slice, for at least one generation, compared to Weibel (supporting trend) projection / multi-slice, 2 generations showing trend no risk of, harmful / radiation, exposure **;** AW detail **;** e.g. can repeat / can use regularly (on same person) can, follow progression of disease *if no reference made to 'yes' results, only allow one of these two marks** *not useful* not the same as / different to, Weibel's results **;** projection results not consistent with multi-slice results / AW **;** data to support **;** *not same as Weibel's* projection **or** multi-Slice, for at least one generation compared to Weibel *projection and multi-slice not the same* projection **and** multi-Slice for at least one generation	**3**