Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **October/November 2022**

MARK SCHEME

Maximum Mark: 100

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.

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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.

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.

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
mp marking point

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Question	Answer	Marks
1(a)	*any **two** from:* 1 habitat loss **;** 2 competition with / disease from, farm / invasive / alien, animals / species **;** 3 climate change **;** 4 hunting / poaching / killing by humans **;** 5 AVP **;**	**2**
1(b)	*any **three** from:* 1 global / international / worldwide (authority / advisory) **;** 2 (to give advice to) conserve / protect, nature / biodiversity / habitats **;** 3 assess / categorise, species conservation status **;** 4 ref. Red List (of Threatened Species) **;** 5 influence, governments / policy **;** 6 educate / raise awareness **;** 7 AVP **;**	**3**

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Question	Answer	Marks
1(c)	*any **four** from:* 1 mating / IVF / (super-ovulate female plus) AI **;** 2 remove embryo (from, mated / artificially inseminated, female) **;** 3 check / select, healthy / normal / best, embryos **;** 4 may freeze embryos for, storage / later use **;** 5 implant embryos in (different female) uterus **;** 6 ref. surrogate (mother) **;** 7 ref. (named female reproductive) hormone(s) **;** 8 AVP **;**	**4**

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Question	Answer	Marks
2(a)	chlorophyll *a* / chlorophyll *b* / (β) carotene **;**	**1**
2(b)	*any **two** from:* 1 action (spectrum) shows rate of photosynthesis for light, wavelengths / colours **;** 2 absorption (spectrum) shows how much each, wavelength / colour, is absorbed **;** 3 higher absorption gives higher photosynthesis **;**	**2**
2(c)	*any **three** from:* 1 ref. (named) enzymes **;** 2 high(er) temperature increases rate **;** 3 (temperature affects) photophosphorylation / light-dependent / Calvin cycle / light-independent / ESC formation **; ora** 4 enzymes denature at, too high a temperature / very high temperature / above optimum temperature **;** 5 AVP **;**	**3**
2(d)	*any **three** from:* 1 RuBP joins with CO_2 to make, 6C intermediate / GP **;** 2 GP to TP **;** 3 (GP → TP) uses ATP **and** reduced NADP **;** 4 TP → glucose / hexose → starch **;** 5 condensation / polymerisation / glycosidic bonds **;**	**3**

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Question	Answer	Marks
3(a)(i)	*any **pair** (max 2) from:* 1 cristae / folds, let inner membrane expand **;** 2 when water enters (matrix), by osmosis / down water potential gradient **;** 3 inner membrane (relatively) impermeable to water **;** 4 (so) water does not enter (matrix), by osmosis / down water potential gradient **;** 5 inner membrane moves (H^+) ions out of matrix **;** 6 so less water enters (matrix), by osmosis / down water potential gradient **;**	**2**
3(a)(ii)	*any **three** names plus explanations from:* 1 pyruvate, for link reaction / to bind to coenzyme A / to make acetyl (CoA) / to make reduced NAD / be dehydrogenated **;** 2 oxaloacetate to, accept acetyl / make citrate **;** 3 citrate to, make reduced NAD / be dehydrogenated **;** 4 enzymes to catalyse, link reaction / Krebs cycle **;** 5 oxygen to, accept electrons / accept protons / form water **;** 6 water as a, solvent / medium for reactions **;** 7 DNA / RNA, to make (named) respiratory, enzymes / proteins **;**	**3**

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Question	Answer	Marks
3(a)(iii)	*any **one** from:* 1 so H^+, cannot move through / must move through ATP synthase **;** 2 to maintain proton gradient **;**	**1**
3(b)(i)	*any **four** from:* 1 (H atoms) split into protons and electrons **;** 2 electrons, flow / move, down ETC **;** 3 (releases) energy used to move H^+ to intermembrane space **;** 4 more / build-up of, H^+ / positive charge, in intermembrane space **;** 5 (causes / sets up) proton / electrochemical, gradient **;**	**4**
3(b)(ii)	*any **two** from:* 1 (P_i) by facilitated diffusion **or** through a protein, channel / carrier **;** 2 P_i and H^+ move together **;** 3 (as) H^+ ions diffuse (through ATP synth(et)ase / to matrix) **;**	**2**
3(b)(iii)	1 constant / sufficient / correct, supply / amount of, ADP / reactant **;** 2 (so) ATP can continue to be made / so enough ATP can be made **;**	**2**

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Question	Answer	Marks
4(a)	*any **four** from:* 1 add DNA to give a new (named), characteristic / protein **;** 2 restriction, enzyme / endonuclease, to obtain, gene / allele / section of DNA **or** restriction, enzyme / endonuclease, to cut plasmid **;** 3 combine gene with / insert gene into, vector / plasmid **;** 4 introduce, (recombinant) vector / plasmid, to, bacterium / (named host) cell **;** 5 clone / multiply, (named, recombinant / GM) organism **;** 6 AVP **;**	**4**
4(b)(i)	1 stem cells, proliferate / divide / multiply / make new cells **;** 2 (correct) gene is, inherited by / passed on to / present in, new cells **;**	**2**
4(b)(ii)	*any **two** from:* 1 to switch gene on / so gene is expressed / allow transcription **;** 2 at right time / all the time / in sufficient quantities **;** 3 to allow binding of, RNA polymerase / transcription factors **;**	**2**

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Question	Answer	Marks
4(b)(iii)	*any **two** from:* 1 retrovirus / new gene, could / must not, insert in wrong place / disrupt other genes **;** 2 could / must not, cause cancer **;** 3 could / must not, cause, infection / disease **;** 4 could / must not, cause, immune / allergic, response **;** 5 AVP **;**	**2**
4(c)	*any **three** from:* 1 HD is caused by a <u>dominant</u> allele **;** 2 adding a 'normal' recessive allele would not work **;** 3 gene editing can / we need to, delete / remove / inactivate, HD / mutant, allele / DNA **;** 4 ref. (surplus CAG) repeats / triplets / stutter **;**	**3**

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Question	Answer	Marks
5(a)	*any **five** from:* 1 evolution / speciation / natural selection **;** 2 random / spontaneous **;** 3 mutations (occurred) **;** 4 adapting some plants to, alpine habitat / high altitude / mountains **;** 5 (in this habitat) these plants, survived / were selected for **;** 6 (selection pressure is / must resist) cold / strong winds / thin soil **;** 7 alleles for alpine features passed to offspring **;** 8 change in, allele frequency / gene pool (of population) **;** 9 population become, morphologically / physiologically / biochemically, different **;** 10 less, herbivores / competition, in new <u>niche</u> **;** 11 AVP **;**	**5**
5(b)(i)	*any **three** from:* 1 time period = from 0.95 million years (to present) **;** 2 mountains high enough to exceed treeline **;** 3 this provides alpine, habitat / region / niches **;**	**3**

Question	Answer	Marks
5(b)(ii)	*any **two** from:* 1 compare / find similarities in / find differences in, DNA **;** 2 of alpine species and related (lowland) species **;** 3 find (time) when species, evolved / separated / diverged / speciated **;** 4 many, DNA / base / nucleotide, differences / changes / mutations, means they, separated a long time ago / have a distant common ancestor **;** 5 AVP **;**	**2**

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Question	Answer	Marks
6(a)	*any **four** from:* 1 breed / cross, plants with desired (named) characteristics **;** 2 breed, better / best, offspring, repeatedly / for many generations **;** 3 (*correct ref. to*) inbreeding / line breeding **;** 4 (*correct ref. to*) hybridisation / outbreeding / outcrossing **;** 5 (gives) hybrid vigour / heterosis / outbreeding enhancement (in offspring) **;** 6 F1 have, same genotype / uniform phenotype **;** 7 AVP **;**	**4**
6(b)(i)	*any **one** from:* 1 (IR8) less likely to, fall over / lodge / collapse **;** 2 (IR8) higher proportion / more, of plant is, edible / grain **;**	**1**
6(b)(ii)	check for, genes / alleles / DNA, for high yield **and** flood tolerance **;**	**1**
6(b)(iii)	*any **one** from:* 1 to, maintain high yield / increase yield / give higher yield **;** 2 to avoid inbreeding depression **or** to maintain, hybrid vigour / heterosis **;**	**1**

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Question	Answer	Marks
6(c)(ii)	*any **four** from:* *variety A:* 1 gibberellin binds to, receptor / GID1 **;** 2 DELLA protein breaks down **;** 3 PIF / transcription factor (released) to, bind to DNA / transcribe genes **;** 4 stem / internode / cell, elongation / growth, occurs **;** 5 **A**, is *lele* / has no *Le* allele **;** 6 **A** does not produce its own (active) gibberellin **;** *variety B:* 7 does not respond to / no effect from, gibberellin **;** 8 lacks / has non-functional, gibberellin receptor **;**	**4**
6(c)(ii)	*any **two** from:* 1 (BZR1) binds to promoter **;** 2 to switch gene on / so gene is expressed / allow transcription **;** 3 allows binding of RNA polymerase (to DNA / promoter) **;**	**2**

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Question	Answer	Marks
7(a)	1 *symbols* **B** / $\mathbf{X^B}$ = (allele for) black (fur) **G** / $\mathbf{X^G}$ = (allele for) ginger (fur) **;** *parents phenotypes* *tortoiseshell female* *ginger male* 2 *parents genotypes* $\mathbf{X^BX^G}$ $\mathbf{X^GY}$ **;** 3 *gametes* $\mathbf{X^B}$ $\mathbf{X^G}$ $\mathbf{X^G}$ **Y** **;** *4* offspring *genotypes* $\mathbf{X^BX^G}$ $\mathbf{X^BY}$ $\mathbf{X^GX^G}$ $\mathbf{X^GY}$ **;** 5 *offspring phenotypes* tortoiseshell female, black male, ginger female, ginger male **;**	**5**
7(b)	*any **three** from:* 1 *TYR* codes for tyrosinase **;** 2 converts tyrosine into DOPA **;** 3 converts DOPA into dopaquinone **;** 4 dopaquinone converted to melanin **;**	**3**

Question	Answer	Marks
8(a)	**A** – distal convoluted tub(ul)e **;** **B** – cortex **;** **C** – loop of Henlé **;**	**3**

Question	Answer	Marks
8(b)	*any **three** from:* 1 as ADH concentration increases urine concentration increases **;** 2 as ADH concentration increases urine flow rate decreases **;** 3 as urine flow rate decreases urine concentration increases **;** 4 data quote with units **;** 5 AVP **;**	**3**
8(c)	*any **five** from:* 1 ADH binds to <u>cell</u>, surface / membrane, receptor (of collecting duct cells) **;** 2 *ref*. G protein / adenyl(ate) cyclase **;** 3 second messenger / cAMP **;** 4 protein kinase activated **;** 5 vesicles, move towards / fuse with, cell (surface) membrane **;** 6 *correct ref.* aquaporins **;** 7 collecting duct / cells / membrane, (more) permeable to water **;** 8 more water, leaves, lumen / nephron **or** more water enters, blood / medulla **;**	**5**

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Question	Answer	Marks
9(a)	*any **four** from:* *motor / neurone* 1 resting potential higher **;** 2 –70 mV (motor) versus –90 mV (muscle) **;** 3 smaller change in membrane potential / smaller depolarisation **;** 4 110 mV (motor) versus 130 mV (muscle) **;** 5 action potential / depolarisation, takes less time / is faster **;** 6 (action potential) 2.7 ms (motor) versus 4 ms (muscle) **or** (depolarisation) 1 ms (motor) versus 2 ms (muscle) **;** 7 hyperpolarisation / <u>relative</u> refractory period, occurs **;**	**4**
9(b)(i)	*any **three** from:* 1 transverse / T- , tubules depolarised **;** 2 Ca^{2+} <u>diffuse</u> out of sarcoplasmic reticulum **;** 3 Ca^{2+} bind to troponin **;** 4 tropomyosin, moves from / exposes, binding sites **;** 5 for myosin on actin **;** 6 cross-bridges form / myosin (head) binds to actin **;**	**3**

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Question	Answer	Marks
9(b)(ii)	*any **one** from:* 1 cross bridges break / myosin heads detach, at different times **;** 2 AVP **;**	**1**

Question	Answer	Marks
10	1 internal **;** 2 <u>negative feedback</u> **;** 3 receptor(s) **;** 4 endocrine / islets of Langerhans / α and β **;** 5 glycogen **;**	**5**

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