Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2021**

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.

Cambridge International is publishing the mark schemes for the May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level 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.

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	<u>'List rule' guidance</u> 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)	**A** – binding site **;** **B** – tropomyosin **;** **C** – troponin **;** **D** – myosin <u>head</u> **; A** ATPase	**4**
1(b)	*any **four** from:* 1 *ref. to* release from, sarcoplasmic reticulum / SR **;** 2 bind to, troponin / **C ;** 3 tropomyosin / **B**, moves / AW **; A** changes shape 4 binding site / **A**, exposed / AW **;** 5 myosin <u>head</u> / **D**, binds to actin **or** *ref. to* formation of cross bridge **;** *allow ecf from **1(a)***	**4**
1(c)	no / little, ATP, produced / available **;** (so) no breaking of cross bridges / myosin head not released **;**	**2**

Question	Answer	Marks
2(a)(i)	active transport **;**	**1**
2(a)(ii)	correct working **;** e.g. $31 \times 30.5 = 945.5$ then $\frac{945.5}{2870}$ **or** $\frac{2870}{31} = 92.58$ then $\frac{30.5}{92.58}$ 32.94 / 32.9 / 33 **;**	**2**
2(a)(iii)	thermoregulation **or** maintaining (constant), body / core, temperature **; I** regulation	**1**
2(a)(iv)	substrate-linked phosphorylation **; A** substrate level phosphorylation	**1**
2(b)	*rest (RQ of 0.8)* 1 a mix of respiratory substrates **or** lipids and, carbohydrates / proteins, are being respired **;** *110 (RQ of 1.0)* 2 respiratory substrate used is carbohydrate / carbohydrate respired (than at rest) **; A** named carbohydrate e.g. glucose *200 (RQ of 1.2)* 3 anaerobic respiration (also) occurring **;** 4 reduced availability of oxygen **or** increased, production / release of CO_2 **;**	**4**

Question	Answer	Marks
2(c)	*any **three** from:* 1 *ref. to* oxygen debt **;** *oxygen needed to* 2 convert lactate to pyruvate **;** 3 convert lactate to glycogen **;** 4 re-oxygenate, Hb / myoglobin **;** 5 AVP **;** e.g. to support a higher metabolic rate / *ref. to* EPOC	**3**

Question	Answer	Marks
3(a)(i)	*any **two** from:* 1 differences in, morphology / phenotype / characteristics **;** 2 differences in, physiology / biochemistry **;** 3 genetic differences / AW **;** 4 differences in behaviour **;** 5 differences in ecological niche **;** 6 isolated, populations / species **or** found in different geographical areas / AW **or** reproductively isolated / AW **;**	**2**
3(a)(ii)	*any **two** from:* 1 mate them together **;** 2 see if offspring can interbreed / see if offspring are fertile**;** 3 *ref. to* bioinformatics investigation / described **;**	**2**
3(b)	*any **two** from:* 1 Fungi **;** 2 Protoctist(a) **;** 3 Prokaryota(e) / Prokaryote **;** **I** bacteria	**2**

Question	Answer	Marks
3(c)	*any **four** from:* 1 hard to control / may become invasive / AW ; 2 may lack predators ; 3 may lack herbivores ; 4 may, prey on / parasitise, local / native, species / organisms ; 5 may compete with, local / native, species / organisms ; **A** description e.g. eat their food supply 6 may decrease, biodiversity / species richness / species abundance / AW ; 7 may have effects on, food web / ecosystem ; 8 may introduce diseases ;	**4**
3(d)	*any **two** from:* 1 ban on African fruit should be lifted ; 2 can export more fruit / can export fruit to Asia / find new overseas markets ; 3 economic benefit / more work / more opportunities for farmers / social benefit ;	**2**

Question	Answer	Marks
4(a)	*any **five** from:* 1 gene / DNA, from *Bacillus thuringiensis* ; 2 *ref. to* restriction, enzyme / endonuclease ; 3 clone gene / amplify gene, using PCR ; 4 insert, gene / DNA, into plasmid ; 5 add promoter ; 6 seal (plasmid) using DNA ligase ; 7 (maize) tissue / cell / callus / embryo, takes up plasmid / recombinant DNA ; 8 (maize) expresses new gene / produces Bt toxin ; 9 AVP ; e.g. Ti (plasmid) / *Agrobacterium tumefaciens*	**5**
4(b)(i)	*any **two** from:* 1 pollen from Bt maize, kills / is toxic to / harms, caterpillars ; 2 pollen from non-Bt maize, does not kill / is not toxic to / does not harm, caterpillars ; 3 (eating) leaves with no pollen does not kill / is not toxic to / does not harm, caterpillars ; 4 more days of eating pollen from Bt maize gives more caterpillar deaths / AW ;	**2**

Question	Answer	Marks
4(b)(ii)	*any **four** from:* 1 Bt pollen did not get deposited (onto milkweed plants) / AW **;** 2 caterpillars and Bt maize located in different areas **;** 3 pollen released at a different time to when caterpillars feed **;** 4 *ref. to* caterpillars develop resistance (to Bt toxin) **;** 5 *ref. to* lab and, quantity / toxicity, of Bt pollen **;** 6 AVP **;** e.g. in 2019 breeding conditions were better than in 1999 e.g. herbicides may reduce milkweed availability in maize fields	**4**

Question	Answer	Marks
5(a)	*any **two** from:* 1 cyclic involves (only) PS1 **and** non-cyclic involves PS1 and PS2 **;** 2 cyclic produces only ATP **and** non-cyclic produces ATP and reduced NADP **;** 3 cyclic does not involve photolysis of water **and** non-cyclic does involve photolysis of water **;** **A** photolysis **only** occurs in non-cyclic	**2**
5(b)(i)	as a, control / reference tube, for comparison **;** **R** control **variable**	**1**
5(b)(ii)	*tube 2 changes to blue* 1 (plant carries out) photosynthesis **;** 2 uses up CO_2 in the, Calvin cycle / light independent stage **or** less CO_2 causes pH to increase **;** **I** oxygen *tube 3 changes to yellow* 3 (snail carries out) respiration **;** 4 produces CO_2 in, the link reaction / Krebs cycle **or** more CO_2 causes pH to decrease **;** **A** more CO_2 acidifies solution **I** oxygen *tube 4 stays green* 5 both photosynthesis and respiration **or** CO_2 produced in respiration **is used** in photosynthesis **or** oxygen produced in photosynthesis **is used** in respiration **;**	**5**

Question	Answer	Marks
5b(iii)	*any **three** from:* 1 no / less, photosynthesis, so, no / less, CO_2 used **;** 2 detail **;** e.g. no light dependent stage / no non-cyclic photophosphorylation no / less, Calvin cycle / light independent stage / carbon (dioxide)fixation 3 respiration occurs producing CO_2 **;** 4 respiration rate slower, in aquatic plants / test-tube 6, than, pond snails / test-tube 7 **;** 5 (so) **slight** decrease in pH **;**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>6(a)(i)</td><td>idea of heat transfer from artery to veins ;</td><td>1</td></tr>
<tr><td>6(a)(ii)</td><td>any one from:
vasodilation / description ; R capillaries / blood vessels move to skin surface
behavioural response ; e.g. dive down to cooler waters before surfacing for air</td><td>1</td></tr>
<tr><td>6(b)(i)</td><td>any four from:
1 concentration of insulin (relatively) constant for all groups before being fed ;
2 (fasting dolphins) insulin concentration very little change ;
3 (fed dolphins) insulin concentration increases then decreases ;
4 (fed dolphins) for 11 g / kg dolphins steep, increase / decrease, in insulin concentration ;
5 (fed dolphins) for 11 g / kg dolphins high(est) peak in insulin concentration ;
6 data quote for mp3 or mp4 with time in min ;
<table>
<tr><td>3 kg</td><td>21 at 0 min</td><td>30 at 180 min</td><td>20 at 240 min</td></tr>
<tr><td>11 kg</td><td>10 at 0 min</td><td>79 at 90 min</td><td>18 at 480 min</td></tr>
</table></td><td>4</td></tr>
<tr><td>6(b)(ii)</td><td>$\frac{79-10}{90}$;
= 0.77 ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
6(c)	*any **three** from:* 1 change in a parameter **;** 2 detected by receptor **;** 3 coordination / described **;** 4 (corrective) action taken by effector **;** 5 return to, set point / norm / optimum **;**	**3**

Question	Answer	Marks
7(a)	*any **four** from:* 1 haemoglobin less soluble **;** 2 (if oxygen concentration decreases) haemoglobin molecules, stick together / form long fibres **;** 3 red blood cells, pulled out of shape / become sickle shaped **;** 4 blood poor at transporting oxygen **;** 5 (so) less oxygen getting to, cells / tissues / organs **;** 6 red blood cells may, get stuck in / block, capillaries / vessels **;** 7 pain / sickle cell crisis / fatigue **;**	**4**
7(b)(i)	both alleles, contribute to / expressed in, the phenotype (in the heterozygote) **;**	**1**
7(b)(ii)	*any **one** from:* smaller quantity of abnormal haemoglobin **;** fewer red blood cells become sickled / sickling less severe **; ORA** not affected by low(er) oxygen concentration **;**	**1**

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Question	Answer					Marks
7(b)(iii)	parental phenotype	SCT		SCT		**3**
	parental genotype	**Hb^A Hb^S**		**Hb^A Hb^S**	;	
	gametes	**Hb^A**	**Hb^S**	**Hb^A**	**Hb^S**	
	offspring genotypes	**Hb^A Hb^A**	**Hb^A Hb^S**	**(Hb^A Hb^S)**	**Hb^SHb^S** ;	
	offspring phenotypes	normal	SCT	(SCT)	SCA ;	
	I *carrier*					

Question	Answer	Marks
8(a)	1 individuals in a population with, intermediate phenotypes / AW, more likely to, survive / reproduce **or** individuals in a population with, intermediate phenotypes / AW, are selected for **;** 2 individuals in a population with extreme phenotypes, die **or** individuals in a population with extreme phenotypes are selected against **;** 3 no change in environment **;**	**3**
8(b)(i)	poor camouflage / AW **;** predation **;**	**2**
8(b)(ii)	narrower curve **;** curve to right with apex at dark brown **;**	**2**
8(c)	1 random / chance, change in <u>allele</u> frequency **or** description of alleles not passed onto the next generation **;** 2 larger influence in smaller population / AW **;**	**2**

Question	Answer	Marks
9(a)	*any **six** from:* 1 add marker gene to the, vector / plasmid **;** 2 gene of interest inserted close to marker gene **;** 3 (marker) gene product / protein, emits light **;** 4 visible colour change **;** 5 *ref. to* exposing to UV light / laser scanner **;** 6 easy to identify transformed, bacteria / organisms **;** 7 examples **;** e.g. GFP 8 *idea of* no known risk **;** 9 AVP **;** e.g. *ref. to* gene of interest inserted into marker gene / insertional inactivation	**6**

Question	Answer	Marks
9(b)	*any **five** from:* *advantages* 1 increase in yield **;** 2 improved quality / AW **;** 3 improvement to health / Golden rice™ and vitamin A deficiency **;** 4 longer shelf-life **;** 5 some GM crops are adapted to unfavourable conditions **;** **A** e.g. drought tolerance / nitrogen fixing / salt tolerance 6 (insect / herbicide, resistant crops) **so** less money spent on, pesticide / herbicide **;** *any **five** from:* *disadvantages* 7 consumer resistance to GM crops **;** 8 may be unsafe for humans / allergies / side effects / harm other animals **;** 9 expensive **;** 10 may have to buy seeds every season **;** 11 seed and related herbicides sales monopolised by big companies **;** 12 *ref. to* affects organic food **;**	**9**

Question	Answer	Marks
10(a)	*any **seven** from:* *selective reabsorption – sodium ions* 1 active transport of Na^+, out of (pct) cells / into blood **;** 2 Na^+ ion concentration, gradient (produced) / reduced in cell **;** 3 Na^+ enters (pct) cells from, lumen / tubule / filtrate **;** 4 by facilitated diffusion / using carrier protein **;** 5 cotransport of, glucose / amino acids / ions **;** 6 glucose diffuses into blood **;** *synapse – calcium ions* 7 (when) presynaptic membrane depolarised **;** 8 calcium (ion) channels / voltage-gated channels, open **;** 9 calcium ions enter presynaptic neurone **;** 10 stimulate vesicles of ACh to, move towards / fuse with, presynaptic membrane **;** 11 causing exocytosis of ACh **;**	**7**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(b)</td><td>

*any **eight** from:*

differences

<table>
<tr><th></th><th></th><th>nervous</th><th></th><th>endocrine</th></tr>
<tr><td>1</td><td>communication</td><td>action potential / impulse</td><td>and</td><td>hormone ;</td></tr>
<tr><td>2</td><td>nature of communication</td><td>electrical (and chemical)</td><td>and</td><td>chemical ;</td></tr>
<tr><td>3</td><td>mode of transmission</td><td>neurone / nerve cell</td><td>and</td><td>blood ;</td></tr>
<tr><td>4</td><td>response destination</td><td>muscle / gland</td><td>and</td><td>target, organs / tissue / cells ;</td></tr>
<tr><td>5</td><td>transmission speed</td><td>fast(er)</td><td>and</td><td>slow(er) ;</td></tr>
<tr><td>6</td><td>effects</td><td>specific / localised</td><td>and</td><td>(can be) widespread ;</td></tr>
<tr><td>7</td><td>response speed</td><td>fast(er)</td><td>and</td><td>slow(er) ;</td></tr>
<tr><td>8</td><td>duration</td><td>short-lived / temporary</td><td>and</td><td>can be long-lasting / permanent ;</td></tr>
<tr><td>9</td><td>receptor location</td><td>on cell surface membrane</td><td>and</td><td>either on cell surface membrane or within cell ;</td></tr>
</table>

similarities

<table>
<tr><td>10</td><td>cell signalling</td><td>both involve cell signalling ;</td></tr>
<tr><td>11</td><td>detail</td><td>both involve signal molecule binding to receptor ;</td></tr>
<tr><td>12</td><td>chemicals</td><td>both involve chemicals ;</td></tr>
</table>

</td><td>8</td></tr>
</table>

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