Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/42**

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	'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

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Question	Answer	Marks
1(a)(i)	**A** – sodium potassium pump **;** CON if channel mentioned **B** – potassium ions **; A** K^+ **D** – sodium ions **; A** Na^+ *max 2 if no ref. to ions*	**3**
1(a)(ii)	ATP **;**	**1**
1(b)	*any **five** from:* *drugs could be in any order* *curare* **1** less / no, ACh binds to receptors **; I** neurotransmitter **2** fewer / no, (ligand gated) Na^+ channels open **or** fewer / no, Na^+ can enter sarcomere / sarcoplasm **or** no / less, depolarisation of, sarcolemma / muscle cell membrane **;** *nerve gas* **3** no / less, ACh broken down **or** ACh remains bound to receptor **;** **4** (ligand gated) Na^+ channels remain open / Na^+ continue to enter post synaptic neurone **or** permanent / AW, depolarisation (of post synaptic membrane) **; A** sarcolemma *alcohol* **5** no / less, binding of, neurotransmitter / ACh, to receptors **;**	**5**

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Question	Answer	Marks
1(b)	**6** fewer / no, (ligand gated) Na^+ channels open **or** fewer / no, Na^+ can enter post synaptic neurone **or** no / less, depolarisation (of post synaptic membrane) **;** **A** sarcolemma	

Question	Answer	Marks
2(a)(i)	*any **two** from:* **1** *ref. to* muscle fibre / sarcomere, contraction **;** **2** active transport of (named), ion / molecule **or** active transport (of substance) against concentration gradient **;** **3** movement of, vesicles / organelles, through cytoplasm / described **;** **4** exocytosis of named substance **;** **5** endocytosis / phagocytosis **;** **6** spindle fibre / chromosome / chromatid, (movement) during, mitosis / meiosis **;** **7** cilia / flagella, wafting / beating / AW **;** **I** movement	**2**

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Question	Answer	Marks
2(a)(ii)	correct working ; e.g. $\frac{150}{0.2} = 750$ then $\frac{750}{24}$ **or** $\frac{150}{24} = 6.25$ then $\frac{6.25}{0.2}$ **or** $\frac{149.8}{0.2} = 749$ then $\frac{749}{24}$ 31 ;	**2**
2(a)(iii)	(respiration) oxidative phosphorylation ; (photosynthesis) photophosphorylation / light dependent stage ;	**2**
2(b)(i)	**1** reduces ATP synthesis / less ADP reacts with P_i ; *any **two** from:* **2** protons diffuse through thermogenin ; **3** proton gradient reduced / reduces concentration of H^+ in intermembrane space ; **4** fewer protons pass through ATP synthase ;	**3**
2(b)(ii)	*any **three** from:* **1** adrenaline binds to receptor on the cell surface membrane (of brown fat cells) ; **2** G-protein / adenyl(yl) cyclase, activated ; **3** *ref. to* cAMP / second messenger, (is formed) ; **4** *ref. to* enzyme cascade / signal amplification / activation of kinase / signalling cascade ; **5** activation of lipase by phosphorylation ;	**3**

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Question	Answer	Marks
3(a)(i)	*any **three** from:* **1** multicellular **;** **2** have, specialised cells / tissues / organs **;** **3** heterotrophic / described **;** **4** *ref. to* nervous system **;** **5** vacuoles / vesicles, are, small / temporary / not permanent **;** **6** are eukaryotes / have eukaryotic cells **;** **7** detail of eukaryote **;** e.g. nucleus / (named) membrane-bound organelle / 80s ribosomes **8** *ref. to* mobility **;**	**3**
3(a)(ii)	*any **three** from:* **1** records / assesses, biodiversity **;** **2** so conservation decisions can be made / AW **;** **3** example of conservation action 1 **;** **4** example of conservation action 2 **;** e.g. (IUCN) red list of threatened species / identifying endangered species (CITES) regulation of trade ref. assisted reproduction or ref. captive breeding seed banks place in, zoos / national parks / marine parks / botanical gardens **5** (taxonomic hierarchy is) internationally, recognised / standardised / AW **;**	**3**

Question	Answer	Marks
3(a)(iii)	*any **two** from:* **1** (**yes** because as number of species has increased) biodiversity has increased **;** **2** (*idea of* **no** because) numbers of new species that are being discovered are greater than the numbers of species becoming extinct **;** **3** (*idea of* **no** because) does not assess number of individuals in a species **;** **4** AVP **;** e.g. some species only exist in captivity	**2**
3(a)(iv)	*insects* $\frac{1024\,945}{1438\,805}(\times 100)$ **;** 71 **;** *ecf – accept 1 mark if wrong data chosen* e.g. $\frac{\text{insects}}{\text{arthropods}}$ $\frac{1024\,945}{1191770}(\times 100) = 86$ $\frac{\text{arthropods}}{\text{animals}}$ $\frac{1191770}{1438\,805}(\times 100) = 83$	**2**
3(b)(i)	*any **two** from:* **1** habitat loss / habitat fragmentation / urbanisation / building / deforestation **;** **2** insecticides / pesticides / farming / agriculture / fertilizers **; I** pollution **3** new / increase in, predators / diseases / parasites **;** **4** food shortage / increased competition (for food) **;**	**2**

Question	Answer	Marks
3(b)(ii)	*any **two** from:* **1** Bt toxin (only) kills, specific insects / insects that feed on the crops **;** **2** reduces use of, insecticides / pesticides **;** **3** *idea that* insects survive to pollinate plants **;**	**2**

Question	Answer	Marks
4(a)	*diabetes:* insulin from (GM) bacteria **;** **A** ref to, yeast / animal cells *single gene disorder:* gene therapy **or** insert, functional / normal / dominant, allele into, target / somatic / stem, cells **or** genome **;** **A** gene **R** *replacing one allele with another*	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(b)(i)</td><td>

*any **four** from:*

valid

1 GM spinach decreases number of, bacteria / *E.coli*
or
GM spinach has lowest number of, bacteria / *E.coli* **;**

2 at all times (meat is stored)
or
the longer the time stored the more effective it is
or
most effective after 72 hours **;**

3 data quote comparing no treatment or buffer alone with GM spinach extract at stated time **;**

<table>
<tr><th>time / hrs</th><th>no treatment</th><th>buffer alone</th><th>buffer plus GM spinach</th></tr>
<tr><td>1</td><td>3.7–3.8</td><td>3.8–3.9</td><td>1.4–1.5</td></tr>
<tr><td>24</td><td>3.2–3.3</td><td>3.5–3.6</td><td>0.5–0.6</td></tr>
<tr><td>72</td><td>2.6–2.7</td><td>3.3–3.4</td><td>0.1–0.2</td></tr>
</table>

not valid

4 no treatment / buffer alone, (also) decrease number of, bacteria / *E.coli*
or
GM spinach does not kill **all**, bacteria / *E.coli* **;**

5 meat should not normally be left at 10°C
or
people unlikely to eat meat left at, 10°C / for 72 hours **;**

6 does not test effect on people / AW **;**

</td><td>**4**</td></tr>
</table>

Question	Answer	Marks
4(b)(ii)	*any **three** from:* **1** may alter, taste / texture / quality, of meat **;** **2** may be unsafe for humans / allergies / side effects **;** **3** may harm, gut / beneficial, bacteria **or** may increase growth of, non-colicin sensitive / other, bacteria **;** **4** contaminate food labelled as organic / AW **;** **5** *E.coli* / bacteria, may develop resistance to, (spray / colicins) **;** **R** GM spray / colicins, cause mutation **6** AVP **;** e.g. may decrease food hygiene practices in, meat factories / abattoirs / restaurants / food outlets **;**	**3**

Question	Answer	Marks
5(a)(i)	*mark first two answers* ATP **;** reduced NADP **; A** NADPH	**2**
5(a)(ii)	*any **two** from:* **1** an accessory pigment **;** **2** absorb, light (energy) / photons **; A** harvest **I** trap / capture **3** pass on <u>energy</u> to, primary pigment / chlorophyll a / reaction centre **;** **4** AVP **;** e.g. *idea of* extending the range of light wavelengths absorbed / absorbs wavelengths not absorbed by primary pigment	**2**

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Question	Answer	Marks
5(b)	100 **;**	**1**
5(c)(i)	**1** 0 – 400 **;** **A** up to 400 **I** units *any **two** from:* **2** temperature / <u>concentration</u> of carbon dioxide, becomes the limiting factor **;** **3** (at a lower than optimum temperature) less kinetic energy so fewer collisions between rubisco and CO_2 **or** a lower temp will limit the rate of (named) enzyme-controlled reactions **;** **4** (with a lower than optimum CO_2 concentration) less fixation of CO_2 / AW **;** **5** all, enzymes / processes, in photosynthesis, already at, highest rate / optimum **or** maximum amount of light is being absorbed (by the pigments) **;**	**3**
5(c)(ii)	*any **three** from:* **1** different wavelengths of light absorbed by different pigments **;** **2** red light is absorbed the most **;** **3** green light is, absorbed less / reflected **;** **4** shorter the wavelength the greater the energy / red light has more energy (than blue light) **; ora** **5** the more, light / energy, absorbed the more, light dependent reaction / photophosphorylation, occurs **; ora**	**3**

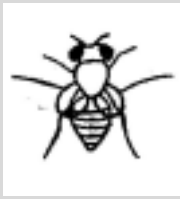
Question	Answer	Marks
6(a)(i)	(glyco / lipo) protein **;**	**1**
6(a)(ii)	blood **;**	**1**
6(b)	glycogenolysis / described **;** gluconeogenesis / described **;** e.g. glucose from, amino acids / fatty acids	**2**
6(c)	to reduce ingestion of food **or** binds to receptor(s) in brain **;**	**1**
6(d)	*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**

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Question	Answer	Marks
6(e)	*any **two** from:* **1** frameshift / described **;** **2** different primary structure / shortened polypeptide **;** **3** TF non-functional / TF cannot bind to, DNA / promoter **or** TF not produced **;** **4** gene coding for GLP-1 not expressed **;** *plus* **5** less / no, GLP-1, produced / secreted **;**	**3**

Question	Answer	Marks
7(a)	*allele* – variety / form, of a gene **;** *dominant* –(allele) always expressed / always has effect on the phenotype / expressed in heterozygote / has effect on the phenotype of heterozygote **;**	**2**

Question	Answer	Marks
7(b)(i)		**5**

	wild type parent		**double homozygous recessive parent**		
parental phenotype	red eye, long wing		purple eye, vestigial wing		;
parental genotype	**RrNn**		**rrnn**		;
offspring					
offspring phenotype	red eye, long wing	purple eye, vestigial wing	red eye, vestigial wing	purple eye, long wing	;
offspring genotype	**RrNn**	**rrnn**	**Rrnn**	**rrNn**	;;
numbers of offspring	1339	1195	151	154	

offspring genotypes – 4 correct = 2 marks, 3 correct = 1 mark
allow short wing for vestigial wing
allow alleles in any order in genotypes
ignore brackets and circles around alleles

Question	Answer	Marks
7(b)(ii)	*any **three** from:* **1** (two) genes are linked / autosomal linkage **or** alleles inherited together **;** **2** no, independent / random, assortment **;** **3** large numbers of parental type offspring / small numbers of recombinant offspring **;** **4** recombinants due to crossing over **;** **5** during, meiosis / prophase 1 / gamete formation **;**	**3**

Question	Answer	Marks
8(a)	**1** different alleles at a single gene locus have small effects (on the phenotype) **;** **2** different genes may have an, additive / combined, effect (on the phenotype) **;** **3** *ref. to* multiple genes / polygenes / description **;**	**3**
8(b)	*any **two** from:* **1** quantity / availability, of, food / nutrients **; A** competition for food **2** quality of food / malnutrition **;** **3** disease **;** **4** temperature **;**	**2**

Question	Answer	Marks
8(c)	*any **four** from:* **1** humans apply selection pressure **;** **2** select parents that show desired characteristic **; R** gene / allele **3** breed these parents together **; R** IVF **ignore** AI **4** select offspring with desired characteristics **;** **5** breed selected offspring **;** **6** repeating over many generations **;** **7** AVP **;** e.g. some outbreeding required to avoid, inbreeding depression / combining harmful recessive alleles	**4**

Question	Answer	Marks
9(a)	*any **nine** from:* **1** (function is) to make ATP **;** **2** *ref. to* double membrane / outer and inner membrane / envelope **;** *inner membrane* **3** folded / cristae, to increase / for large, surface area **;** **4** has, ATP synthase / stalked particles **;** **5** has, ETC / carrier (proteins) / cytochromes **;** **6** (site of) oxidative phosphorylation / chemiosmosis **;** **7** impermeable to protons **;** *intermembrane space* **8** has low pH / high concentration of protons **;** **9** protons pumped into intermembrane space **;** **10** proton gradient between intermembrane space and matrix **or** protons diffuse from intermembrane space to matrix **;** *matrix* **11** contains (co)enzymes for, link reaction / the Krebs cycle **;** *outer membrane* **12** permeable to, pyruvate / reduced NAD / oxygen **;** **13** AVP **;** e.g. ribosomes / DNA, involved in protein synthesis	**9**

Question	Answer	Marks
9(b)	*any **six** from:* **1** aerenchyma **;** **2** in stem **and** roots **;** **3** help oxygen to, move / diffuse, to, roots / submerged parts **;** **4** shallow roots **;** **5** air (film) trapped on underwater leaves / described **;** **6** greater internode growth **or** leaves or flowers grow above water level **;** **7** (growth regulated by) gibberellin / ethene **;** **8** anaerobic respiration, in roots / underwater / when submerged **; A** alcoholic fermentation **9** tolerant to high ethanol (concentration) **;** **10** *ref. to* ethanol / alcohol, dehydrogenase **;**	**6**

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Question	Answer	Marks
10(a)	*any **nine** from:* *gene mutation* **1** base substitution **;** **2** (often) does not have a significant effect on phenotype / silent mutation **;** **3** base, insertion / deletion leads to, frame shift / described **;** **4** (so) has significant effect on phenotype **;** **5** change in, primary structure / amino acid sequence / polypeptide made **;** **6** change in, tertiary structure / 3D shape / folding **;** **7** loss of function in protein or enzyme / example described **;** **8** (premature) stop codon **;** *Huntinton's disease* **9** (mutant allele) is dominant **;** **10** HD / dominant, allele has more repeats of base triplet CAG (than normal) **;** **11** heterozygote will have disease **;** **12** <u>brain</u> cells die more rapidly (than normal) / <u>brain</u> degeneration **;** **13** involuntary movements / mental deterioration or described / mood changes **;** **14** onset in middle age / *idea that* no change in phenotype in earlier life **;** **15** AVP **;** e.g. greater number of CAG repeats affects, earlier onset / severity of disease	**9**

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Question	Answer	Marks
10(b)	*any **six** from:* **1** DELLA proteins inhibit, transcription factor / PIF**;** **2** gibberellin binds to receptor **;** **3** in aleurone layer **;** **4** *ref. to* enzyme involved **;** **5** DELLA proteins broken down **;** **6** TF / PIF, binds to promoter region (of DNA) **;** **7** transcription of **gene** coding for amylase / AW **;** **8** *ref. to* translation (leading to amylase production) **;**	**6**

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