CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **February/March 2024**

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 February/March 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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PUBLISHED

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 descriptions 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 normal)
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
( )	the word / phrase in brackets is not required, but sets the context

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Question	Answer	Marks
1(a)	**A** – label line to collecting duct **;** **B** – label line to **inner** part of Bowman's capsule **;** **C** – label line to, loop of Henle / part of collecting duct below level of convoluted tubules **;** **D** – label line to wider blood vessel entering Bowman's capsule **;**	**4**
1(b)	*any **four** from:* 1 microvilli, for large surface area / increases surface area (for reabsorption) **;** 2 cotransporter (proteins) for movement of, glucose / amino acids (with sodium ions) **;** 3 tight junctions / described, to, stop substances passing in between cells / cause substances to pass though cells **;** 4 **many** mitochondria to provide ATP for, active transport / pumping of Na^+ **;** 5 folded basal membrane for many sodium (potassium) pumps **;**	**4**

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Question	Answer	Marks
2(a)	*any **four** from*: 1 test cross **;** 2 cross (tall plant) with dwarf plant **;** 3 (dwarf plant must be) *le le* / homozygous recessive **;** 4 if all offspring are tall then parent plant is, *Le Le* / homozygous dominant **;** 5 if offspring are 1:1 tall:dwarf / if any offspring are dwarf, then parent plant is, *Le le* / heterozygous **;** 6 AVP **;** e.g. detail of breeding experiment cross pollination, seed harvesting, seed germination	**4**
2(b)(i)	hormone / cell signalling (molecule) **; A** ligand / plant growth regulator	**1**
2(b)(ii)	1 (causes) cell elongation **; A** increases cell, division / mitosis 2 *idea that* plant / stem, grows taller **;**	**2**

Question	Answer	Marks
3(a)	1 both alleles of a, gene / genotype, are the same **;** 2 **phenotype** / effect, of (recessive) allele is masked by a dominant allele **or** two copies of the (recessive) allele are needed for **phenotype** to be displayed **or** alleles only affect the **phenotype** in the absence of a dominant allele **or** (genotype) must be homozygous for the (recessive) allele to affect the **phenotype ;**	**2**

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Question	Answer	Marks
3(b)(i)	number of heterozygous people = 1 680 000 **; ; ;** must be to 3 significant figures or more **A** 1 675 000 to 1 685 000 **; ; ;** **R** 1 700 000 max 2 if decimal places in final answer ***allow*** *max 2 for working if final answer incorrect* ($q = \sqrt{10\,800 / 67\,100\,000}$ or $\sqrt{0.000161}$ or 0.0127) $p = 1 - 0.0127$ or 0.987 ($2pq = 2 \times 0.9873 \times 0.0127$ or 0.0251) calculation for number of heterozygous people = $67\,100\,000 \times 0.0251$ or $2pq$	**3**
3(b)(ii)	*any* ***three*** *from*: 1 ref. natural selection **;** 2 selection pressure against cystic fibrosis (CF) **;** 3 (people with) CF do not survive as long / AW **;** 4 heterozygotes are calculated from a smaller CF population / AW **;** 5 (some) people with CF who have died will have passed on CF allele **;**	**3**

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Question	Answer	Marks
3(c)(i)	*any **three** from*: 1 (median) predicted life expectancy increased (over time) **;** 2 data quote **;** e.g. from 2008 to 2020 increase from 38.8 to 50.6 years increase of 11.8 % increase of 30.4 3 treatment can be started **early ;** 4 better treatment / improved care (between 2008 and 2020) **;**	**3**
3(c)(ii)	*any **three** from*: 1 reduces worry / AW, if result is negative **; ora** 2 can make informed reproductive decisions / AW **;** 3 cost / availability, of test **;** 4 plan for care of child with CF **;** 5 *idea of* further genetic testing **;** e.g. counselling / testing of embryo / testing of partners 6 *idea that* test is not 100% accurate **;** 7 problems related to, stigma / discrimination / insurance / confidentiality **;**	**3**

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Question	Answer	Marks
4(a)	1 temperature increases **and** milk yield decreases **;** 2 comparative data quote – April = 10 °C and 792–798 kg cow^{-1}, August = 18 °C and 711–716 kg cow^{-1} **;**	**2**
4(b)	1 continuous **and** (milk yield) does not fall into distinct classes / shows a range / intermediates / no distinct categories / AW **;** 2 environment **and** (milk yield) affected by air temperature **;** 3 genetic / polygenic **and** many / 20, genes have effect (on milk yield) **or** heat-tolerant cattle have lower milk yield than Holstein Friesian cattle **;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(c)</td><td>
any three from:

1 SLICK allele increases milk yield (in both months / at both temperatures) ;

2 in March / at 5 °C, there is a small difference (between milk yield) ;

3 in September / at 14 °C, there is a larger difference (between milk yields) ;

4 cattle with SLICK allele maintain milk yield
(in both months / at both temperatures) ;

5 comparative data quote to support mp1–mp4 ;

<table>
<tr><td>Month</td><td>Holstein without SLICK / kg cow^{-1}</td><td>Holstein with SLICK / kg cow^{-1}</td></tr>
<tr><td>March / at 5 °C</td><td>780–785</td><td>795–800</td></tr>
<tr><td>Sept / at 14 °C</td><td>690–700</td><td>770–780</td></tr>
</table>
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
4(d)	*any **six** from:*	**6**

	gene editing		***selective breeding***	
1	(first) offspring have *SLICK* allele			;
2	can have, negative / unknown, effects			;
3	presence of *SLICK* allele (in offspring) can be confirmed by, genetic testing / phenotypic observation			;
4	done by humans / artificial methods			;
5	**only**, *PRLR* / one, gene is affected	**and**	affects many genes	;
6	**all** offspring have SLICK allele	**and**	**some** offspring have SLICK allele	;
7	immediate / one generation	**and**	performed over (many) **generations**	;
8	performed on, embryos / zygotes / cells	**and**	mating / artificial insemination	;
9	technical requirements e.g. laboratory, training, molecular method	**and**	mating / performed on the farm e.g. physiological method	;
10	maintains, heterozygosity / genetic variation / desirable characteristics	**and**	loss of, heterozygosity / genetic variation / desirable characteristics	;
11	regulatory approval	**and**	no regulatory approval	;
12	no outbreeding required	**and**	outbreeding required	;

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Question	Answer	Marks
5	(many) generations / (many) years / (a long) time / AW **;** mutations / similarities **;** meiosis / crossing over / recombination **;** databases **;** amino acid **;** microarray **;**	**6**

Question	Answer	Marks
6(a)	absorb carbon dioxide (produced by peas) **;**	**1**
6(b)	*any **two** from:* 1 *idea of* repeatability **;** 2 check to see how consistent the results are / the more consistent the results, the more valid the results / carry out a (named) statistical test or measure / calculate standard deviation / calculate standard error **;** 3 a control respirometer / described **;** e.g. with glass beads instead of peas 4 ref. to checking variables (other than temperature) **;** e.g. volume of germinating peas / volume / concentration of KOH	**2**
6(c)	acclimatisation / equilibration / AW **;**	**1**

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Question	Answer	Marks
6(d)	5 points plotted accurately **;** smooth curve drawn linking all plotted points / curve of best fit **;** **R** extrapolation	**2**
6(e)	*any **three** from:* 1 ref to enzymes **;** 2 (as temperature increases) kinetic energy increases **;** 3 (so) rate increases, due to **more** enzyme-substrate complexes formed (in same time) **or** (so) rate increases, due to higher, proportion / frequency, of, successful / effective, collisions **;** 4 (rate decreases after 30 °C) due to denaturation of enzymes **;** 5 further detail **;** e.g. active site shape change / ref. optimum temperature	**3**

Question	Answer	Marks
7(a)(i)	light not absorbed / stop photosynthesis / stop photoactivation / stop light dependent stage **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)(ii)</td><td>
any three from:

1 all decrease in absorbance (with time) ;

2 (all decrease) at constant rate ;

3 green, highest absorbance (throughout) /
absorbance stays fairly constant / smallest decrease in absorbance ;
ora red

4 smallest rate of decrease in green ; ora red

5 data quote – 2 colours compared to support mp1 or mp3 ;

<table>
<tr><td></td><td>4 mins</td></tr>
<tr><td>green</td><td>1.44</td></tr>
<tr><td>blue</td><td>0.90</td></tr>
<tr><td>red</td><td>0.70</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>7(a)(iii)</td><td>
any three from:

with red light ora green light

1 more, light / energy, absorbed (by chlorophyll) ;

2 (so) more, photoactivation / electrons emitted ;

3 more / faster rate of, electrons transferred to DCPIP ;

4 more / faster, decolourisation of DCPIP ;
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
7(b)		**3**

factor	stage	✓or ×	
carbon dioxide concentration	Calvin cycle	✓	;
	photophosphorylation	×	
light intensity	Calvin cycle	×	;
	photophosphorylation	✓	
temperature	Calvin cycle	✓	;
	photophosphorylation	✓	

Question	Answer	Marks
8(a)(i)	chemoreceptor **;**	**1**
8(a)(ii)	*any **two** from:* 1 (different mycobacterial species produce) the same / similar, chemicals / proteins **;** 2 (since) share common ancestors / same genus / share many genes / closely related **;** 3 **same** chemoreceptors stimulated **;**	**2**

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Question	Answer	Marks
8(b)		**2**

kingdom	Animalia
phylum	Chordata
class	Mammalia
order	Rodentia
family	Nesomyidae
genus	***Cricetomys***
species	*gambianus*

4 correct = 2 marks
1 / 2 / 3 correct = 1 mark

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(c)</td><td>
any four from:

comparative statements required

<table>
<tr><td></td><td>Eukarya</td><td></td><td>Bacteria</td><td></td></tr>
<tr><td>1</td><td>linear DNA</td><td>and</td><td>plasmids / circular DNA</td><td>;</td></tr>
<tr><td>2</td><td>histones</td><td>and</td><td>no histones</td><td>;</td></tr>
<tr><td>3</td><td>cell walls only in some</td><td>and</td><td>cell walls in all</td><td>;</td></tr>
<tr><td>4</td><td>cellulose / chitin, cell walls</td><td>and</td><td>peptidoglycan cell wall</td><td>;</td></tr>
<tr><td>5</td><td>divide by mitosis</td><td>and</td><td>divide by binary fission</td><td>;</td></tr>
<tr><td>6</td><td>some sexual reproduction</td><td>and</td><td>asexual reproduction</td><td>;</td></tr>
<tr><td>7</td><td>(70S and) 80S ribosomes</td><td>and</td><td>70S ribosomes (only)</td><td>;</td></tr>
<tr><td>8</td><td>have cells > 5 μm diameter</td><td>and</td><td>cells1–5 μm diameter</td><td>;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>8(d)</td><td>
any two from:

1 have DNA or RNA ;

2 nucleic acid is double or single stranded ;

3 AVP ; e.g.presence or absence of phospholipid envelope
presence or absence of tail sheath
type of host
type of disease caused
</td><td>2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(a)</td><td>
any four from:

1 (blue) light decreases germination / AW ;

2 as intensity of (blue) light increases percentage germination decreases ;

3 data quote ;

<table>
<tr><th>light intensity / arbitrary units (au)</th><th>percentage germination</th></tr>
<tr><td>0 (dark)</td><td>98.0</td></tr>
<tr><td>36</td><td>76.9</td></tr>
<tr><td>48</td><td>45.0</td></tr>
<tr><td>57</td><td>14.7</td></tr>
</table>
4 (blue) light increases (the concentration of) ABA ;

5 ABA inhibits gibberellin (synthesis / activity) ;

6 any further valid suggestion of ABA action ;
e.g. DELLA not broken down / promotes dormancy / stops gene expression
</td><td>4</td></tr>
</table>

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Question	Answer	Marks
9(b)	*any **seven** from:* 1 auxin binds to receptor on the cell surface membrane **;** 2 stimulates proton pumps **;** 3 protons move from, cytoplasm / cell, to cell wall **;** 4 pH of cell wall decreases **;** 5 expansins activated **;** 6 loosens linkage between cellulose microfibrils **;** 7 by breaking hydrogen bonds **; Ignore** weakening bonds 8 K^+ channels open **;** 9 K^+ diffuse into, cytoplasm / cell **;** 10 water potential (of cytoplasm / cell) decreases **;** 11 water enters by osmosis **;** 12 increase in turgor pressure / volume of cell increases **;**	**7**

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Question	Answer	Marks
10(a)	*any **four** from:* 1 **troponin** binds Ca^{2+} and changes shape **;** 2 (so) **tropomyosin** moves away from the binding sites on **actin ;** 3 **myosin heads**, bind to / form cross-bridges, with **actin ;** 4 **myosin head**, pulls **actin** / performs power stroke, to, **either** shorten / contract, sarcomere **or** cause Z lines to move closer together / Z lines move closer to M lines **;** 5 **myosin head,** is ATPase / binds to ATP, to allow detachment **;**	**4**
10(b)	*any **three** from:* 1 succinylcholine binds to ACh receptors **or** succinylcholine acts as a competitive inhibitor **;** **R** if binds to active site of receptor 2 (sodium ions) channel proteins do not open **; R** if voltage gated 3 sodium ions do not enter, muscle cell / sarcoplasm **;** 4 sarcolemma / post-synaptic membrane, not depolarised **;**	**3**

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Question	Answer	Marks
10(c)	*any **three** from:* 1 sex-linked / **gene** on X chromosome **;** 2 recessive (allele) **;** 3 males only have one, copy of gene / allele / X chromosome **;** 4 female heterozygotes, do not have DMD / are carriers **or** only homozygous females have DMD **;**	**3**

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