CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 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 May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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.

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.

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 point
A	accept (for answers correctly cued by the question, or by extra guidance)
R	reject
I	ignore
( )	the word / phrase in brackets is not required, but sets the context
AW	alternative wording (where responses vary more than usual)
underline	actual word given 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 (with relevant number)
ecf	error carried forward
AVP	alternative valid point

Question	Answer	Marks
1(a)	**A** – G protein **;** **B** – cyclic AMP / cAMP **;** **C** – aquaporin **; I** water channel	**3**
1(b)	*any **three** from:* 1 dehydration / not drinking enough water **;** 2 ingesting salty food / description **;** 3 more, ions / glucose / amino acids / solute, (in blood) **;** 4 sweating / perspiration / evaporation (of water) **;** 5 AVP **;** e.g. disease where ADH is not, made / secreted	**3**
1(c)	*any **two** from:* 1 increase in / large, urine volume **or** more frequent urination **or** dilute / less concentrated, urine **;** 2 fatigue **;** 3 feelings of thirst / dry mouth **;** 4 AVP **;** e.g. dehydration change in blood pressure	**2**

Question	Answer	Marks
1(d)	*any **two** from:* 1 few / no, aquaporins added to membrane / **P ;** 2 reduced / low, permeability of, membrane / **P**, to **water ; R** impermeable to water 3 less water moves through, membrane / **P ;** **ecf** for mp1 if **C** named as water channels in 1(a)	**2**
1(e)	*(gene is on X chromosome)* X (chromosome with recessive allele) inherited from mother **;** Y (chromosome) inherited from father **;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
<table>
<tr><th>description of phenotypic variation</th><th>cause of variation</th></tr>
<tr><td>Tomato plants grown in a glasshouse and grown outside vary in the yield of tomatoes they produce. Seventeen genes associated with tomato yield have been identified.</td><td>$V_G + V_E$</td></tr>
<tr><td>New strawberry plants from the variety called Sweet Ann are made by asexual reproduction. The new plants grow to different sizes and produce different numbers of fruit.</td><td>V_E</td></tr>
<tr><td>The domestic cat has a blood group system with three possible blood types: A, B and AB. The blood types are determined by antigens present on the cell surface membrane of red blood cells.</td><td>V_G</td></tr>
<tr><td>Over 50 genes have variants that are associated with excessive weight-gain in humans. Other risk factors for excessive weight-gain include diet and exercise.</td><td>$V_G + V_E$</td></tr>
<tr><td>Resting heart rate in humans varies between different individuals. Some factors that influence resting heart rate include: biological sex, family history of heart disease, number of cigarettes smoked, medication taken.</td><td>$V_G + V_E$</td></tr>
</table>
five correct = 3 marks **;;;**

four or three correct = 2 marks

two or one correct = 1 mark</td><td>**3**</td></tr>
<tr><td>2(b)</td><td>mutation **;**</td><td>**1**</td></tr>
</table>

Question	Answer	Marks
2(c)	*any **three** from:* 1 crossing over **;** 2 independent / random, assortment **;** 3 random, fusion of gametes / fertilisation **;** 4 random mating **;**	**3**
3(a)(i)	Ttdd and TTdd **;**	**1**
3(a)(ii)	13:3 **;**	**1**
3(a)(iii)	epistasis **;**	**1**
3(a)(iv)	*any **five** from:* 1 dominant allele / T / D, results in a functional protein **;** 2 two recessive alleles / tt / dd, results in a non-functional protein **;** 3 *T* could code for an enzyme **;** 4 (so enzyme catalyses) production of, malvidin / pigment **;** 5 *D* could code for an inhibitor **;** 6 (inhibitor) binds to enzyme (coded for by) gene *T*/*t* **;** 7 (so) reaction to produce, malvidin / pigment, does not occur **;** 8 protein (coded by T / t) could be a transcription factor **;** 9 transcription factor allow the production of enzyme (needed in the metabolic pathway) **;** 10 protein (coded by *D*/*d*) could cause the inhibition of transcription factor **;**	**5**

Question	Answer	Marks
3(b)	*any **four** from:* 1 located on X chromosome / sex-linked **;** 2 *ref. to* recessive allele **;** 3 non-functioning, factor VIII / protein **or** less, factor VIII / protein **or** no, factor VIII / protein **;** 4 (so) blood does not clot quickly enough / excessive bleeding occurs (after an injury) **;** 5 link the phenotype to the genotype **;** e.g. X^FX^F = normal female X^FX^f= normal female X^fX^f= affected female X^FY = normal male X^fY = affected male 6 AVP **;** e.g. prevents activation of thrombin / fibrinogen not converted to fibrin / *ref. to* mostly males affected /different mutations cause a range of severity of haemophilia	**4**
4(a)(i)	*restriction endonuclease* 1 cuts, DNA / plasmid **;** *DNA ligase* 2 joins DNA with the plasmid **;** *DNA polymerase* 3 forms dsDNA **or** makes a complementary DNA strand **;** r*everse transcriptase* 4 uses mRNA (as a template) to make, cDNA / complementary (ss)DNA **; R** converts	**4**

Question	Answer	Marks
4(a)(ii)	*any **three** from* 1 for transcription factor(s) to bind **;** 2 for RNA polymerase to bind **;** 3 (so) gene is, expressed / switched on / activated / transcribed **;** 4 to, increase / control, transcription of the, gene of interest / marker gene**;** 5 to cause transcription with a specific environmental change **; A** inducible promoter 6 AVP **;** e.g. choose promoter to give transcription in, all tissues / all developmental stages	**3**
4(b)	plasmid **X** - no insulin because the gene is, inserted backwards / the wrong way around **;** plasmid **Y** - produces insulin because the gene, is inserted the correct way around / AW **;** plasmid **Z** - no insulin because, the gene was not inserted / the plasmid closed up / it is a non-recombinant plasmid **;**	**3**
5(a)	crossing over **; A** chiasma formation	**1**

Question	Answer	Marks
5(b)(i)	*any **three** from:* 1 mutation occurred a long time ago **or** someone in original population had mutation **or** mutation in common ancestor **;** 2 *ref. to*. founder effect **;** 3 (original / current) population is small **;** 4 *idea that* much of the population is closely related **or** small gene pool / low genetic diversity **; A** inbreeding 5 *ref. to* isolated (population) **;** 6 (caused) increase in frequency of, mutation / 999del5 / *BRCA2* allele **;**	**3**
5(b)(ii)	*any **three** from:* 1 reduce worry if negative **;** *(if positive)* 2 lifestyle changes / described **;** 3 early treatment / breast removal / can have frequent checks **;** 4 informed decision about having children **;** 5 *ref. to* counselling **;** 6 could lead to lower death rates from breast cancer **;**	**3**

Question	Answer	Marks
5(b)(iii)	*any **one** from:* 1 only screen for mutations that occur with high frequency in a population (as opposed to hundreds of mutations) **;** 2 cost effective **;** 3 early diagnosis / early treatment / targeted treatment **;** 4 identifies mutation known to increase the risk of developing breast cancer (as opposed to a neutral mutation) **;** 5 could lead to lower death rates from breast cancer **;**	**1**
5(c)(i)	*any **two** from:* 1 it, inserted / deleted / replaced, DNA (in, *Lcn2* / regulatory sequence) **;** 2 (so) transcription of, *Lcn2* / gene, prevented **;** 3 (replaced mutated section of DNA) with correct sequence **;**	**2**
5(c)(ii)	only specific, sites / sequences, (on DNA targeted) **or** target site on DNA only found in *Lcn2* **;**	**1**
6(a)	*any **three** from:* 1 need to open to obtain carbon dioxide for, photosynthesis / Calvin cycle **;** 2 need to close to prevent water loss by, transpiration / described **;** 3 can close, at night / when dark, (to save water) as no photosynthesis **;** AW 4 must close to prevent water loss when, high light intensity / high temperatures / high wind speed / water stress / drought conditions **;**	**3**

Question	Answer	Marks
6(b)	*any **six** from:* 1 H^+, pumped / moved by active transport, out (of guard cells) **;** 2 decrease in H^+ inside (of guard cells) / proton gradient set up / AW **;** 3 K^+ channels open / K^+ enters (guard cells) **;** 4 water potential (in guard cells), decreases / lowers / becomes more negative **;** 5 water enters (guard cells) by, osmosis / down the water potential gradient **;** 6 cells, expand / become (more) turgid **;** 7 outer wall thinner to allow (more), stretching / bending **or** inner wall thicker to allow less, stretching / bending **;** 8 AVP **;** e.g. light activates, ATP production / proton pump sentry of, chloride ions / Cl^- (in addition to K^+) / entry of water via aquaporins *max 3 if stomatal closure described*	**6**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)(i)</td><td>
<table>
<tr><th>light intensity / lux</th><th>total CO_2 uptake after 20 seconds / µmol</th><th>rate of photosynthesis / $µmols^{-1}$</th></tr>
<tr><td>0</td><td>0</td><td>0.0</td></tr>
<tr><td>3</td><td>20</td><td>10</td></tr>
<tr><td>6</td><td>44</td><td>22 ;</td></tr>
<tr><td>9</td><td>72</td><td>36</td></tr>
<tr><td>12</td><td>80</td><td>40</td></tr>
</table>
</td><td>1</td></tr>
<tr><td>7(a)(ii)</td><td>five points plotted correctly ;

best fit curve drawn for plots ;

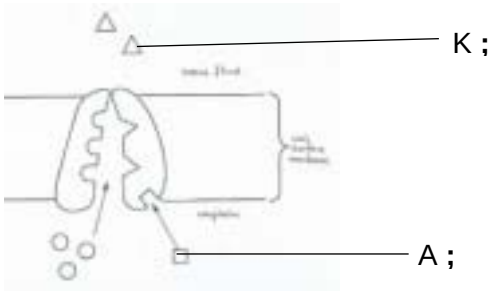
curve levels off from 12 lux to 18 lux
or
curve continues up at smaller gradient ;</td><td>3</td></tr>
<tr><td>7(a)(iii)</td><td>curve levels off from 12 lux to 18 lux
1 because light <u>intensity</u> no longer limiting ;

2 temperature / carbon dioxide <u>concentration</u>, now limiting ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
7(b)	*any **four** from:* 1 electrons, excited / emitted / described **;** 2 electrons travel along ETC **and** energy released **;** 3 (use energy released) to pump H^+ into thylakoid, space/ lumen **;** 4 increases concentration of H^+ / protons (in thylakoid space / lumen) / creates proton gradient **;** 5 H^+ / protons, diffuse through ATP synthase **;** 6 (from thylakoid space) to stroma **;** 7 chemiosmosis **;**	**4**

Question	Answer	Marks
8(a)	*any **four** from:* *outer / inner membranes* 1 allow entry of, oxygen for oxidative phosphorylation / pyruvate for link reaction **;** **I** Krebs cycle 2 allow exit of carbon dioxide from, Krebs cycle / link reaction **;** 3 compartmentalisation / described **;** *inner membrane* 4 (location of) ETC to release energy to pump protons into intermembrane space **;** 5 (location of) ATP synthase for production of ATP **;** 6 cristae / infoldings, to increase surface area for many, ETCs / ATP synthases **;** 7 impermeable to, hydrogen ions / protons, to maintain proton gradient **or** impermeable to, hydrogen ions / protons, to maintain, high H^+ concentration in intermembrane space **;** 8 site of, oxidative phosphorylation / chemiosmosis **;**	**4**
8(b)(i)	*any **two** from:* 1 *ref. to* cells, metabolic rate / energy needs **;** 2 in cells about to undergo, mitosis / cell division **;** 3 AVP **;** e.g. to replace damaged mitochondria	**2**
8(b)(ii)	hydrolysed / bond broken, (to release energy) **or** G proteins bind to GTP rather than to ATP **;**	**1**
8(c)	1 degraded / broken down by, lysosomes / hydrolytic enzymes **;** 2 components of breakdown / AW, used to produce new mitochondria **;**	**2**

Question	Answer	Marks
9(a)(i)	367 (%) **;;** allow 1 mark for: $\frac{(738-540)}{540} \times 100$ **or** 36.66666667	**2**
9(a)(ii)	*any **four** from:* 1 increase in temperature / global warming **;** 2 sea levels increase **;** 3 habitat change / example **;** e.g. forest fires / ocean acidification 4 food web / food chain / ecosystem, disrupted **;** 5 change in biodiversity **;** 6 *ref. to* extinction **;** 7 AVP **;**	**4**

Question	Answer	Marks
9(b)	*any **four** from:* 1 may have future use **;** 2 aesthetic / ethical / cultural, reasons **;** 3 medical uses / example **;** 4 ecotourism **;** 5 *idea of* maintaining stability in, ecosystems / food chains / food webs **;** 6 resource material **;** e.g. wood for building / fibres for clothes / food (for humans) / agriculture 7 maintain / increase, gene pool / genetic diversity **;** 8 *ref. to* soil stability / desertification **;**	**4**
10(a)	 K **;** A **;**	**2**

Question	Answer	Marks
10(b)	*any **four** from:* 1 sodium (ion) channels open **or** Na^+ enters (axon) **;** 2 (so) membrane <u>depolarised</u> **;** 3 *ref. to* threshold (potential) reached (for action potential to occur) **;** 4 potassium (ion) channels open **or** K^+ moves out (of axon) **;** 5 (causes) <u>repolarisation</u> (of membrane) **;** 6 *ref. to* <u>hyperpolarisation</u> (of membrane) **;** 7 return to resting potential **;** 8 AVP **;** e.g. entry of sodium ions causes more sodium channels to open	**4**
10(c)	*any **four** from:* *description* 1 myelinated axon / myelination, produces faster transmission speed (than unmyelinated) **;** 2 a larger the diameter (for unmyelinated) results in a faster transmission speed **; ora** 3 myelination has a greater effect on transmission speed than axon diameter **;** *explanation* 4 (myelinated faster due to) saltatory conduction **or** action potential jumps from node (of Ranvier) to node **;** 5 axons with wider diameter have, less ion leakage / larger surface area / lower resistance **;**	**4**