Cambridge International AS & A Level

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BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **May/June 2019**

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.

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
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
I	ignore
AVP	alternative valid point

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>compound / structure</th><th>location</th></tr>
<tr><td>acetylcholine</td><td>C and D ;</td></tr>
<tr><td>voltage-gated channel</td><td>A ;</td></tr>
<tr><td>receptor protein</td><td>B ;</td></tr>
<tr><td>acetylcholinesterase</td><td>C ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(b)</td><td>any two from:
1 ref. to ion (transport) ;
2 open / closes, when, voltage / depolarisation / charge / electrical potential, changes ; A arrival of an action potential
3 detail ; e.g. ion specificity / hydrophilic pore / transmembrane / (made of) protein</td><td>2</td></tr>
<tr><td>1(c)</td><td>any three from:
1 breaks down acetylcholine ;
2 (so) acetylcholine leaves, binding site / receptor / B ; ora
3 depolarisation stops in <u>post-synaptic membrane</u> / B ;
4 stops continuous action potentials (in post-synaptic membrane) ;
5 recycle ACh / described ;</td><td>3</td></tr>
</table>

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Question	Answer	Marks
1(d)	*any **two** from:* 1 one-way transmission **;** 2 interconnection of nerve pathways **;** 3 AVP **;** e.g. memory / learning integration of impulses	**2**

Question	Answer	Marks
2(a)	*any **two** from:* 1 no melanin **;** 2 white hair **;** 3 (very) pale skin **;** 4 pink / very pale / AW, eyes **;**	**2**

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Question	Answer	Marks
2(b)(i)	*any **three** from:* 1 more males / fewer females, have ocular albinism **;** 2 males with (one copy of) recessive allele have ocular albinism / females with (one copy of) recessive allele are carriers **;** 3 males (with ocular albinism) receive recessive allele from mothers **;** 4 fathers cannot pass on ocular albinism to their sons **;** 5 (because) males pass Y chromosome to sons **;** 6 males with ocular albinism pass recessive allele to daughters **;** 7 detail from Fig. 2.1 **;** e.g. all daughters (3, 5, 7) of male 1 are carriers / all sons (9 and 10) of male 1 do not have ocular albinism / males 11, 12, 13, get ocular albinism from mothers 3 and 5	**3**
2(b)(ii)	*symbols* normal <u>allele</u> = **A** OA1 <u>allele</u> = **a ;** *parental genotypes* $\mathbf{X^aY}$ x $\mathbf{X^AX^A}$ and *gametes* $\mathbf{X^a}$ **Y** and (all) $\mathbf{X^A}$ **;** *offspring genotypes (phenotypes correctly linked)* $\mathbf{X^AX^a}$ $\mathbf{X^AY}$ **;** normal / carrier, female normal male **;**	**4**

Question	Answer	Marks
2(b)(iii)	*any **two** from:* 1 frameshift / every triplet from site of deletion is changed **;** 2 primary structure / tertiary structure / 3D shape, is changed **or** (protein) folded incorrectly**;** 3 (protein has) changed, binding / active, site**;** 4 premature STOP codon leads to incomplete protein **;**	**2**
2(b)(iv)	*any **one** from:* *for* 1 decide whether to have children **;** 2 earlier treatment if child born with ocular albinism **;** *any **one** from:* *against* 3 test may be expensive **;** 4 condition, is mild / not life threatening **;** 5 can't be treated **;**	**2**

Question	Answer	Marks
3(a)(i)	continuous**;**	**1**

Question	Answer	Marks
3(a)(ii)	*any **two** from:* 1 smoking **;** 2 air pollution **;** 3 workplace pollution **;** 4 previous lung disease **;**	**2**
3(b)(i)	1 *ref. to* transcription factors **;** *any **three** from:* 2 TF / gene product / protein, bind to DNA **;** 3 (TF binds to) promoter **;** 4 *ref. to* binding of RNA polymerase **; R** if operator mentioned 5 (so) mRNA is made / transcription occurs **; ora** 6 detail from Fig. 3.2 **;** gene **A**, switches on / controls, 4 genes **or** genes B and C and 2 other genes gene **B**, switches on / controls, 6 genes gene **C**, switches on / controls, 11 genes	**4**

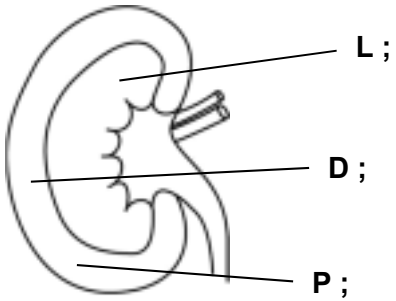
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Question	Answer	Marks
3(b)(ii)	*any **five** from:* 1 obtain mRNA from (basal) cell (expressing gene C) **;** 2 reverse transcription of mRNA to produce cDNA **;** 3 add fluorescent label to (c)DNA **; I** colour 4 (microarray has) ssDNA probes **;** 5 each from a, different / known, gene **;** 6 (c)DNA hybridises / AW, to, probes / ssDNA (on microarray) **;** 7 fluorescence shows the expressed genes **;** 8 AVP **;** e.g. *ref. to* washing off excess cDNA (after hybridisation) UV light / laser scanning (to record fluorescence pattern) intensity of fluorescence gives quantitative measure	**5**
3(c)	*any **three** from:* 1 sequence gene(s) **;** 2 predict, primary structure / amino acid sequence **;** 3 model receptor protein (3D) structure **;** 4 find molecules, that can block receptors **;** 5 without triggering effects **;** 6 *ref. to* limiting receptor protein production **;**	**3**

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Question	Answer	Marks
4(a)	*any **four** from:* 1 gene(s) from, another species / variety / (soil) bacterium / *Bacillus thuringensis* **;** 2 *ref. to* restriction enzyme **;** 3 *ref. to* (Ti) plasmid / vector / *Agrobacterium tumefaciens* / gene gun **;** 4 (DNA) ligase **;** 5 *ref. to* recombinant, DNA / plasmid **;** 6 introduced into rice, cells / genome / DNA **;** 7 (new) gene, expressed / transcribed, 8 toxic protein produced **;** 9 *ref. to* marker genes / insert promoter **;**	**4**
4(b)(i)	*any **two** from:* 1 (crop) yields would decrease if GM banned **;** 2 prices would increase if GM banned **;** 3 AVP **;** e.g. issues involving, food security / social unrest / wars	**2**
4(b)(ii)	*growing GM crops* 1 helps protect, ecosystems / habitat / biodiversity **; ora** 2 helps reduce, greenhouse effect / global warming / climate change / risk of flooding **; ora**	**2**

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Question	Answer	Marks
5(a)	 **L ;** **D ;** **P ;**	**3**
5(b)	*any **four** from:* 1 blood pressure increases in kidney **;** 2 (so) more ultrafiltration **;** 3 (therefore) increased volume of urine **;** 4 ADH concentration in blood decreases **;** 5 *ref. to* less reabsorption of water in collecting duct **;** 6 AVP **;** e.g. blood pressure drop in skin sweating stops so increases volume of blood	**4**

Question	Answer	Marks
5(c)	*any **five** from:* 1 osmoreceptors detect decrease (in water potential) **; ora A** change 2 (osmoreceptors) in hypothalamus **;** 3 ADH released (into blood) **;** 4 by posterior pituitary (gland) **;** 5 *ref. to* increase in aquaporins in, collecting duct / DCT**; ora** 6 more water reabsorbed **; ora** 7 water potential returns to set point **;**	**5**
5(d)	*water potential* – decrease **and** *volume* – decrease **;**	**1**

Question	Answer	Marks
6(a)(i)	(theory) **C ;**	**1**

Question	Answer	Marks
6(a)(ii)	1 (theories) **A** and **B** **;** *any **three** from* 2 (**A**) energy acts as a selection pressure / having eyes is a selective disadvantage **; ora** 3 detail of mp2 **;** e.g. less energy used means lower need for food 4 (**B**) selection for more chemoreceptors / more chemoreceptors is a selective advantage **;** 5 detail of mp4 **;** e.g. more chemoreceptors allows detection of more food 6 no eyes / more chemoreceptors, allows individuals to, survive / reproduce **;** AW 7 pass on advantageous, mutation / alleles, to offspring / increase in allele frequency **; ora**	**4**
6(b)(i)	*any **two** from:* 1 count, base / nucleotide, sequence differences **;** 2 few(er) differences in (mt)DNA sequences suggest same species **; ora** 3 fewer mutations means less time has passed since, most recent common ancestor **;**	**2**

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Question	Answer	Marks
6(b)(ii)	*any **three** from:* *mitochondrial DNA* accept **ora** throughout 1 inherited from mother alone **;** 2 recombination / crossing over, doesn't occur **;** 3 mutations, occur at a constant rate / molecular clock **;** 4 mtDNA mutates faster (than nuclear DNA) **;** 5. many copies of mtDNA (per cell) **;** 6 is smaller / has fewer genes **;** 7 not associated with histones **;** 8 mtDNA analysis is quicker **;**	**3**

Question	Answer	Marks
7	recapture **;** small / mobile / AW **;** harm **;** predators **;** mix / disperse / integrate **;** marked **;**	**6**

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Question	Answer	Marks
8(a)		**4**

correct order	letter of stage
1	**E**
2	**H**
3	**A**
4	**I**
5	**F**
6	**B**
7	**C**
8	**G**
9	**D**

E and **H** in correct position **;**

A and **I** in correct position **;**

B and **C** in correct position **;**

G and **D** in correct position **;**

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Question	Answer	Marks
8(b)	*any **five** from:* *in yeast* 1 only glycolysis occurs ; 2 (net) 2 ATP produced ; 3 no oxygen as (final) electron acceptor ; 4 (so) pyruvate does not enter mitochondria ; 5 ETC / chemiosmosis / oxidative phosphorylation / Krebs cycle / link reaction, does not occur ; 6 (ETC / chemiosmosis / oxidative phosphorylation) produce most ATP ; 7 pyruvate / ethanal, converted to ethanol ; 8 ethanol still energy-rich / AW ;	**5**

Question	Answer	Marks
9(a)	*any **eight** from:* 1 ground substance / stroma ; 2 for, light independent stage / Calvin cycle ; 3 contains enzymes / named enzyme e.g. rubisco ; 4 also, sugars / lipids / starch / ribosomes / DNA ; 5 internal membrane system ; 6 for, light dependent stage ; 7 fluid-filled sacs / thylakoids ; 8 grana are stacks of thylakoids ; 9 (grana) hold (photosynthetic) pigments ; 10 (grana) have large surface area for (maximum) light absorption ; 11 (pigments are arranged in), light harvesting clusters / photosystems ; 12 primary pigment / reaction centre / chlorophyll a, surrounded by accessory pigments ; 13 (accessory pigments) pass energy to, primary pigment / reaction centre / chlorophyll a ; 14 different photosystems absorb light at different wavelengths ; 15 membranes hold, ATP synthase / electron carriers ; 16 for, photophosphorylation / chemiosmosis ;	**8**

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Question	Answer	Marks
9(b)	*any **seven** from:* 1 grind leaf ; 2 use, solvent / named solvent ; 3 leaf extract contains mixture of pigments ; 4 *ref. to* concentrate extract ; 5 further detail ; e.g. pencil line drawn / extract placed on chromatography paper / extract placed on thin layer chromatography plate 6 paper placed (vertically) in jar of (different) solvent ; 7 solvent rises up paper ; 8 each pigment travels at different speed ; 9 pigments separated as they ascend ; 10 distance moved by each pigment is unique ; 11 R_f value ; 12 two dimensional chromatography ; 13 better separation of pigments ;	**7**

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Question	Answer	Marks
10(a)	*any **eight** from:* 1 reduced, NAD / FAD ; 2 passed to ETC ; 3 inner membrane / cristae ; 4 hydrogen released (from reduced, NAD / FAD) ; 5 split into electrons and protons ; 6 electrons pass along, ETC / carriers / cytochromes ; 7 energy released pumps protons into intermembrane space ; 8 proton gradient is set up ; 9 protons <u>diffuse</u>, (back) through membrane / down gradient ; 10 ATP synthase / stalked particles / protein channels ; 11 (ATP produced from) ADP and (inorganic) phosphate ; 12 *idea of* oxygen as final electron acceptor ; 13 addition of proton (to oxygen) to form water / (oxygen) reduced to water ;	**8**

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Question	Answer	Marks
10(b)	*any **seven** from:* 1 detail of placing larvae in respirometer **;** e.g. on gauze / use spoon 2 use and role of, KOH / AW**;** 3 water bath / maintain temperature **;** 4 choose 4 different temperatures **;** 5 mark initial position of liquid drop **;** 6 leave for set time **;** 7 measure distance moved by drop (in set time) **;** 8 (use tap to) reset respirometer **;** 9 (at least 3) replicates **;** 10 calculate mean values **;** 11 calculate rate as distance ÷ time **;** 12 plot graph of rate v temperature **;**	**7**

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