Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/42**

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.

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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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Question	Answer	Marks
1(a)	**A** – Schwann cell / myelin sheath **;** **B** – axon / axoplasm / cytoplasm **;**	**2**
1(b)	1 action potential / impulse, 'jumps' from node to node **;** 2 local circuits, set up between nodes / longer **; A** local currents 3 fast / increases speed (of transmission of impulse) **;**	**3**
1(c)	*any **five** from:* 1 no calcium ions enter (the presynaptic knob) **;** 2 (so) vesicles do not, move towards / fuse with, presynaptic membrane **;** 3 no, exocytosis / release, of ACh **; R** exocytosis of vesicles 4 ACh does not diffuse across (synaptic) cleft **;** 5 no binding with receptor (protein) on postsynaptic membrane **;** 6 sodium (ion) channels do not open **;** 7 sodium ions do not enter (postsynaptic) neurone **;** 8 no depolarisation (of postsynaptic membrane) **;**	**5**

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Question	Answer	Marks
2(a)(i)	continuous **;** **A** normal distribution	**1**
2(a)(ii)	evolution / natural selection / artificial selection / directional selection / adaptation / selective breeding **;**	**1**
2(b)	*any **three** from:* *captive fish:* 1 controlled conditions **so** phenotype less varied **;** 2 more oxygen **so** larger **;** 3 less space / overcrowding, **so** smaller **;** 4 less space / overcrowding, **so** (signs of) disease / wounds **;** 5 food qualified **linked to**, size / muscle / fat **;** 6 AVP **;** e.g. named tank condition **linked to** skin colour / no predators linked to increase in size / temperature linked to size	**3**

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Question	Answer	Marks
2(c)(i)	*any **five** from:* 1 obtain mRNA from wild and captive bred fish / AW **;** 2 reverse transcription of mRNA to produce cDNA **;** 3 add fluorescent label to (c)DNA **; I** colour **A** dyes / markers / tags 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 intensity of fluorescence (shows level of gene expression) **;** 9 compare, fluorescence / gene expression (between fish groups) **;** 10 AVP **;** e.g. *ref. to* washing off excess (c)DNA (only), after hybridisation UV light / laser scanning (to record fluorescence pattern)	**5**

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Question	Answer	Marks
2(c)(ii)	1 *ref. to* transcription factors **;** *any **three** from:* 2 TF / gene product / protein, bind to DNA **;** 3 (TF binds to) promoter **;** 4 switches genes, on / off **;** AW **I** genes, expressed / not expressed 5 *ref. to* binding of RNA polymerase **; R** if operator mentioned 6 mRNA is made / transcription occurs **; ora** 7 AVP **;** e.g.(so that genes are expressed) at the correct time / in the correct context / in the correct cell type / in the correct order **;**	**4**
2(d)(i)	*any **one** from:* 1 differences caused by selection in captive-bred population **;** 2 (not environmental because) all, offspring / fish, were kept in same environment **;**	**1**
2d(ii)	*idea that* captive fish have better, wound healing / immune response **;**	**1**

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Question	Answer	Marks
3(a)	*any **four** from:* 1 gene (for herbicide resistance) from, another species / variety / (soil) bacterium **;** **A** allele 2 *ref. to* restriction enzyme **;** 3 *ref. to* (Ti) plasmid / vector / *Agrobacterium* / gene gun **;** 4 (DNA) ligase **;** 5 *ref. to* recombinant, DNA / plasmid **;** 6 introduced into soybean, cells / genome / DNA **;** **I** embryos 7 (new) gene, expressed / transcribed **;** 8 (to produce) protein / enzyme, resistant to, glyphosate / herbicide **;** 9 AVP **;** e.g. *ref. to* tissue culture / produce callus / detail such as grow cells on growth medium / marker genes / insert promoter	**4**

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Question	Answer	Marks
3(b)	1 decrease / ban / 0%, GM soybean (cultivation), decreases yield **;** 2 use GM soybean, more / 94%, increases yield **;** *use GM crops – accept **ora** throughout if GM crops banned* 3 increase food supply / decrease food cost **;** 4 relieve, hunger / starvation **;** 5 less / more, herbicides used **;** *correct context needed* 6 less / more, money spent on herbicides **;** *correct context needed* 7 increase profits / improve economy **;** 8 unknown health consequences **;** (can be positive or negative) 9 high cost of GM seed **;** 10 *idea of* decrease in, genetic variation / biodiversity **;**	**5**

Question	Answer	Marks
4(a)	*parental genotypes* **Aa** × **Aa** **and** *gametes* **A** **a** and **A** **a ;** *offspring genotypes* **AA** **Aa** (**Aa**) **aa ;** *offspring phenotypes (correctly linked to genotypes)* normal normal / carrier (normal / carrier) OCA1A / albino / described **;** *probability* 25% **; A** 1 in 4 / 0.25 / ¼ **I** ratio	**4**
4(b)(i)	*missense* results in a different amino acid **;** *nonsense* *ref. to* STOP codon **;**	**2**
4(b)(ii)	*any **four** from:* 1 frameshift / described **;** 2 change in, primary structure / amino acid sequence **;** 3 protein / enzyme / tyrosinase, folds incorrectly / changes tertiary structure / changes 3D shape **;** 4 may introduce STOP codon **;** 5 shortened polypeptide / no tyrosinase produced **;** 6 <u>tyrosinase</u>, non-functional / lacks active site / active site changed shape / cannot form ESCs **;** 7 tyrosine not converted to DOPA / DOPA not converted to dopaquinone **;** 8 (so) dopaquinone not formed to produce melanin **;**	**4**

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Question	Answer	Marks
4(c)	*any **two** from:* 1 small gene pool / low genetic variation / low genetic diversity / low heterozygosity / high homozygosity ; 2 isolated (population) / described ; 3 inbreeding (within their population) ; 4 albinism has a selective advantage ; 5 founder effect / genetic bottleneck ; 6 genetic drift ;	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)(i)</td><td>correct lines ;;</td><td>2</td></tr>
<tr><td>5(a)(ii)</td><td><u>basement membrane</u> ;</td><td>1</td></tr>
<tr><td>5(b)</td><td>
<table>
<tr><th>afferent arteriole lumen diameter</th><th>efferent arteriole lumen diameter</th><th>GFR</th></tr>
<tr><td>normal</td><td>normal</td><td>normal</td></tr>
<tr><td>decreased</td><td>normal</td><td>decrease ;</td></tr>
<tr><td>normal</td><td>increased</td><td>decrease ;</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>5(c)</td><td>any five from:
1 active transport / pumping, of Na+ (out of cells) into, blood / tissue fluid ;
2 sodium (potassium) pumps in basal membrane ;
3 Na^+ concentration decreases inside cells / Na^+ concentration gradient set up ;
4 (so) Na^+ enters (epithelial / tubule) cells from, lumen / filtrate ;
5 by facilitated diffusion ;
6 Na^+ co-transports glucose into cell ;
7 this is, secondary / indirect, active transport ;
8 (facilitated) diffusion of glucose (out of cells) into blood ;
9 GLUT proteins ;</td><td>5</td></tr>
</table>

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Question	Answer	Marks
5(d)	*any **three** from:* 1 microvilli, has large surface area / for increased (re)absorption **;** **I** increase surface to volume ratio 2 many mitochondria provide ATP for, sodium (potassium) pumps / active transport **;** 3 tight junctions / closely packed cells, hold adjacent cells together / prevents leakage / fluid cannot pass between cells / substances must pass through cells **;** 4 many transport proteins for movement of named substance **;**	**3**

Question	Answer	Marks
6(a)	*idea that* organisms have changed over time **;**	**1**
6(b)	*any **four** from:* 1 *ref. to* mutation **;** 2 (mutation) results in a change in eye structure **;** 3 *ref. to* natural selection / selective advantage **;** 4 light receptor (cells) develop **;** 5 light receptor layer becomes cup-shaped **;** 6 *idea that* entry for light becomes narrower **;** 7 lens forms **;** 8 fixed lens / cornea, (forms) **;**	**4**

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Question	Answer	Marks
6(c)	*any **two** from:* *must refer to both octopus and mammal* 1 had similar, selection pressures / light conditions **;** 2 allows organisms to escape predators **;** 3 allows organisms to find food **;** 4 convergent evolution / described **;**	**2**
6(d)(i)	shared origin / common ancestor / same ancestor **;**	**1**
6(d)(ii)	*any **two** from:* 1 compare (amino acid sequences of two species) **;** 2 more similar (amino acid sequence) more closely related the species are **; ora** 3 more similar (amino acid sequence) more recent common ancestor / less time has elapsed (since a common ancestor)**;** **ora** 4 *ref. to* molecular clock **;**	**2**

Question	Answer	Marks
7(a)	*any **three** from:* 1 functional / self-contained / specific, entity / unit / area **;** 2 community (of organisms) / all living organisms of all species / all populations of organisms **;** 3 *ref. to* interactions **;** 4 abiotic / physical, and, biotic / biological, factors **; A** living and non-living 5 *idea that* linked by, energy flow / mineral cycling / food webs / food chains / nutrient cycle **;**	**3**
7(b)	niche **;** species **;** abiotic **;**	**3**

Question	Answer	Marks
8(a)	<table><tr><th>correct order</th><th>letter of stage</th></tr><tr><td>1</td><td>**V**</td></tr><tr><td>2</td><td>**S**</td></tr><tr><td>3</td><td>**U**</td></tr><tr><td>4</td><td>**W**</td></tr><tr><td>5</td><td>**R**</td></tr><tr><td>6</td><td>**Q**</td></tr><tr><td>7</td><td>**X**</td></tr><tr><td>8</td><td>**T**</td></tr></table> 6 correct = 4 marks 4/5 correct = 3 marks 2/3 correct = 2 marks 1 correct = 1 mark ;;;;	**4**
8(b)	*ATP synthase* - cristae / inner membrane ; *Krebs cycle* - matrix ; *electron transport chain* - cristae / inner membrane ; *coenzyme A* - matrix ; *pyruvate* - matrix ;	**5**

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Question	Answer	Marks
9(a)	*any **eight** from:* 1 microburette / (gas) syringe / photosynthometer ; 2 cut shoot (of aquatic plant) ; 3 place shoot in tube of hydrogen carbonate solution ; 4 to provide carbon dioxide ; 5 water bath / maintain temperature ; 6 choose 4 different temperatures ; 7 acclimatisation ; 8 lamp placed fixed distance away ; 9 measure length of bubble of, gas / oxygen, in set time **or** count number of bubbles produced in set time ; 10 repeat experiment twice more ; 11 calculate mean values ; 12 method to calculate rate of photosynthesis ; 13 AVP ; e.g. dark room / heat shield / LED bulbs	**8**

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Question	Answer	Marks
9(b)	*any **seven** from:* *restoration techniques* 1 reforesting / replanting ; 2 reintroduction of, named / native, animal (species) ; 3 bioremediation / described ; 4 bubbling oxygen through / oxygenation of, water ; 5 *ref. to* normalising pH of, water bodies / soil ; 6 dredging / clearing / purifying, rivers / lakes / water bodies ; 7 litter / waste, removal ; 8 removal of toxic layer of soil / soil cleaned and put back ; 9 *idea of* improving soil fertility ; 10 removal of alien (plant / animal) species ; 11 protection against grazing ; 12 named example ; 13 named example ;	**7**

Question	Answer	Marks
10(a)	*any **eight** from:* 1 synthetic hormones used **;** 2 as they do not get broken down quickly / act for longer **;** 3 oestrogen / progesterone, (blood) concentrations remain high **;** 4 (act on) anterior pituitary (gland) **;** 5 FSH not, produced / secreted **;** 6 Graafian / dominant, follicle does not develop **;** 7 LH not, produced / secreted **;** 8 ovulation prevented / described **;** 9 cervical mucus thickens (to stop sperm) **;** 10 prevents implantation / endometrium less well developed **;** 11 *ref. to* negative feedback **;** 12 AVP **;** e.g. taken daily for 21 days **then** stops (for 7 days) to allow menstruation / taken daily throughout month	**8**

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Question	Answer	Marks
10(b)	*any **seven** from:* 1 named geographical barrier **;** e.g. river / mountain / sea 2 two populations (of same species) separated **;** 3 no, breeding / allele flow / gene flow, between populations **or** reproductively isolated **;** 4 different, selection pressures / (environmental) conditions **;** 5 mutations occur **;** 6 individuals with beneficial alleles, are selected for / survive / reproduce / have a selective advantage **;** 7 beneficial <u>alleles</u> passed on **;** 8 change in, <u>allele</u> frequency / gene pool **;** 9 genetic drift **;** 10 *ref. to* over a long time / many generations **;** 11 (eventually) unable to interbreed to produce fertile offspring / reproductively isolated **;** 12 <u>allopatric</u> (speciation) **;**	**7**

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