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 2018**

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)	*any 3 of:* 1 killed by humans **;** 2 difficulty in finding a mate **;** 3 loss of habitat / habitat fragmentation / habitat polluted / deforestation **;** 4 food shortage **;** 5 (new) diseases **;**	**3**
1(b)	*any 3 of:* 1 maintains or increases, gene pool / genetic diversity / genetic variation **;** 2 maintains or increases, heterozygosity **;** 3 hybrid vigour **;** 4 reduces / prevents, inbreeding depression **;** 5 reduce chances of harmful recessive alleles coming together **;**	**3**
1(c)	*any 2 of:* 1 IVF or description**;** 2 embryo transfer **;** 3 surrogacy or description **;** 4 artificial insemination **;**	**2**

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Question	Answer	Marks
2(a)	*(autosomal)* not a sex chromosome **;** *(linkage)* genes on the same chromosome / alleles inherited together **;**	**2**
2(b)(i)	1 *F1 genotypes* **FG/fg or FGfg or (FG) (fg) ; A FfGg** 2 *gametes* **FG fg FG fg ;** 3 *F2 genotypes* **FGFG FGfg FGfg fgfg ;** **A FFGG FfGg FfGg ffgg** 4 *F2 phenotypes* purple long / purple long / purple long / red round **ecf** *for mp3 from incorrect gametes (mp2)* **R** *if sex linkage*	**4**
2(b)(ii)	*any 1 of:* do not show 9:3:3:1 ratio **;** large(r) numbers of parental phenotypes / low(er) numbers of recombinant phenotypes **;**	**1**
2(c)(i)	**fgfg** / homozygous recessive **; A ffgg**	**1**
2(c)(ii)	12.7 **or** 13 **;**	**1**
2(c)(iii)	low, COV / crossover value, indicates genes closer together **or** high, COV / crossover value, indicates genes further apart **;**	**1**

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Question	Answer	Marks
3(a)(i)	*any 4 of:* 1 chromosomes become visible **;** 2 condensation / coiling / supercoiling **; A** description 3 nuclear envelope or nuclear membrane, disintegrates / disappears **;** 4 nucleolus, disintegrates / disappears **;** 5 centrioles migrate to (opposite) poles **; I** centrosomes 6 spindle forms / microtubules assemble **;** 7 synapsis / bivalents form / homologous chromosomes pair up **;** 8 chiasmata formation / crossing over **;**	**4**
3(a)(ii)	*any 2 of:* 1 (homologous chromosomes / bivalents) line up randomly on the, equator / metaphase plate **;** 2 produces (many) different chromosome combinations **;** 3 number of possible combinations is 2^n **;** 4 new combinations of maternal and paternal alleles **;**	**2**
3(b)(i)	*any 2 of:* 1 protoctist uses up nutrients **;** 2 loss of appetite / inability to feed **;** 3 *idea of* impaired absorption / diarrhoea **;** 4 (so) less nutrients available for, growth / gain of body mass / increase in biomass **;** 5 AVP **;** e.g. *idea of* energy used to fight infection / *ref. to* immune response	**2**

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Question	Answer	Marks
3(b)(ii)	(chicken) body temperature / competition with microbes / presence of drugs / presence of plant extract **;**	**1**
3(c)(i)	*t*-test **;**	**1**
3(c)(ii)	*any 3 of:* 1 two labelled bell-shaped curves **;** 2 high dose curve shifted to left of low dose curve **;** 3 high dose curve peak to left of 2063 **;** 4 high dose curve, narrower / peak higher **;**	**3**

Question	Answer	Marks
4(a)	*any 4 of:* 1 spontaneous / random, mutation **;** 2 produces an allele coding for enzyme (that gives resistance) **;** 3 toxin is selection pressure **;** 4 flies or larvae, with, allele / enzyme / mutation, have selective advantage **;** 5 (flies with, allele / enzyme / mutation) survive / reproduce **; ora** 6 pass on this allele (to offspring) **;** 7 this allele increases in frequency **;**	**4**

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Question	Answer	Marks
4(b)	*any 3 of:* 1 separated by a geographical barrier / description **;** 2 different, environmental conditions / selection pressures **;** 3 allopatric speciation **;** 4 reproductive isolation / no breeding with mainland flies / no gene flow (between two populations) **; A** pre-zygotic isolation 5 new allele not, lost / diluted in frequency **;** 6 founder effect / genetic drift **;** 7 (more pronounced) in small population **;**	**3**
4(c)	*any 3 of:* 1 obtain, DNA / genome / gene / base / nucleotide, sequences (from database) **;** 2 obtain, amino acid / protein, sequences (from database) **;** 3 compare sequences (of two populations) **;** 4 calculate percentage of, bases / amino acids, changed **;** 5 mitochondrial DNA **;** 6 molecular clock / mutation rate, (to estimate time) **;**	**3**

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Question	Answer	Marks
5(a)(i)	*any 2 of:* 1 to treat disease caused by, faulty / recessive, allele **;** **A** cure 2 deliver, gene / allele / DNA (into target cells of individuals) **;** 3 named example **;** e.g. SCID / cystic fibrosis	**2**
5(a)(ii)	(reverse transcriptase) uses mRNA to make (ss)DNA **;** (DNA polymerase) makes DNA double-stranded / description **;**	**2**
5(a)(iii)	1 to prevent virus spreading (throughout the body) **;** 2 to limit, side effects / immune response / cancer / illness / infection / cell destruction **;**	**2**
5(b)(i)	*any 3 of:* 1 control **;** 2 *idea of* to see if gene therapy has worked **or** to compare the effect of no gene therapy with gene therapy **or** to compare the effect of no hG-CSF gene with presence of hG-CSF gene **;** 3 to see where the gene (carried by the vector), goes (in, body / brain) **or** to see if the gene (carried by the vector), enters cells **or** to see where cells have been transformed **;** 4 to see the effects of the, vector / virus, alone **;**	**3**

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Question	Answer	Marks
5(b)(ii)	*any 1 of:* 1 (control) to compare results (of mice without stroke) to mice with stroke **;** 2 to establish baseline figures (in mice without a stroke) / act as a reference point **;** 3 to make the study valid **;**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(c)</td><td>
any 4 of:
survival
1 increases survival ;

brain damage
2 reduces (percentage of brain occupied by) fluid filled space ;

behaviour test
3 improves / lowers, behavioural test score ; A score closer to normal

general
4 comparative data quote to support, mp1 / mp2 / mp3 ; A processed data

<table>
<tr><td>mp1</td><td>25% v 63%
25% v 100%
63% v 100%</td></tr>
<tr><td>mp2</td><td>5.2% v 3.6%
5.2% v 3.0%
3.6% v 3.0%</td></tr>
<tr><td>mp3</td><td>0.90 v 0.67</td></tr>
</table>
5 eye drops four times is better than eye drops once ; ora

6 if effective with mice likely to be effective with humans ;

7 ref. to unknown differences between mice and humans / study is only on mice ;

8 treatment is, non-invasive / quick ;
</td><td>4</td></tr>
</table>

Question	Answer	Marks
6(a)	link reaction **;** matrix of mitochondrion **;** **2** and **3** **;** substrate–linked phosphorylation **;** **A** substrate-level phosphorylation (**Q** =) NAD and (**R**=) FAD **;**	**5**
6(b)	reduced, NAD / FAD, to ETC **; A** description *ref. to* oxidative phosphorylation **/** chemiosmosis **; A** description	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)</td><td>
<table>
<tr><th>compound</th><th>location</th></tr>
<tr><td>PEP carboxylase</td><td>C</td></tr>
<tr><td>RuBP</td><td>B</td></tr>
<tr><td>rubisco</td><td>B</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>7(b)</td><td>any 2 of:
1 stop, air / oxygen, getting to cells B / rubisco / RuBP / bundle sheath cells ;

2 so rubisco does not catalyse reaction of oxygen with RuBP ;

3 reduce / stop, photorespiration ;</td><td>2</td></tr>
<tr><td>7(c)</td><td>any 3 of:
describe
1 (enzyme in) Amaranthus / C4, peaks, at higher temperature
or
(enzyme in) Amaranthus / C4, has higher optimum temperature
or
(enzyme in) Pisum / C3, has higher activity at low(er) temperatures ; ora

2 data quote ; e.g. C4 – 45 °C and C3 – 30 °C at 100%
or C4 – 70% and C3 – 25% at 50 °C ;

explain
3 enzyme in, Pisum / C3, less thermostable / denatures at lower temperature ; ora

4 AVP ; e.g. Amaranthus adapted to a hot climate / ora e.g. enzyme in Amaranthus has more S-S bonds</td><td>3</td></tr>
</table>

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Question	Answer	Marks
8(a)	*any 4 of:* 1 (presynaptic) membrane depolarised **;** 2 calcium (ion) channels open / (presynaptic membrane becomes) more permeable to Ca^{2+} **;** 3 Ca^{2+} move in (to presynaptic, neurone / knob) **; R** membrane 4 causes vesicles (of ACh) to move towards (presynaptic) membrane **;** 5 vesicle fuses with (presynaptic) membrane / exocytosis **;**	**4**
8(b)	*any 2 of:* 1 no Na^{+} enter (postsynaptic neurone) **;** 2 no depolarisation of (postsynaptic) membrane **;** 3 no, action potentials / impulses (transmitted) **;**	**2**
8(c)(i)	**A** – myelin sheath / Schwann cell **;** **B** – sarcolemma **;** **C** – mitochondria **;**	**3**
8(c)(ii)	*any 2 of:* 1 insulates axon / prevents movement of ions / AW **;** 2 increases speed (of impulses) **;** 3 saltatory conduction / described **;**	**2**

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Question	Answer	Marks
8(c)(iii)	1 produces / releases, ATP **;** *any 3 of mp2-5:* 2 (for) production / recycling, of ACh **;** 3 (for) production / movement, of vesicles **or** exocytosis **;** 4 (for) contraction of sarcomere **;** 5 (for) sodium potassium pumps / active transport **;**	**4**

Question	Answer	Marks
9(a)	*any 8 of:* 1 no, nucleus / nuclear envelope **;** 2 circular DNA / plasmid **; A** circular chromosome 3 cell membrane composition different (from, bacteria / eukarya) **;** 4 no membrane-bound organelles / named example **;** 5 70S ribosomes **;** 6 cell wall present **;** 7 cell wall does not contain peptidoglycans **;** 8 cells divide by, binary / multiple, fission **;** 9 (mostly) unicellular **;** 10 (some) have histones associated with DNA **;** 11 (some) are extremophiles / description **;**	**8**

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Question	Answer	Marks
9(b)	*any 7 of:* 1 variety / collection, of seeds **;** 2 long-term storage **;** 3 (storage) to, prevent germination / maintain dormancy **;** 4 detail of storage conditions **;** e.g. frozen **or** stored at temperatures below –13 °C dried 5 seeds regularly tested for viability / description **;** 6 seeds re-stocked regularly **;** 7 maintain genetic diversity / genetic material preserved / acts as a gene bank **;** 8 detail of future use **;** e.g. can be used after environmental disaster / new diseases / used to increase numbers 9 maintains biodiversity **;** 10 research / education **;** 11 AVP **;** e.g. takes up less space than growing plants / *ref. to* cheaper to store than whole plants	**7**

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Question	Answer	Marks
10(a)	*any 9 of:* *structure* 1 microvilli **;** **A** brush border 2 many mitochondria **;** 3 tight junctions **;** 4 folded, basal membrane / described **;** 5 many, transport proteins / cotransporters / pumps / carrier proteins **;** *process* 6 active transport of Na^+, out of (pct) cells / into blood **;** 7 Na^+ ion concentration, gradient (produced) / reduced in cell **;** 8 Na^+ enters (pct) cells from, lumen / tubule / filtrate **;** 9 by facilitated diffusion **/** using carrier protein **;** 10 cotransport (from lumen to pct cell) **;** 11 of, glucose / amino acids / ions **;** *only award if mp10 given* 12 AVP **;** e.g. water enters (pct) cells	**9**

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Question	Answer	Marks
10(b)	*any 6 of:* 1 hypothalamus detects water potential of blood **;** 2 (using) osmoreceptors **;** 3 (if) water potential, decreases / is low **;** 4 ADH produced **;** 5 *ref. to* neurosecretion / neurosecretory cells **;** 6 which extend into posterior pituitary **;** 7 ADH released from posterior pituitary **;** 8 enters blood stream **;** 9 water potential of blood, increases / returns to set point **;** 10 negative feedback **;**	**6**

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