Cambridge International AS & A Level

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BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **March 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 marking point
R	reject
A	accept (for answers correctly cued by the question, or by additional 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

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Question	Answer	Marks
1(a)(i)	Eukarya ;	**1**
1(a)(ii)	*any **one** from:* 1 habitat destruction / deforestation / logging ; 2 new disease ; 3 hunting ;	**1**
1(a)(iii)	*any **three** from:* 1 captive breeding / AW ; 2 release into the wild ; 3 conservation projects (in Madagascar) / establish reserves ; 4 education / raise awareness ; 5 research ; 6 healthcare qualified ;	**3**

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Question	Answer	Marks
1(b)(i)	*any **four** from:* 1 geographical, isolation / barrier **;** 2 (due to) named barrier **;** e.g. rivers / mountains 3 (west and east populations) unable to interbreed / no gene flow / AW **;** 4 different, selection pressures / environmental conditions, (acting on west and east populations) **;** 5 different mutations (in west and east populations) / AW **;** 6 so different alleles selected for (in west and east populations) **;** 7 ref. to genetic drift **;** 8 (west and east populations) separated for a long time **;**	**4**
1(b)(ii)	<u>allopatric</u> **;**	**1**

Question	Answer	Marks
1(b)(iii)	1 physical / morphological / mechanical ; 2 reproductive features do not match / unable to mate ; **or** 3 behaviour ; 4 different, calls / courtship rituals / AW ; **or** 5 gametic / sperm and oocytes ; 6 fertilisation unsuccessful ; **or** 7 temporal / AW ; 8 breed / fertile, at different times ;	**2**

Question	Answer	Marks
2(a)(i)	**A** node of Ranvier **;** **B** axon **;** **C** cell body **;** **A** soma	**3**
2(a)(ii)	transmit, impulses / action potentials, from, sensory / relay / intermediate, neurones **;** to, effectors / muscle / glands **;**	**2**
2(b)(i)	*any **four** from:* 1 Schwann cells wrap around, the axon / **B** **;** 2 (to form) myelin sheath **;** **A** axon myelinated 3 insulate the axon / ref. to lack of movement of ions **;** 4 depolarisation / action potentials, can only occur at, nodes (of Ranvier) / **A** **;** 5 ref. longer local circuits / (nodes are) 1–3 mm apart **;** 6 action potentials, move by saltatory conduction / jump from node to node **;** 7 AVP **;** e.g. (speed of transmission) 100 m s^{-1} / approx. 50× faster	**4**
2(b)(ii)	ref. to, large size / long neurones, and need to, respond / avoid danger, (quickly) **;**	**1**

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Question	Answer	Marks
3(a)(i)	polymerase chain reaction / PCR **;**	**1**
3(a)(ii)	*any **one** from:* so that, DNA is / fragments are, visible (on gel) / AW **;** (only need) a small starting quantity of DNA (from embryo) / AW **;**	**1**
3(b)	*any **four** from:* 1 **Hb^S** allele has, change in base sequence / mutation , in *Mst*II restriction site **;** 2 *Mst*II can no longer cut the **HbS** allele **;** 3 difference in number of restriction sites **;** (**Hb^A** allele has 3 / **Hb^S** allele has 2) 4 difference in number of fragments **;** (**Hb^A** allele has 4 / **Hb^S** allele has 3) 5 *Mst*II produces different sized DNA fragments when incubated with **Hb^A** and **Hb^S** alleles **;** 6 difference in size of, main / middle, fragment **;** **A** approx. 1200 bases and 200 bases v approx. 1400 bases	**4**
3(c)	*any **three** from:* 1 DNA / phosphate groups, negatively-charged **;** 2 moves to anode **;** 3 due to electric field / when current applied **;** 4 larger / longer, fragments move, more slowly / less far **;** **ora** 5 ref. to gel, impedance / resistance **;** 6 ref. to buffer **;**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(d)(i)</td><td>used as a comparison (to show correct position of Hb^A and Hb^S on gel) ;</td><td>1</td></tr>
<tr><td>3(d)(ii)</td><td>
<table>
<tr><th>embryo</th><th>genotype</th></tr>
<tr><td>1</td><td>Hb^A Hb^A</td></tr>
<tr><td>2</td><td>Hb^A Hb^S</td></tr>
<tr><td>3</td><td>Hb^S Hb^S</td></tr>
<tr><td>4</td><td>Hb^A Hb^S</td></tr>
</table>
one mark for correctly identifying sample 3 as Hb^S Hb^S ;
one mark for correctly identifying samples 2 and 4 as Hb^A Hb^S ;</td><td>2</td></tr>
<tr><td>3(e)</td><td>any three from:
pros:
1 can avoid having offspring with, serious / genetic, disease ; A named example
2 can avoid late abortions (if genetic disease discovered later in foetal development) ;
3 allows couples to have children who would otherwise choose not to (due to risk of genetic disease) ;
cons:
4 viable embryo(s) discarded ; R abortion
5 idea of use of healthcare resources by couple that can conceive naturally ;
6 may conflict with religious beliefs ;
7 could lead to selection based on gender or specific traits (“designer babies”) ;
8 AVP ; e.g. genetic disease may not develop</td><td>3</td></tr>
</table>

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Question	Answer	Marks
4(a)	1 covalent / peptide **;** 2 hydrogen **;** 3 ionic / electrostatic **;** 4 disulfide **;** 5 hydrophobic interactions **;** 6 Van der Waals **;** *4 correct = 2 marks* *2 / 3 correct = 1 mark*	**2**
4(b)	remove sugar phosphates from, active site / rubisco / enzyme **;** **A** breaks down sugar phosphate	**1**
4(c)(i)	*any **three** from:* 1 RuBP **and** rubisco in bundle sheath cells **;** 2 mesophyll cells surround the bundle sheath cells **;** 3 stops, air / oxygen, getting to bundle sheath cells **;** 4 (so) oxygen does not, combine with RuBP / react with rubisco **or** (so) carbon dioxide, combines with RuBP / reacts with rubisco **;**	**3**

Question	Answer	Marks
4(c)(ii)	*any **two** from:* 1 increase in (rate of), light dependent stage / photophosphorylation / photolysis **;** 2 (so) increase in oxygen produced **;** 3 leads to an increase in oxygen to carbon dioxide ratio **;** 4 favours reaction with oxygen (ref. to rubisco) **;** 5 more stomata open **;**	**2**
4(c)(iii)	*any **two** from:* 1 less RuBP to combine with carbon dioxide / less carbon fixation **;** 2 less, GP / TP **;** 3 ref. to reduction in (rate of), Calvin cycle / light independent stage **;**	**2**

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Question	Answer	Marks
5(a)(i)	sarcomere shortens / Z lines move closer together **or** ref. to rowing motion of the head / power stroke ;	**1**
5(a)(ii)	*any **three** from:* 1 (ATP) binds to myosin head ; 2 hydrolysed by, ATPase / myosin head ; 3 head detaches from actin ; 4 head tilts back to original position ;	**3**
5(b)(i)	afferent arteriole is wider than efferent arteriole ;	**1**
5(b)(ii)	basement membrane ;	**1**
5(c)(i)	*any **two** from:* 1 the higher the creatinine concentration the lower the GFR ; **ora** **A** inversely proportional 2 exponential curve / non-linear ; **A** description of non-linear 3 data quote for two points including units ;	**2**
5(c)(ii)	0.013 ; g dm^{-3} ;	**2**

Question	Answer	Marks
5(c)(iii)	*any **two** from:* 1 kidney, disease / damage **;** 2 cancer **;** 3 dehydration **;** 4 low blood pressure **;** **A** loss of blood	**2**

Question	Answer	Marks
6(a)(i)	*any **four** from:* 1 random / spontaneous **;** 2 change in, base / nucleotide, sequence of DNA **;** 3 ref. to base, substitution / deletion / addition **;** 4 ref. to frame shift / AW **;** 5 AVP **;** e.g. mutagens / UV light / ionising radiation	**4**
6(a)(ii)	allele only expressed, when a dominant allele not present / in a homozygote **or** allele not expressed in a heterozygote **;**	**1**
6(a)(iii)	symbols explained **;** e.g. **A** = allele for, melanin production / normal pigment **a** = allele for, no melanin production / albinism parental genotypes **;** e.g. **Aa** and **Aa** offspring genotypes identifying child with albinism as **aa ;** e.g. (**AA Aa Aa**) **aa**	**3**

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Question	Answer	Marks
6(b)	*any **three** from:* 1 the greater the concentration of extract, the lower the activity of tyrosinase **;** **A** inversely proportional 2 extract acts as an inhibitor / enzyme inhibited **;** 3 binds to, active site / allosteric site, (of tyrosinase) **;** 4 ref. to alters pH **;** 5 extract denatures tyrosinase **;**	**3**

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Question	Answer	Marks
7(a)(i)	166.7 / 167 / 170 **;** **;** $\frac{360\,000 - 135\,000}{135\,000} \times 100$ *for one mark*	**2**
7(a)(ii)	*any **three** from:* 1 predation **;** 2 competition for food / decrease in food available / limited amount of food **;** 3 disease **;** 4 loss of, habitat / breeding sites **;** **A** size of habitat limited 5 pesticides / herbicides **;**	**3**
7(b)(i)	same shape but to the right **;** directional (selection) **;**	**2**
7(b)(ii)	same position but two peaks each side of the medium dashed line **;** disruptive (selection) **;**	**2**

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Question	Answer	Marks
8	7 ; 4 ; 9 / 4 ; 2 ; 10 ; 3 ;	**6**

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Question	Answer	Marks
9(a)	*any **nine** from:* *cyclic photophosphorylation:* 1 (only) PSI / P700, involved ; 2 light energy absorbed ; 3 (results in) electron excited / AW ; 4 (electron) emitted from chlorophyll ; 5 chain of electron carriers / ETC ; 6 ATP synthesis ; 7 electron returns to, PSI / P700 ; *photosystems:* 8 pigments arranged in light-harvesting clusters ; 9 primary pigment / chlorophyll a / reaction centre ; 10 accessory pigments / chlorophyll b / carotenoids, surround, primary pigment / reaction centre / chlorophyll a ; 11 photosystem located in thylakoid ;	**9**

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Question	Answer	Marks
9(b)	*any **six** from:* *formation:* 1 both photosystems involved ; 2 photolysis of water ; 3 H^+ released from, PSII / P680 ; 4 e^- released from, PSI / P700 ; 5 e^- and H^+ / both, combine with NADP (to form reduced NADP) ; *use:* 6 reduces GP / AW ; 7 TP formed ; 8 (takes place in) stroma ;	**6**

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Question	Answer	Marks
10(a)	*any **eight** from:* 1 auxin binds to receptor ; 2 in cell surface membrane ; 3 (auxin) increases proton pump activity / described ; 4 (more) protons enter cell <u>wall</u> ; 5 cell <u>wall</u>, becomes more acidic / has reduced pH ; 6 expansins activated ; 7 (expansins) loosen / break, bonds between (cellulose) microfibrils ; 8 K^+ enters cell ; 9 water potential of cell decreases ; 10 more water can enter cell by osmosis / AW ; 11 turgor pressure / described ; 12 ref. to acid growth hypothesis ;	**8**

Question	Answer	Marks
10(b)	*any **seven** from:* 1 *idea that* phenotype results from interaction of genotype and environment **;** 2 environment may, limit / modify, expression of gene(s) / AW **;** 3 continuous variation example **;** e.g. size / mass / height 4 qualified **;** e.g. because, food / nutrients / ions, missing or malnutrition occurs 5 environment may, trigger / switch on, gene **;** 6 / 7 two named examples **; ;** e.g. temperature and change in animal colour high temperature and gender in crocodiles UV light and melanin production wavelength of light and, flowering / fruit colour 8 environment effect usually greater on polygenes **;** 9 environment may induce mutation (affecting phenotype) **;** 10 AVP **;**	**7**

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