Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**BIOLOGY** **9700/43**

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.

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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:<br><br>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:<br><br>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)(i) | 0.03 **;** | **1** |
| 1(a)(ii) | *three from:*<br><br>1 more humans result in fewer macaques / ora **;**<br>2 (humans) kill macaques **;**<br>3 (humans) destroy macaque habitat / named example **;**<br>4 (humans) bring disease **;** | **3** |
| 1(b) | *four from:*<br><br>1 captive breeding / assisted reproduction **;**<br>2 release into wild **;**<br>3 education **;**<br>4 ban, hunting / trade **;**<br>5 reserves / national parks / zoos **;**<br>6 provide food **;**<br>7 provide healthcare / monitor populations for disease **;**<br>8 limit / ban, on new building **;** | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | <table><tr><th>number of individuals expected</th><th>expected ratio</th></tr><tr><td></td><td>9</td></tr><tr><td>75</td><td></td></tr><tr><td></td><td>3</td></tr><tr><td>25</td><td></td></tr></table> **; ;**<br>4 correct boxes = 2 marks<br>3 correct boxes = 1 mark | **2** |
| 2(a)(ii) | *parental genotypes*<br>**EeNn** × **eenn ;**<br><br>*encircled gametes*<br>**EN** **En** **eN** **en** × **en** **;**<br><br>*offspring genotypes*<br>**EeNn Eenn eeNn eenn ;**<br><br>*phenotypes correctly linked to genotypes*<br>red eyes and normal wings, red eyes and vestigial wings, purple eyes and normal wings, purple eyes and vestigial wings **;** | **4** |

| Question | Answer | Marks |
|---|---|---|
| 2(b)(i) | prophase I **;**<br>crossing over **;** **A** chiasmata | **2** |
| 2(b)(ii) | genes on the same chromosome / alleles inherited together **;**<br>no independent assortment **;** **A** description | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | *three from:*<br><br>1 *idea of* halving the number of chromosomes **;**<br>2 (to make) haploid / n, gametes **;**<br>3 (so) on fertilisation, (restores) diploid number / 2n **;**<br>4 maintains constant chromosome number / prevent chromosome number doubling **;** | **3** |
| 3(b)(i) | *two from:*<br><br>1 ref. to light intensity **and** change in size of, plant / part of plant **;**<br>2 wind speed **and** size of plant **;**<br>3 waterlogged soil **and** leaves / flowers, above water **;**<br>4 pH **and** flower colour **;**<br>5 AVP **;** environmental condition **and** effect<br>6 AVP **;** environmental condition **and** effect | **2** |
| 3(b)(ii) | *two from:*<br><br>1 genetic variation / new alleles **;**<br>2 (therefore) new phenotypes **;**<br>3 (new phenotype) has a selective advantage / is selected for **;**<br>4 more likely to survive (selection pressure) **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 3(c) | *two from:*<br><br>1 in full nutrient there is little difference (between two populations) **;**<br>2 in low phosphate non-functional **X** root growth is, longer / **ora ;**<br>3 in low phosphate both populations grow less well than in full nutrient / **ora ;**<br>4 comparative data quote to support mp1 / mp2 / mp3 **;** **A** processed data | **2** |
| 3(d)(i) | 69.67 to 70.6 **; ;** *max 2 d.p*<br><br>allow 1 working mark for<br><br>21 – 33 = (–)12 (for calculating difference between means)<br><br>$\sqrt{0.5^2/30 + 0.8^2/30}$ (for calculating the standard error in the difference) | **2** |
| 3(d)(ii) | *reject null hypothesis*<br><br>*t* / 69.67, is higher than, 2.00 / the critical value (at $p = 0.05$) **;**<br>there is a significant difference between, the means of the functional **X** and non-functional **X** populations **;**<br><br>**allow** ecf from calculated value of *t* | **2** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | *four from:*<br><br>1 spontaneous / random, mutation **;**<br>2 produces an allele coding for insect-deterring chemicals **;**<br>3 (grazing by) insects, is selection pressure **;**<br>4 plants with, alleles / mutations, have selective advantage / were selected for / **ora ;**<br>5 (plants with alleles / mutations) survived / reproduced / produced more seeds / **ora ;**<br>6 passed on this allele (to offspring) **;**<br>7 this allele increases in frequency **;** | **4** |
| 4(b)(i) | directional **;** | **1** |
| 4(b)(ii) | stabilising **;** | **1** |
| 4(c) | (genetic drift) occurs due to chance events / **ora** for natural selection **;**<br>(genetic drift) shows no trend in results / **ora** for natural selection **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | *four from:*<br><br>1 obtain (dominant *APP*) allele **;**<br>2 detail **;** *any one from:*<br>e.g. synthesise gene<br>make cDNA from mRNA<br>use probe<br>select and amplify with PCR<br>gel electrophoresis<br>3 restriction enzyme **;**<br>4 use, vector / plasmid / virus **;** **A** gene gun / direct (micro)injection<br>5 (on) zygote / secondary oocyte / egg (cell) / early embryo **;** **I** sperm<br>6 AVP **;** e.g. cloning / embryo splitting<br>add promoter<br>marker gene / tag gene | **4** |
| 5(a)(ii) | *one from:*<br><br>to test treatments without harming humans **;**<br>to investigate, cause / progress, of disease **;** | **1** |
| 5(b) | *four from:*<br><br>1 identifies, active / switched on / expressed / transcribed, genes **;**<br>2 transcription of a gene produces mRNA **;**<br>3 ssDNA act as, probes / reporters **;**<br>4 (ssDNA) bound at known positions to a, solid surface / slide / chip **;**<br>5 cDNA, binds to / hybridises with, complementary (probe) ssDNA **;**<br>6 show up / identified as, fluorescent spots / named colour **;**<br>7 positions / intensity, recorded by, laser / scanner **;**<br>8 positions identified as named genes **;**<br>9 intensity proportional to gene expression **;** | **4** |

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| Question | Answer | Marks |
|---|---|---|
| 5(c)(i) | 2.7 (%) **; ;** **A** 2.68<br><br>allow 1 working mark for:<br><br>932 – 28 = (904)<br><br>904 ÷ 33 696 | **2** |
| 5(c)(ii) | training causes more genes to be expressed **;** | **1** |
| 5(d)(i) | gene therapy **;** | **1** |
| 5(d)(ii) | *two from:*<br><br>1 switches on genes needed for forming, memories / synapses **;**<br>2 allows better learning (of water maze) **;**<br>3 reduces, memory loss / symptoms of Alzheimer's **;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | *two from:*<br><br>glycolysis **;**<br>link reaction **;**<br>Krebs cycle **;** | **2** |
| 6(a)(ii) | *two from:*<br><br>1 splits H into electrons and $H^+$ **;**<br>2 ref. to electrons along, ETC / carriers, provides energy **;**<br>3 (energy) used to pump $H^+$ into intermembrane space **;** | **2** |

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| Question | Answer | Marks |
|---|---|---|
| 6(a)(iii) | **Y** oxygen **;**<br>**Z** ATP synthase / ATP synthetase **;**<br>**A** stalked particle<br>**R** ATPase | **2** |
| 6(b) | *two from:*<br><br>increase in surface area **;**<br>more, carriers / ATP synthase / ETCs **;**<br>more ATP (produced) **;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 7(a) | <table><tr><th>substrate or product</th><th>location</th></tr><tr><td>oxygen produced</td><td>A</td></tr><tr><td>carbon dioxide used</td><td>B</td></tr><tr><td>reduced NADP used</td><td>B</td></tr><tr><td>ATP produced</td><td>A</td></tr><tr><td>hexose produced</td><td>B</td></tr></table> **; ; ;**<br><br>5 correct = 3 marks<br>3 or 4 correct = 2 marks<br>1 or 2 correct = 1 mark | **3** |

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| Question | Answer | Marks |
|---|---|---|
| 7(b)(i) | *two from:*<br><br>1 light dependent reaction / photophosphorylation / photolysis occurred **;**<br>2 hydrogen, produced / released **;** **R** $H^+$<br>3 DCPIP reduced **;** | **2** |
| 7(b)(ii) | *one from:*<br><br>to show that any change in colour is, due to chloroplasts / not due to buffer **;**<br>to make (the experiment) valid / to act as reference point **;** | **1** |
| 7(b)(iii) | *two from:*<br><br>1 swell / burst / lyse / lysis **;**<br>2 higher water potential outside chloroplast **; ora**<br>3 water enters, by osmosis / down water potential gradient **;** | **2** |
| 7(c) | carbon dioxide concentration **;**<br><br>not involved in, light dependent reaction / photophosphorylation / photolysis<br>**or**<br>only involved in light independent reaction / Calvin Cycle / **ora ;** | **2** |

| Question | Answer | Marks |
|---|---|---|
| 8(a) | *four from:*<br><br>*thick filaments (max 3)*<br>1 myosin **;**<br>2 fibrous protein **;**<br>3 globular heads / ATPase **;**<br>4 AVP **;** e.g. 15 nm diameter / M lines<br><br>*thin filaments (max 3)*<br>5 actin **;**<br>6 globular protein **;**<br>7 tropomyosin / troponin **;**<br>8 binding site for myosin (head) **;**<br>9 AVP **;** e.g. 7 nm diameter / Z lines | **4** |
| 8(b) | *five from:*<br><br>1 (when) sarcoplasmic reticulum depolarised **;**<br>2 calcium (ion) <u>channels</u> open **;**<br>3 calcium ions, move in (sarcoplasm) **;**<br>4 bind to troponin **;**<br>5 troponin / tropomyosin, changes shape **;**<br>6 moves tropomyosin out of the way / exposes (actin-myosin) binding sites **;**<br>7 (allows) myosin to bind (to actin) / cross bridge formation **;** | **5** |

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| Question | Answer | Marks |
|---|---|---|
| 8(c) | *four from:*<br><br>*description*<br>1 (pyruvate) accepts hydrogen / becomes reduced **;**<br><br>2 from reduced NAD **;**<br><br>3 produce lactate **;**<br><br>4 ref. to lactate dehydrogenase **;**<br><br>*importance*<br>5 glycolysis can continue **;**<br><br>6 ref. to small amount of ATP produced **;**<br><br>7 AVP **;** e.g. cannot continue for long / reversible / pyruvate does not enter mitochondrion | **4** |

| Question | Answer | Marks |
|---|---|---|
| 9(a) | *eight from:*<br><br>1 nucleus **;**<br>2 (double) membrane-bound organelles **;** **A** example<br>3 80S ribosomes **;**<br>4 chloroplasts / mitochondria, have 70S ribosomes **;**<br>5 linear DNA **;**<br>6 DNA associated with, histones / proteins **;**<br>7 chloroplasts / mitochondria, DNA is circular **;**<br>8 unicellular, colonial and multicellular **;**<br>9 cells divide by mitosis **;**<br>10 reproduction can be asexual **and** sexual **;**<br>11 AVP **;** | **8** |
| 9(b) | *seven from:*<br><br>1 useful for species where reproduction is difficult / AW **;**<br>2 example **;** e.g. from habitat fragmentation / reproductive physiology<br>3 increases the rate of, reproduction / offspring production **;**<br>4 IVF **;**<br>5 hormone treatment / superovulation **;**<br>6 (many) oocytes harvested **;**<br>7 (oocytes) mixed with sperm **;**<br>8 embryos placed in uterus **;**<br>9 surrogacy **;**<br>10 detail **;** e.g. use a similar species / non-rare breed<br>11 ref. to portmanteau animal / embryo transfer **;**<br>12 AVP **;** e.g. embryo splitting<br>cryopreservation of sperm<br>artificial insemination | **7** |

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| Question | Answer | Marks |
|---|---|---|
| 10(a) | eight from:<br><br>1 ADH reaches (cells of) collecting duct **;**<br>2 binds to receptor on cell surface membrane **;**<br>3 enzyme-controlled reactions / enzyme cascade **;**<br>4 (active) phosphorylase **;**<br>5 (which causes) vesicles with, aquaporins / water channels **;**<br>6 to, move to / fuse with, (cell surface) membrane **;**<br>7 increase (membrane) permeability (to water) **;**<br>8 (more) water moves out of collecting duct **;**<br>9 by osmosis / down water potential gradient **;**<br>10 (then) into blood **;**<br>11 urine (more) concentrated / small volume of urine **;**<br>12 AVP **;** e.g. role of loop of Henle in creating water potential gradient<br>movement of urea increases water potential gradient | **8** |
| 10(b) | *seven from:*<br><br>1 (glucagon) acts as cell signalling molecule **;**<br>2 binds to receptor on cell surface membrane **;**<br>3 liver cell **;**<br>4 G-protein activated **;**<br>5 adenylyl cyclase activated **;**<br>6 formation of cAMP **;**<br>7 (which is) second messenger **;**<br>8 enzyme-controlled reactions / enzyme cascade **;**<br>9 signal amplified **;**<br>10 glycogen hydrolysed to glucose / glycogenolysis **;**<br>11 (glucose released) into blood **;**<br>12 AVP **;** e.g. ref. to glucose exits via GLUT2 proteins / gluconeogenesis | **7** |

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