Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/41**

Paper 4 A Level Structured **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)(i)	*any one from:* positive correlation **;** as area (of forest) increases, number / population / orangutans, increase(s) **; ora**	**1**
1(a)(ii)	25 000 – 7300 2016–1985 **;** 571 (per year) **;**	**2**
1(a)(iii)	12.78 / 12.8 / 13 (years) **;**	**1**
1(b)	*any two from:* 1 hunting / poaching, for, bushmeat / (traditional) medicine / crop protection **;** 2 hunting / (live) capture, for pets / trade **;** 3 disease **;** 4 breeding problems due to, individuals isolated / mates inaccessible / inbreeding in small populations **;**	**2**
1(c)	*any three from:* 1 breeding (programmes) **;** 2 release / reintroduction (to, wild / Sumatra/ reserves) **;** 3 educate / raise public awareness **;** 4 research**,** diet / breeding / behaviour / genetic diversity **;** 5 raise money for**,** reserves / protecting wild population **;** 6 AVP **;** e.g. cooperate with governments	**3**

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Question	Answer	Marks
2(a)	*any four from:* 1 population / a species, show(s) genetic, variation / diversity **;** 2 *ref. to* chance / random / spontaneous, mutation **;** 3 *ref. to* selection pressure / competition / predation / disease **;** 4 fitter / fittest OR better adapted / best adapted, (individuals) survive **; ora** 5 reproduce / breed, more OR have more offspring **; ora** 6 pass on, beneficial / advantageous / favourable / desirable, allele(s) **; ora** 7 change / increase, in allele frequency **;**	**4**
2(b)(i)	*any two from:* normal distribution **;** 5 is, usual / commonest / most frequent / peak, clutch size **;** few(er) clutches, are very large and very small / are of size 2 and 8 / lie at (both) extremes **;**	**2**
2(b)(ii)	*any four from:* 1 stabilising selection **;** 2 4 / 5 (eggs) **or** mean / average (clutch size), is optimum / better / best / selected for / has selective advantage / gives most (surviving) offspring **;** 3 low clutch size / 2 / 3 , gives few(er) (surviving) offspring **;** 4 high clutch size / 6 / 7 / 8 , not all offspring survive **;** 5 high clutch size *linked to* more competition (between chicks) for, food / parental care **;** 6 high clutch size *linked to* (more) predation (of eggs / chicks) **;** 7 high clutch size *linked to* (more) disease (of eggs / chicks) **;**	**4**

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Question	Answer	Marks
2(c)(i)	*step 1:* 17 / 86 **or** <u>0.198</u> / 0.20 (q^2) **;** *step 2:* √ 0.198 **or** <u>0.445</u> / 0.45 / 0.44 (*q*) **AND** 1 – 0.445 **or** <u>0.555</u> / 0.55 / 0.56 (*p*) **;** *step 3:* 2 × 0.555 × 0.445 **or** 0.49(395) / 0.495 (*2pq*) **AND** 0.49(395) × 86 **or** 42 / 42.479 / 42.48 / 42.5 / 42.57 **;**	**3**
2(c)(ii)	*any two from:* 1 small population **;** 2 (natural / artificial / sexual) selection **;** 3 non-random mating / inbreeding **;** 4 migration (of individuals) **;** 5 (new) mutation (is occurring)**;** 6 non-diploid organisms **;** 7 overlapping generations **;** 8 asexual reproduction **;** 9 allele frequencies not equal in both sexes **;**	**2**

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Question	Answer	Marks
3(a)(i)	**1** promoter **2** operator **3** *lac Z* / β-galactosidase gene **4** *lac Y* / lactose permease gene **; ;**	**2**
3(a)(ii)	*β-galactosidase – any one of:* digests / hydrolyses, lactose to, monomers / glucose + galactose **;** converts / isomerises, lactose to allolactose **;** *lactose permease* increases / allows, lactose uptake / lactose entry / permeability (of cell) **to** lactose **;**	**2**
3(b)(i)	*any one from:* (protein) produced all the time **;** (protein) concentration does not vary (in response to molecular signals) **;**	**1**
3(b)(ii)	*any three from:* **1** repressor (protein) not bound to, lactose / allolactose **;** **2** repressor binds to operator **;** **3** RNA polymerase cannot move to, operator / (structural) genes **;** **4** no / prevents, transcription (of genes) / formation of mRNA **;**	**3**
3(b)(iii)	*any one from:* proteins / enzymes, made, all the time / when not needed / too much / in excess / in uncontrolled fashion **;** waste of, amino acids / ATP / nucleotides **;** decrease growth **;**	**1**

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Question	Answer	Marks
4(a)	*grey badgerface* **A^bA^g ;** *white* **AA AA^b AA^g Aa ;**	**2**
4(b)	(grandparent cross **A–** x **aa** (any white x black) to give **Aa** white parent may be shown, but no mark) *cross 1:* **Aa** x **A^gA^g** → **AA^g** **A^ga** ; white grey ; *cross 2:* **Aa** x **A^ga** → **AA^g** **Aa** **A^ga** **aa** ; white white grey black ;	**4**
4(c)	**(aa / a),** protein product does not, block / bind, melanocortin 1 / receptor **;** (so) MSH / hormone, binds to, melanocortin 1 / receptor, causing melanin synthesis **;**	**2**

Question	Answer	Marks
5(a)(i)	*any two from: (transgenic pigs – **ora** for normal pigs)* 1 GH (concentration) higher / GH always present not just at certain times **;** 2 hGH, works for longer / broken down less quickly (than pig GH) **;** 3 increase in cell signalling **;** 4 increased / activates, (growth) gene, expression / transcription **;** 5 increased / stimulates, cell division / mitosis **;** 6 (make) more, muscle / bone / fat **;**	**2**
5(a)(ii)	*any three from:* 1 (mouse DNA / it) **is,** the <u>promoter</u> **;** 2 (where) RNA polymerase / transcription factor(s)**,** bind **;** 3 controls / allows / ensures / is needed for, gene expression / gene activation / mRNA production / hGH production **;** 4 gene can be, switched on / transcribed, by adding metal ions **;** 5 *idea of* controlling, when / where / how much, the gene is, expressed / transcribed **;**	**3**
5(b)(i)	*NO arguments (any two to question max three):* 1 few offspring / don't pass on gene(s) / unsustainable / assisted reproduction is expensive (as problem with mating*)* **;** 2 cost of healthcare / less growth / die young (due to ulcers) **;** 3 people may, avoid / refuse to buy / pay less for, GM food **;** 4 (GM) production cost, expensive / outweighs benefits (as 1% success) **;** *YES arguments (any two to question max three):* 1 greater yield / more meat (as higher, body mass / muscle) **;** 2 higher price / worth more money, as more muscle to fat **;** 3 sell / slaughter / process, earlier / at younger age **;**	**3**

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Question	Answer	Marks
5(b)(ii)	*any two from:* *unethical / not good / not right, because:* 1 pigs, suffer / have (stomach) ulcers / experience pain **;** 2 pigs cannot, behave normally / move much / exercise / keep fit / socialise / mate **;** *ethical / good / right, because:* 1 more / better quality, meat / food, for humans **;** 2 pigs suffer less than (normal) pigs given hGH by injection **;**	**2**
5(c)(i)	*any two from:* success rate (in altering gene) is, greater / 100% (instead of 1%) **;** (only) specific gene is altered / targets gene more precisely **;** (unwanted) gene is, removed / deleted / disabled / knocked out **;**	**2**
5(c)(ii)	*one or two arguments about statement's truth to question max 3:* 1 not selective breeding as, DNA / genes, manipulated / altered / changed / removed **;** 2 not selective breeding as IVF is used **;** 3 not selective breeding as no, crossing and, selection (of offspring) / repetition **;** 4 <u>not</u> genetic engineering as no new gene is put into, organism / zygote **;** *one or two reasons why more acceptable to question max 3:* 5 no foreign gene inserted / no cross-species gene transfer **;** 6 (only) one / single, gene, altered / silenced **;** 7 (application) reduces, suffering of / (viral) disease in, pigs **;**	**3**

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Question	Answer	Marks
6(a)	<table><tr><th>compound or structure</th><th>location</th></tr><tr><td>ATP synthase</td><td>**P**</td></tr><tr><td>acetyl CoA</td><td>**Q**</td></tr><tr><td>phospholipid bilayer</td><td>**P**</td></tr><tr><td>oxaloacetate</td><td>**Q**</td></tr></table> **;;;**	**3**
6(b)(i)	$16(.00) \times 10^{-3}$ **;**	**1**
6(b)(ii)	*any two from:* mitochondria / respiration, produce(s) ATP **;** heart / cardiac muscle (cell), is more active OR needs more, energy / ATP **;** heart / cardiac muscle, (cell) <u>contract</u>s **; ora**	**2**
6(b)(iii)	mitochondria vary, in size / in surface area of inner membrane **;**	**1**

Question	Answer	Marks
7(a)(i)	thylakoid (membranes) / lamellae / granum / grana **;**	**1**
7(a)(ii)	**A** photolysis (of water) **;** **B** chemiosmosis / (cyclic) photophosphorylation **;**	**2**
7(a)(iii)	*any one of:* diffuses out / lost / expelled / released, from, leaf / stomata / plant **;** used in, (aerobic) respiration / oxidative phosphorylation **;**	**1**
7(a)(iv)	chlorophyll a **;**	**1**
7(a)(v)	ATP and reduced NADP / NADPH**;**	**1**
7(b)	*any three from:* regenerate / produce / make/ form, RuBP **;** (triose phosphate / glucose / acetyl coA) for respiration **;** to make any two of: glucose / sucrose / ribose / deoxyribose / glycerol / acetyl (coA) / fatty acids / amino acids starch / cellulose **; ;**	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(a)</td><td>
<table>
<tr><th>feature</th><th>nervous system</th><th>endocrine system</th></tr>
<tr><td>method of communication</td><td>electrical / impulses / action potentials / wave of depolarisation</td><td>hormones / chemical(s) (messengers)</td></tr>
<tr><td>method of transmission</td><td>neurones / nerve fibres / nerve cells / axons</td><td>blood (stream / plasma) / circulation</td></tr>
<tr><td>transmission speed</td><td>fast(er) / quick(er) / rapid</td><td>slow(er)</td></tr>
<tr><td>duration of effect</td><td>short(er) / temporary / seconds</td><td>long(er) / permanent / minutes – years</td></tr>
</table>
; ; ; ;
</td><td>4</td></tr>
<tr><td>8(b)</td><td>1 <u>D</u> ;
2 <u>C</u> ;
3 <u>D</u> (and C) ;
4 A / B ;</td><td>4</td></tr>
<tr><td>8(c)</td><td>any five from:

1 reduce / stops, FSH and LH (secretion / concentration) ;
2 ref. to <u>negative feedback</u> ;
3 ref. to hypothalamus / anterior pituitary (gland) ;
4 stops follicle, developing / maturing ;
5 prevents ovulation ;
6 <u>cervical</u> mucus, thick / builds up / is hostile to sperm ;
7 uterine lining / endometrium, thin / not ready, preventing implantation ;</td><td>5</td></tr>
</table>

Question	Answer	Marks
9(a)	*any six from:* 1 (short-term) store of energy **;** 2 (energy derived) from, food / respiration / photophosphorylation / chemiosmosis **;** 3 transfers energy (to) / (immediate) energy donor (to) **;** 4 in <u>all</u>, cells / organisms **;** 5 hydrolysis / phosphate loss, releases, energy / 30.5 kJ (per mole) **;** 6 reversible reaction / (AMP and) ADP recycled to ATP **;** 7 small (molecule) / water soluble, so can move within, cell / cytoplasm **;** 8 links energy yielding and energy requiring reactions **;** 9 high turnover (rate) **;** *and any two uses up to question total of 6 from:* 10 active transport / action potential / electrical discharge **;** 11 muscle contraction **;** 12 anabolic reactions / condensation reactions / transcription / translation / DNA replication / Calvin cycle / phosphorylation reactions **;** 13 exocytosis / endocytosis / intracellular transport **;** 14 bioluminescence **;**	**6**

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Question	Answer	Marks
9(b)	*any nine from:* *anaerobic respiration in, mammalian cells / lactic fermentation (**M**):* 1 pyruvate, is reduced / accepts H / accepts H^+ + electron **;** 2 (process uses) reduced NAD **;** 3 from glycolysis **;** 4 converted to, lactate / lactic acid **;** 5 *ref. to* lactate dehydrogenase **;** 6 regeneration of NAD allows glycolysis to continue **;** 7 small energy yield / 2 ATP, (from glycolysis) **;** *difference to, yeast cells / alcoholic fermentation (**Y**): accept **ora** mps 8–11* 8 **M** no, decarboxylation / CO_2 removed (to form ethanal) **;** 9 **M** single / one, step **/** enzyme **or Y** two, steps / enzymes **;** 10 **M** pyruvate is H acceptor **and** in **Y** ethanal is H acceptor **;** 11 **M** reversible / lactate is (later) converted back to pyruvate **or Y** irreversible or ethanal / ethanol, cannot be converted back to pyruvate **;** 12 **M** needs oxygen / by oxidation / *ref. to* oxygen debt **;**	**9**

Question	Answer	Marks
10(a)	*any six from:* 1 nucleus in, cell body / soma **;** 2 (long) dendron **;** 3 (short) axon **;** 4 many mitochondria (in cell body) **;** 5 many, RER / ribosomes **or** presence of Nissl's granules (in cell body) **;** 6 synaptic, knobs / terminals / boutons **;** 7 Schwann cells **/** myelin sheath **;** 8 nodes of Ranvier **;**	**6**
10(b)	*any nine from:* 1 Na^+ moves out of, cell **and** K^+ moves into cell **;** 2 3 Na^+ for every 2 K^+ **;** 3 by, active transport / use of ATP **;** 4 sodium-potassium pump / Na^+ K^+ pump **;** 5 against concentration gradient **;** 6 K^+ diffuses out of cell **and** Na^+ diffuses into cell **;** 7 by facilitated diffusion **/** diffusion through (ion) channels **;** 8 membrane more permeable to K^+ / more K^+ goes out than Na^+ in **;** 9 inside of, cell / membrane, more negative than outside **; ora** 10 membrane / cell, polarised / repolarised **;** 11 (resting potential is), –60 mV / –65 mV / –70 mV **;** 12 AVP **;** e.g. ion movement only at nodes of Ranvier	**9**

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