Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/41**

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.

Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

© UCLES 2019

PUBLISHED

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.

© UCLES 2019

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.

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or guidance for examiners)
I	ignore (for answers that include irrelevant information that does not contradict the expected answer)
AW	alternative wording (where responses vary more than usual)
ora	or reverse argument (for answers which are written as the opposite to the expected answer)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ecf	error carried forward
mp	marking point (with relevant number)

© UCLES 2019

Question	Answer	Marks
1(a)(i)	(auxin) receptor (protein) / auxin binding protein **;**	**1**
1(a)(ii)	**B** – proton / H^+ / hydrogen ion, pump **;** **C** – potassium / K^+ / ion, channel / pore **;** **D** – aquaporin **;**	**3**
1(b)	*any **three** from:* 1 (cell wall) pH decreases / becomes more acidic **;** 2 expansins **;** 3 break / loosen, non-covalent, bonds / cross-links **;** 4 between cellulose and, hemicellulose / matrix / calcium pectate **or** between cellulose microfibrils **;** 5 cell wall, expands / stretches **OR** microfibrils move past each other **;** 6 due to turgor pressure (on wall) **;**	**3**
1(c)	*any **two** from:* 1 water potential, decreases / becomes more negative **;** 2 water moves into cell, by osmosis / down water potential gradient **;** 3 cell, expands / increases in volume / elongates **;**	**2**

Question	Answer	Marks
2(a)(i)	1 continuous **;**	**1**
2(a)(ii)	*any **three** from:* 1 several / many, genes **;** 2 additive effect / gene(s) (products) interact **;** 3 environment has, big / significant, effect **;** 4 (named) environment(al factors) affects gene expression **;** 5 e.g. age / diet / disease / parasites / chemicals / mutagens / alcohol in utero, can affect, development / growth / IPD / phenotype **;**	**3**
2(b)(i)	1 regulator(y) (gene) **;** *plus any **two** from:* 2 gene codes for / makes, transcription factor / activator / inducer **or** protein is, transcription factor / activator / inducer **;** 3 TF / (PAX3) protein / gene product / inducer / activator, binds to DNA **;** 4 (binding site for TF is) promoter / enhancer **;** 5 helps / stimulates, RNA polymerase (binding / action) **;**	**3**
2(b)(ii)	*any **five** from:* 1 get (total) mRNA from (embryonic) cell (expressing *PAX3)* **;** 2 make, cDNA / ssDNA from mRNA **;** 3 add fluorescent, label / tag / dye / chemical, to (this) DNA **;** 4 microarray / chip, has DNA, spots / probes / reporters / oligos, from, known / named, genes **;** 5 cDNA / ssDNA, hybridises with / binds to / complementary base pairs with, (spots / probes / reporters / DNA, on) chip **;** 6 fluorescent spots, indicate / show, (gene / DNA) expression **;** 7 AVP **;** e.g. *ref. to* wash off excess (c)DNA after hybridisation UV / laser (scan), to see fluorescence intensity of fluorescence gives quantitative measure	**5**
2(b)(iii)	*any **three** from:* 1 small genetic difference / one gene / *PAX3*, gives, many / big, phenotypic effect(s) **;** 2 because *PAX3*, regulates / controls, many / other, genes **;** 3 different, level / magnitude / intensity / pattern, of gene expression (of other genes in chimps) **;** 4 higher PAX3 (expression / protein) makes, chimps eyes closer together / chimp IPD smaller / decreases face width **;**	**3**

© UCLES 2019

Question	Answer	Marks
3(a)	1 *symbols:* normal (allele) = **E** and EOPD (allele) = **e ;** 2 *parent genotypes + gametes:* **Ee** x **Ee and E e E e ;** 3 *offspring genotypes:* **EE Ee (Ee) ee ;** 4 *ratio of offspring phenotypes:* **3** normal **: 1**, EOPD / with disease **;**	**4**
3(b)	*any **five** from:* 1 missense mutation **;** 2 mRNA forms with different, codon / triplet **;** 3 different tRNA, binds / base pairs **;** 4 amino acid / primary structure (of, polypeptide / protein / kinase), changed / different **;** 5 tertiary / 3D, structure (of, polypeptide / protein / kinase) changed **;** 6 (change) may affect / distort, active / catalytic / ATP binding, site **;** 7 nonsense mutation **;** 8 forms (early) STOP codon **;** 9 no, matching tRNA / amino acid added **;** 10 shortened / truncated / incomplete, polypeptide **;**	**5**
3(c)	*any **two** from:* 1 only need one allele to produce inhibitor **;** 2 other proteins cannot be, phosphorylated / activated **;** 3 no / less, aerobic respiration / ATP, in (mitochondria of) neurones **;** 4 (less ATP so) problem with, dopamine recycling / sodium-potassium pump / establishing resting potential / repolarisation**;** 5 neurones die **;**	**2**

© UCLES 2019

Question	Answer	Marks
4(a)	<table><tr><th>correct order</th><th>letter of stage</th></tr><tr><td>1</td><td>*E*</td></tr><tr><td>2</td><td>**I**</td></tr><tr><td>3</td><td>**F**</td></tr><tr><td>4</td><td>**A**</td></tr><tr><td>5</td><td>**G**</td></tr><tr><td>6</td><td>*J*</td></tr><tr><td>7</td><td>**B**</td></tr><tr><td>8</td><td>**K**</td></tr><tr><td>9</td><td>**C/H**</td></tr><tr><td>10</td><td>**H/C**</td></tr><tr><td>11</td><td>*D*</td></tr></table> ; ; ; ;	**4**
4(b)	*any **four** from:* 1 acts as, coenzyme / cofactor **;** 2 to dehydrogenase / in dehydrogenation **;** 3 takes / carries / delivers / releases / gives, hydrogen / H (atoms) **;** 4 to, (carrier on) ETC / inner mitochondrial membrane / cristae **or** for, ATP production / oxidative phosphorylation **;** 5 *ref. to* redox / reduction and oxidation / reduced **and** oxidised **;** 6 2.5 / 3, ATP per reduced NAD **;**	**4**

Question	Answer	Marks
4(c)(i)	6 **;**	**1**
4(c)(ii)	*any **one** from:* 1 hydrogen carbonate (ions) prevents decrease in (blood) pH **;** 2 buffer system / carbonic acid dissociates / *ref. to* carbonic anhydrase **;**	**1**

Question	Answer	Marks
5(a)(i)	(mean hind limb length) should decrease / legs get short**er ;**	**1**
5(a)(ii)	(mean hind limb length) will vary **;**	**1**
5(b)	*any **five** from descriptions (**D**), suggestions (**S**) and explanations (**E**):* **D1** on, all / seven / the, experimental / founder, islands hind limb length decreased **;** **S1** directional selection **;** **D2** on source island hind limb length stayed the same **;** **S2** stabilising selection **;** *explanation in context of experimental islands:* **E1** selection pressure is, (reduced / thinner) perch / branch, (diameter)**;** **E2** short (hind) limbs are, a selective advantage / selected for, on, experimental islands / founder islands / thin branches **;** **E3** (short hind limbs) allow / increase, stability **/** survival **;** **E4** (survivors), reproduce / breed / pass on allele(s) (for short hind limbs) **;** **E5** allele(s) for short (hind) limbs increases in frequency **;**	**5**

Question	Answer	Marks
5(c)	*any **three** from:* 1 allopatric ; 2 populations / lizards / *A. sagrei*, on different islands, geographically / geologically, isolated / separated ; 3 have different, selection pressures / environmental conditions ; 4 different mutations occur ; 5 genetic drift ; 6 no gene flow / reproductive isolation, between, lizards on different islands / populations / (new) species ; 7 genetic differences accumulate ;	**3**
5(d)	*any **three** from:* 1 (each island has a) small population ; 2 with, low genetic diversity / small gene pool ; 3 inbreeding depression / low heterozygosity / high homozygosity ; 4 environmental change **/** natural disaster, may, kill them all / make (whole / each) population extinct ;	**3**

© UCLES 2019

Question	Answer	Marks
6(a)	*any **four** from:* 1 gene(s) from, another species / (soil) bacterium / *B.(acillus) thuringiensis* ; 2 restriction, enzyme / endonuclease ; 3 (Ti) plasmid / *Agrobacterium (tumefaciens)* / vector / virus / liposome / gene gun ; 4 (DNA) ligase ; 5 (forms) recombinant, DNA / plasmid / vector ; 6 new gene / rDNA / plasmid, enters, maize / MON810, embryos / cells / genome / DNA ; 7 gene, expressed / transcribed (and translated), to make, protein / toxin ; 8 *ref. to* marker genes / insert promoter ;	**4**
6(b)	*any **four** from:* *description (D), social (S), ethical (E)* **D1** ban / 0%, GM maize, decreases, yield / harvest ; **D2** (grow) more / 88%, GM maize , increases, yield / harvest ; **S1** GM crops increase food supply ; **S2** GM crops decrease food cost ; **S3** GM crops increase a country's wealth ; **E1** GM crops relieve, hunger / starvation ; **E2** GM crops reduce land area for crops so, conserve habitats / protect biodiversity / allow biofuel cultivation ; 8 less insecticides could be used (in Argentina / Honduras / Spain) ; 9 negative, social / ethical, implication **from data** ;	**4**

Question	Answer	Marks
7(a)(i)	*any **three** from:* 1 blood glucose concentration rises in both with drink ; 2 diabetic, always / initially, has high**er** blood glucose concentration ; 3 diabetic has, high**er** peak / steep**er** rise, in blood glucose concentration ; 4 diabetic blood glucose concentration, has slower fall / does not return to normal in 3 hours / is still high after 3 hours ; 5 compare two data points with *x* and *y* figures and units ;	**3**

© UCLES 2019

Question	Answer	Marks
7(a)(ii)	β cells / pancreas / islets of Langerhans / hypothalamus ;	1
7(a)(iii)	negative feedback ;	1
7(b)(i)	**A** – glucose oxidase ; **B** – (hydrogen) peroxidase ;	2
7(b)(ii)	*biosensor* – rapid / immediate / 2 seconds, reading **or** (more), accurate / precise / quantitative / numerical / sensitive **or** shows current blood glucose / re-usable ; *dipstick* – non-invasive / painless / less risk of infection / easy to use / cheap ;	2
7(c)	*any **five** from:* 1 (insulin) binds to receptors on, liver / muscle / adipose (cells / tissue / organ) ; 2 GLUT(4) added to membrane of, muscle / adipose, cells **or** (GLUT 4) increases , muscle / adipose, cell, permeability (to glucose) ; 3 glucokinase phosphorylates glucose in liver cells **or** increased (rate of) diffusion of glucose into liver cells ; 4 more / faster, respiration of glucose ; 5 activates glycogen synthase / causes glycogenesis / causes glycogen synthesis ; 6 causes, lipid / triglyceride / fatty acid, synthesis **or** decreases, glycogenolysis / lipolysis / gluconeogenesis ; 7 blood glucose concentration decreases ;	5

© UCLES 2019

Question	Answer	Marks
8(a)	1 **C ;** 2 greater / highest / most, number of (plant + insect) species / species richness **;** 3 greater / highest / most, number of habitats **;**	**3**
8(b)	area **A** because if one species, increases / decreases (in abundance), this may affect the whole, community / food web / ecosystem **;**	**1**
8(c)	*any **one** from:* 1 species may have, medicinal / economic / aesthetic, benefits **;** 2 (to maintain) genetic diversity / genetic variation / alleles **;** 3 *ref. to* ethical / moral / stewardship **;**	**1**

Question	Answer	Marks
9(a)	*any **seven** from:* 1 reaction / photosynthesis, controlled / affected, by more than one / several, factors **;** 2 factor / variable, nearest its minimum value / in shortest supply **;** 3 which, prevents increase in rate / restricts rate / makes rate plateau **;** *to increase crop yield in glass house:* 4 light intensity **+** temperature **+** carbon dioxide concentration **;** 5 artificial lights / lamps / provide lighting at night **;** 6 heaters / open windows / control ventilation **;** 7 CO_2 from, cylinders / dry ice / combustion / (named) fuel heater **;** 8 automation / computerised control / digital control **;** 9 *ref. to* optimum, light intensity / temperature / CO_2 concentration / conditions **;** 10 AVP **;** e.g. water / irrigation / sprinklers control / optimum, humidity (named) fertiliser / nitrate / manure	**7**

Question	Answer	Marks
9(b)	*any **eight** from:* *meiosis I* 1 chromosomes, condense / thicken / spiralise ; 2 homologous chromosomes pair up / bivalents form ; 3 crossing over / chiasma(ta) ; 4 spindle fibres / microtubules, attach to / pull, centromeres / kinetochores ; 5 bivalents, line up / arranged, on equator ; 6 independent / random, assortment (of homologous pairs) ; 7 chromosomes, move / pulled, to poles ; *meiosis II* 8 (single) chromosomes / pairs of chromatids, line up on, equator / mid-line ; 9 at right angles to first equator ; 10 centromeres divide ; 11 chromatids separate ; 12 *ref. to* haploid / chromosome no. halved / one set of chromosomes ;	**8**

Question	Answer	Marks
10(a)	*any **seven** from:* 1 impulse / action potential / depolarisation, reaches, synaptic knob ; 2 (voltage-gated) Ca^{2+} channels open (in pre-synaptic membrane) ; 3 Ca^{2+} enters (synaptic knob / pre-synaptic neurone) ; 4 vesicles with acetylcholine, move towards / fuse with, pre-synaptic membrane ; 5 (ACh) released / secreted / exocytosis ; 6 ACh diffuses across synaptic cleft ; 7 binds to receptors on post-synaptic membrane ; 8 (ligand-gated) Na^{+} channels open **and** Na^{+} enters post-synaptic neurone ; 9 depolarisation / action potential / EPSP ; 10 acetylcholinesterase, breaks down ACh / recycles Ach ;	**7**

© UCLES 2019

Question	Answer	Marks
10(b)	*any **eight** from:* 1 Hill reaction **;** 2 oxidised DCPIP is blue **;** 3 (DCPIP) goes colourless when reduced **;** 4 method for making chloroplast, extract / suspension **;** 5 *ref. to* buffer solution / control osmosis / control pH **;** 6 expose chloroplasts + DCPIP to wavelength of light **;** 7 (method 1) measure time for, blue to disappear / blue-green → green / colour to match control with no DCPIP **or** (method 2) leave for fixed time and measure with colorimeter **;** 8 calculate rate as, (method 1) $1/t$ **or** (method 2) change in colour value divided by time **;** 9 test five (or more), wavelengths / colours **;** 10 do three repeats **/** calculate means **;** 11 plot wavelength on *x*-axis against, dependent variable / calculated rate, on *y*-axis **;** 12 AVP **;**	**8**

© UCLES 2019