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

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 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.

© UCLES 2019

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

© UCLES 2019

Question	Answer	Marks
1(a)	**A** – Schwann cell / myelin sheath **;** **B** – axon / axoplasm / cytoplasm **;**	**2**
1(b)	1 action potential / impulse, 'jumps' from node to node **;** 2 local circuits, set up between nodes / longer **; A** local currents 3 fast / increases speed (of transmission of impulse) **;**	**3**
1(c)	*any **five** from:* 1 no calcium ions enter (the presynaptic knob) **;** 2 (so) vesicles do not, move towards / fuse with, presynaptic membrane **;** 3 no, exocytosis / release, of ACh **; R** exocytosis of vesicles 4 ACh does not diffuse across (synaptic) cleft **;** 5 no binding with receptor (protein) on postsynaptic membrane **;** 6 sodium (ion) channels do not open **;** 7 sodium ions do not enter (postsynaptic) neurone **;** 8 no depolarisation (of postsynaptic membrane) **;**	**5**

© UCLES 2019

Question	Answer	Marks
2(a)(i)	continuous **;** **A** normal distribution	**1**
2(a)(ii)	evolution / natural selection / artificial selection / directional selection / adaptation / selective breeding **;**	**1**
2(b)	*any **three** from:* *captive fish:* 1 controlled conditions **so** phenotype less varied **;** 2 more oxygen **so** larger **;** 3 less space / overcrowding, **so** smaller **;** 4 less space / overcrowding, **so** (signs of) disease / wounds **;** 5 food qualified **linked to**, size / muscle / fat **;** 6 AVP **;** e.g. named tank condition **linked to** skin colour / no predators linked to increase in size / temperature linked to size	**3**

© UCLES 2019

Question	Answer	Marks
2(c)(i)	*any **five** from:* 1 obtain mRNA from wild and captive bred fish / AW **;** 2 reverse transcription of mRNA to produce cDNA **;** 3 add fluorescent label to (c)DNA **; I** colour **A** dyes / markers / tags 4 (microarray has) ssDNA probes **;** 5 each from a, different / known, gene **;** 6 (c)DNA hybridises / AW, to, probes / ssDNA (on microarray) **;** 7 fluorescence shows the expressed genes **;** 8 intensity of fluorescence (shows level of gene expression) **;** 9 compare, fluorescence / gene expression (between fish groups) **;** 10 AVP **;** e.g. *ref. to* washing off excess (c)DNA (only), after hybridisation UV light / laser scanning (to record fluorescence pattern)	**5**

© UCLES 2019

Question	Answer	Marks
2(c)(ii)	1 *ref. to* transcription factors **;** *any **three** from:* 2 TF / gene product / protein, bind to DNA **;** 3 (TF binds to) promoter **;** 4 switches genes, on / off **;** AW **I** genes, expressed / not expressed 5 *ref. to* binding of RNA polymerase **; R** if operator mentioned 6 mRNA is made / transcription occurs **; ora** 7 AVP **;** e.g.(so that genes are expressed) at the correct time / in the correct context / in the correct cell type / in the correct order **;**	**4**
2(d)(i)	*any **one** from:* 1 differences caused by selection in captive-bred population **;** 2 (not environmental because) all, offspring / fish, were kept in same environment **;**	**1**
2d(ii)	*idea that* captive fish have better, wound healing / immune response **;**	**1**

© UCLES 2019

Question	Answer	Marks
3(a)	*any **four** from:* 1 gene (for herbicide resistance) from, another species / variety / (soil) bacterium **;** **A** allele 2 *ref. to* restriction enzyme **;** 3 *ref. to* (Ti) plasmid / vector / *Agrobacterium* / gene gun **;** 4 (DNA) ligase **;** 5 *ref. to* recombinant, DNA / plasmid **;** 6 introduced into soybean, cells / genome / DNA **;** **I** embryos 7 (new) gene, expressed / transcribed **;** 8 (to produce) protein / enzyme, resistant to, glyphosate / herbicide **;** 9 AVP **;** e.g. *ref. to* tissue culture / produce callus / detail such as grow cells on growth medium / marker genes / insert promoter	**4**

© UCLES 2019

Question	Answer	Marks
3(b)	1 decrease / ban / 0%, GM soybean (cultivation), decreases yield **;** 2 use GM soybean, more / 94%, increases yield **;** *use GM crops – accept **ora** throughout if GM crops banned* 3 increase food supply / decrease food cost **;** 4 relieve, hunger / starvation **;** 5 less / more, herbicides used **;** *correct context needed* 6 less / more, money spent on herbicides **;** *correct context needed* 7 increase profits / improve economy **;** 8 unknown health consequences **;** (can be positive or negative) 9 high cost of GM seed **;** 10 *idea of* decrease in, genetic variation / biodiversity **;**	**5**

Question	Answer	Marks
4(a)	*parental genotypes* **Aa** × **Aa** **and** *gametes* **A** **a** and **A** **a ;** *offspring genotypes* **AA** **Aa** (**Aa**) **aa ;** *offspring phenotypes (correctly linked to genotypes)* normal normal / carrier (normal / carrier) OCA1A / albino / described **;** *probability* 25% **; A** 1 in 4 / 0.25 / ¼ **I** ratio	**4**
4(b)(i)	*missense* results in a different amino acid **;** *nonsense* *ref. to* STOP codon **;**	**2**
4(b)(ii)	*any **four** from:* 1 frameshift / described **;** 2 change in, primary structure / amino acid sequence **;** 3 protein / enzyme / tyrosinase, folds incorrectly / changes tertiary structure / changes 3D shape **;** 4 may introduce STOP codon **;** 5 shortened polypeptide / no tyrosinase produced **;** 6 <u>tyrosinase</u>, non-functional / lacks active site / active site changed shape / cannot form ESCs **;** 7 tyrosine not converted to DOPA / DOPA not converted to dopaquinone **;** 8 (so) dopaquinone not formed to produce melanin **;**	**4**

© UCLES 2019

Question	Answer	Marks
4(c)	*any **two** from:* 1 small gene pool / low genetic variation / low genetic diversity / low heterozygosity / high homozygosity ; 2 isolated (population) / described ; 3 inbreeding (within their population) ; 4 albinism has a selective advantage ; 5 founder effect / genetic bottleneck ; 6 genetic drift ;	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)(i)</td><td>correct lines ;;</td><td>2</td></tr>
<tr><td>5(a)(ii)</td><td><u>basement membrane</u> ;</td><td>1</td></tr>
<tr><td>5(b)</td><td>
<table>
<tr><th>afferent arteriole lumen diameter</th><th>efferent arteriole lumen diameter</th><th>GFR</th></tr>
<tr><td>normal</td><td>normal</td><td>normal</td></tr>
<tr><td>decreased</td><td>normal</td><td>decrease ;</td></tr>
<tr><td>normal</td><td>increased</td><td>decrease ;</td></tr>
</table>
</td><td>2</td></tr>
<tr><td>5(c)</td><td>any five from:
1 active transport / pumping, of Na+ (out of cells) into, blood / tissue fluid ;
2 sodium (potassium) pumps in basal membrane ;
3 Na^+ concentration decreases inside cells / Na^+ concentration gradient set up ;
4 (so) Na^+ enters (epithelial / tubule) cells from, lumen / filtrate ;
5 by facilitated diffusion ;
6 Na^+ co-transports glucose into cell ;
7 this is, secondary / indirect, active transport ;
8 (facilitated) diffusion of glucose (out of cells) into blood ;
9 GLUT proteins ;</td><td>5</td></tr>
</table>

© UCLES 2019

Question	Answer	Marks
5(d)	*any **three** from:* 1 microvilli, has large surface area / for increased (re)absorption **;** **I** increase surface to volume ratio 2 many mitochondria provide ATP for, sodium (potassium) pumps / active transport **;** 3 tight junctions / closely packed cells, hold adjacent cells together / prevents leakage / fluid cannot pass between cells / substances must pass through cells **;** 4 many transport proteins for movement of named substance **;**	**3**

Question	Answer	Marks
6(a)	*idea that* organisms have changed over time **;**	**1**
6(b)	*any **four** from:* 1 *ref. to* mutation **;** 2 (mutation) results in a change in eye structure **;** 3 *ref. to* natural selection / selective advantage **;** 4 light receptor (cells) develop **;** 5 light receptor layer becomes cup-shaped **;** 6 *idea that* entry for light becomes narrower **;** 7 lens forms **;** 8 fixed lens / cornea, (forms) **;**	**4**

© UCLES 2019

Question	Answer	Marks
6(c)	*any **two** from:* *must refer to both octopus and mammal* 1 had similar, selection pressures / light conditions **;** 2 allows organisms to escape predators **;** 3 allows organisms to find food **;** 4 convergent evolution / described **;**	**2**
6(d)(i)	shared origin / common ancestor / same ancestor **;**	**1**
6(d)(ii)	*any **two** from:* 1 compare (amino acid sequences of two species) **;** 2 more similar (amino acid sequence) more closely related the species are **; ora** 3 more similar (amino acid sequence) more recent common ancestor / less time has elapsed (since a common ancestor)**;** **ora** 4 *ref. to* molecular clock **;**	**2**

Question	Answer	Marks
7(a)	*any **three** from:* 1 functional / self-contained / specific, entity / unit / area **;** 2 community (of organisms) / all living organisms of all species / all populations of organisms **;** 3 *ref. to* interactions **;** 4 abiotic / physical, and, biotic / biological, factors **; A** living and non-living 5 *idea that* linked by, energy flow / mineral cycling / food webs / food chains / nutrient cycle **;**	**3**
7(b)	niche **;** species **;** abiotic **;**	**3**

Question	Answer	Marks
8(a)	<table><tr><th>correct order</th><th>letter of stage</th></tr><tr><td>1</td><td>**V**</td></tr><tr><td>2</td><td>**S**</td></tr><tr><td>3</td><td>**U**</td></tr><tr><td>4</td><td>**W**</td></tr><tr><td>5</td><td>**R**</td></tr><tr><td>6</td><td>**Q**</td></tr><tr><td>7</td><td>**X**</td></tr><tr><td>8</td><td>**T**</td></tr></table> 6 correct = 4 marks 4/5 correct = 3 marks 2/3 correct = 2 marks 1 correct = 1 mark ;;;;	**4**
8(b)	*ATP synthase* - cristae / inner membrane ; *Krebs cycle* - matrix ; *electron transport chain* - cristae / inner membrane ; *coenzyme A* - matrix ; *pyruvate* - matrix ;	**5**

© UCLES 2019

Question	Answer	Marks
9(a)	*any **eight** from:* 1 microburette / (gas) syringe / photosynthometer ; 2 cut shoot (of aquatic plant) ; 3 place shoot in tube of hydrogen carbonate solution ; 4 to provide carbon dioxide ; 5 water bath / maintain temperature ; 6 choose 4 different temperatures ; 7 acclimatisation ; 8 lamp placed fixed distance away ; 9 measure length of bubble of, gas / oxygen, in set time **or** count number of bubbles produced in set time ; 10 repeat experiment twice more ; 11 calculate mean values ; 12 method to calculate rate of photosynthesis ; 13 AVP ; e.g. dark room / heat shield / LED bulbs	**8**

© UCLES 2019

Question	Answer	Marks
9(b)	*any **seven** from:* *restoration techniques* 1 reforesting / replanting ; 2 reintroduction of, named / native, animal (species) ; 3 bioremediation / described ; 4 bubbling oxygen through / oxygenation of, water ; 5 *ref. to* normalising pH of, water bodies / soil ; 6 dredging / clearing / purifying, rivers / lakes / water bodies ; 7 litter / waste, removal ; 8 removal of toxic layer of soil / soil cleaned and put back ; 9 *idea of* improving soil fertility ; 10 removal of alien (plant / animal) species ; 11 protection against grazing ; 12 named example ; 13 named example ;	**7**

Question	Answer	Marks
10(a)	*any **eight** from:* 1 synthetic hormones used **;** 2 as they do not get broken down quickly / act for longer **;** 3 oestrogen / progesterone, (blood) concentrations remain high **;** 4 (act on) anterior pituitary (gland) **;** 5 FSH not, produced / secreted **;** 6 Graafian / dominant, follicle does not develop **;** 7 LH not, produced / secreted **;** 8 ovulation prevented / described **;** 9 cervical mucus thickens (to stop sperm) **;** 10 prevents implantation / endometrium less well developed **;** 11 *ref. to* negative feedback **;** 12 AVP **;** e.g. taken daily for 21 days **then** stops (for 7 days) to allow menstruation / taken daily throughout month	**8**

© UCLES 2019

Question	Answer	Marks
10(b)	*any **seven** from:* 1 named geographical barrier **;** e.g. river / mountain / sea 2 two populations (of same species) separated **;** 3 no, breeding / allele flow / gene flow, between populations **or** reproductively isolated **;** 4 different, selection pressures / (environmental) conditions **;** 5 mutations occur **;** 6 individuals with beneficial alleles, are selected for / survive / reproduce / have a selective advantage **;** 7 beneficial <u>alleles</u> passed on **;** 8 change in, <u>allele</u> frequency / gene pool **;** 9 genetic drift **;** 10 *ref. to* over a long time / many generations **;** 11 (eventually) unable to interbreed to produce fertile offspring / reproductively isolated **;** 12 <u>allopatric</u> (speciation) **;**	**7**

© UCLES 2019

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 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 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

© UCLES 2019

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>compound / structure</th><th>location</th></tr>
<tr><td>acetylcholine</td><td>C and D ;</td></tr>
<tr><td>voltage-gated channel</td><td>A ;</td></tr>
<tr><td>receptor protein</td><td>B ;</td></tr>
<tr><td>acetylcholinesterase</td><td>C ;</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(b)</td><td>any two from:
1 ref. to ion (transport) ;
2 open / closes, when, voltage / depolarisation / charge / electrical potential, changes ; A arrival of an action potential
3 detail ; e.g. ion specificity / hydrophilic pore / transmembrane / (made of) protein</td><td>2</td></tr>
<tr><td>1(c)</td><td>any three from:
1 breaks down acetylcholine ;
2 (so) acetylcholine leaves, binding site / receptor / B ; ora
3 depolarisation stops in <u>post-synaptic membrane</u> / B ;
4 stops continuous action potentials (in post-synaptic membrane) ;
5 recycle ACh / described ;</td><td>3</td></tr>
</table>

© UCLES 2019

Question	Answer	Marks
1(d)	*any **two** from:* 1 one-way transmission **;** 2 interconnection of nerve pathways **;** 3 AVP **;** e.g. memory / learning integration of impulses	**2**

Question	Answer	Marks
2(a)	*any **two** from:* 1 no melanin **;** 2 white hair **;** 3 (very) pale skin **;** 4 pink / very pale / AW, eyes **;**	**2**

© UCLES 2019

Question	Answer	Marks
2(b)(i)	*any **three** from:* 1 more males / fewer females, have ocular albinism **;** 2 males with (one copy of) recessive allele have ocular albinism / females with (one copy of) recessive allele are carriers **;** 3 males (with ocular albinism) receive recessive allele from mothers **;** 4 fathers cannot pass on ocular albinism to their sons **;** 5 (because) males pass Y chromosome to sons **;** 6 males with ocular albinism pass recessive allele to daughters **;** 7 detail from Fig. 2.1 **;** e.g. all daughters (3, 5, 7) of male 1 are carriers / all sons (9 and 10) of male 1 do not have ocular albinism / males 11, 12, 13, get ocular albinism from mothers 3 and 5	**3**
2(b)(ii)	*symbols* normal <u>allele</u> = **A** OA1 <u>allele</u> = **a ;** *parental genotypes* $\mathbf{X^aY}$ x $\mathbf{X^AX^A}$ and *gametes* $\mathbf{X^a}$ **Y** and (all) $\mathbf{X^A}$ **;** *offspring genotypes (phenotypes correctly linked)* $\mathbf{X^AX^a}$ $\mathbf{X^AY}$ **;** normal / carrier, female normal male **;**	**4**

Question	Answer	Marks
2(b)(iii)	*any **two** from:* 1 frameshift / every triplet from site of deletion is changed **;** 2 primary structure / tertiary structure / 3D shape, is changed **or** (protein) folded incorrectly**;** 3 (protein has) changed, binding / active, site**;** 4 premature STOP codon leads to incomplete protein **;**	**2**
2(b)(iv)	*any **one** from:* *for* 1 decide whether to have children **;** 2 earlier treatment if child born with ocular albinism **;** *any **one** from:* *against* 3 test may be expensive **;** 4 condition, is mild / not life threatening **;** 5 can't be treated **;**	**2**

Question	Answer	Marks
3(a)(i)	continuous**;**	**1**

Question	Answer	Marks
3(a)(ii)	*any **two** from:* 1 smoking **;** 2 air pollution **;** 3 workplace pollution **;** 4 previous lung disease **;**	**2**
3(b)(i)	1 *ref. to* transcription factors **;** *any **three** from:* 2 TF / gene product / protein, bind to DNA **;** 3 (TF binds to) promoter **;** 4 *ref. to* binding of RNA polymerase **; R** if operator mentioned 5 (so) mRNA is made / transcription occurs **; ora** 6 detail from Fig. 3.2 **;** gene **A**, switches on / controls, 4 genes **or** genes B and C and 2 other genes gene **B**, switches on / controls, 6 genes gene **C**, switches on / controls, 11 genes	**4**

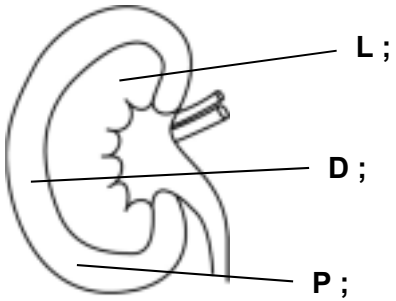
© UCLES 2019

Question	Answer	Marks
3(b)(ii)	*any **five** from:* 1 obtain mRNA from (basal) cell (expressing gene C) **;** 2 reverse transcription of mRNA to produce cDNA **;** 3 add fluorescent label to (c)DNA **; I** colour 4 (microarray has) ssDNA probes **;** 5 each from a, different / known, gene **;** 6 (c)DNA hybridises / AW, to, probes / ssDNA (on microarray) **;** 7 fluorescence shows the expressed genes **;** 8 AVP **;** e.g. *ref. to* washing off excess cDNA (after hybridisation) UV light / laser scanning (to record fluorescence pattern) intensity of fluorescence gives quantitative measure	**5**
3(c)	*any **three** from:* 1 sequence gene(s) **;** 2 predict, primary structure / amino acid sequence **;** 3 model receptor protein (3D) structure **;** 4 find molecules, that can block receptors **;** 5 without triggering effects **;** 6 *ref. to* limiting receptor protein production **;**	**3**

© UCLES 2019

Question	Answer	Marks
4(a)	*any **four** from:* 1 gene(s) from, another species / variety / (soil) bacterium / *Bacillus thuringensis* **;** 2 *ref. to* restriction enzyme **;** 3 *ref. to* (Ti) plasmid / vector / *Agrobacterium tumefaciens* / gene gun **;** 4 (DNA) ligase **;** 5 *ref. to* recombinant, DNA / plasmid **;** 6 introduced into rice, cells / genome / DNA **;** 7 (new) gene, expressed / transcribed, 8 toxic protein produced **;** 9 *ref. to* marker genes / insert promoter **;**	**4**
4(b)(i)	*any **two** from:* 1 (crop) yields would decrease if GM banned **;** 2 prices would increase if GM banned **;** 3 AVP **;** e.g. issues involving, food security / social unrest / wars	**2**
4(b)(ii)	*growing GM crops* 1 helps protect, ecosystems / habitat / biodiversity **; ora** 2 helps reduce, greenhouse effect / global warming / climate change / risk of flooding **; ora**	**2**

© UCLES 2019

Question	Answer	Marks
5(a)	 **L ;** **D ;** **P ;**	**3**
5(b)	*any **four** from:* 1 blood pressure increases in kidney **;** 2 (so) more ultrafiltration **;** 3 (therefore) increased volume of urine **;** 4 ADH concentration in blood decreases **;** 5 *ref. to* less reabsorption of water in collecting duct **;** 6 AVP **;** e.g. blood pressure drop in skin sweating stops so increases volume of blood	**4**

Question	Answer	Marks
5(c)	*any **five** from:* 1 osmoreceptors detect decrease (in water potential) **; ora A** change 2 (osmoreceptors) in hypothalamus **;** 3 ADH released (into blood) **;** 4 by posterior pituitary (gland) **;** 5 *ref. to* increase in aquaporins in, collecting duct / DCT**; ora** 6 more water reabsorbed **; ora** 7 water potential returns to set point **;**	**5**
5(d)	*water potential* – decrease **and** *volume* – decrease **;**	**1**

Question	Answer	Marks
6(a)(i)	(theory) **C ;**	**1**

Question	Answer	Marks
6(a)(ii)	1 (theories) **A** and **B** **;** *any **three** from* 2 (**A**) energy acts as a selection pressure / having eyes is a selective disadvantage **; ora** 3 detail of mp2 **;** e.g. less energy used means lower need for food 4 (**B**) selection for more chemoreceptors / more chemoreceptors is a selective advantage **;** 5 detail of mp4 **;** e.g. more chemoreceptors allows detection of more food 6 no eyes / more chemoreceptors, allows individuals to, survive / reproduce **;** AW 7 pass on advantageous, mutation / alleles, to offspring / increase in allele frequency **; ora**	**4**
6(b)(i)	*any **two** from:* 1 count, base / nucleotide, sequence differences **;** 2 few(er) differences in (mt)DNA sequences suggest same species **; ora** 3 fewer mutations means less time has passed since, most recent common ancestor **;**	**2**

© UCLES 2019

Question	Answer	Marks
6(b)(ii)	*any **three** from:* *mitochondrial DNA* accept **ora** throughout 1 inherited from mother alone **;** 2 recombination / crossing over, doesn't occur **;** 3 mutations, occur at a constant rate / molecular clock **;** 4 mtDNA mutates faster (than nuclear DNA) **;** 5. many copies of mtDNA (per cell) **;** 6 is smaller / has fewer genes **;** 7 not associated with histones **;** 8 mtDNA analysis is quicker **;**	**3**

Question	Answer	Marks
7	recapture **;** small / mobile / AW **;** harm **;** predators **;** mix / disperse / integrate **;** marked **;**	**6**

© UCLES 2019

Question	Answer	Marks
8(a)		**4**

correct order	letter of stage
1	**E**
2	**H**
3	**A**
4	**I**
5	**F**
6	**B**
7	**C**
8	**G**
9	**D**

E and **H** in correct position **;**

A and **I** in correct position **;**

B and **C** in correct position **;**

G and **D** in correct position **;**

© UCLES 2019

Question	Answer	Marks
8(b)	*any **five** from:* *in yeast* 1 only glycolysis occurs ; 2 (net) 2 ATP produced ; 3 no oxygen as (final) electron acceptor ; 4 (so) pyruvate does not enter mitochondria ; 5 ETC / chemiosmosis / oxidative phosphorylation / Krebs cycle / link reaction, does not occur ; 6 (ETC / chemiosmosis / oxidative phosphorylation) produce most ATP ; 7 pyruvate / ethanal, converted to ethanol ; 8 ethanol still energy-rich / AW ;	**5**

Question	Answer	Marks
9(a)	*any **eight** from:* 1 ground substance / stroma ; 2 for, light independent stage / Calvin cycle ; 3 contains enzymes / named enzyme e.g. rubisco ; 4 also, sugars / lipids / starch / ribosomes / DNA ; 5 internal membrane system ; 6 for, light dependent stage ; 7 fluid-filled sacs / thylakoids ; 8 grana are stacks of thylakoids ; 9 (grana) hold (photosynthetic) pigments ; 10 (grana) have large surface area for (maximum) light absorption ; 11 (pigments are arranged in), light harvesting clusters / photosystems ; 12 primary pigment / reaction centre / chlorophyll a, surrounded by accessory pigments ; 13 (accessory pigments) pass energy to, primary pigment / reaction centre / chlorophyll a ; 14 different photosystems absorb light at different wavelengths ; 15 membranes hold, ATP synthase / electron carriers ; 16 for, photophosphorylation / chemiosmosis ;	**8**

© UCLES 2019

Question	Answer	Marks
9(b)	*any **seven** from:* 1 grind leaf ; 2 use, solvent / named solvent ; 3 leaf extract contains mixture of pigments ; 4 *ref. to* concentrate extract ; 5 further detail ; e.g. pencil line drawn / extract placed on chromatography paper / extract placed on thin layer chromatography plate 6 paper placed (vertically) in jar of (different) solvent ; 7 solvent rises up paper ; 8 each pigment travels at different speed ; 9 pigments separated as they ascend ; 10 distance moved by each pigment is unique ; 11 R_f value ; 12 two dimensional chromatography ; 13 better separation of pigments ;	**7**

© UCLES 2019

Question	Answer	Marks
10(a)	*any **eight** from:* 1 reduced, NAD / FAD ; 2 passed to ETC ; 3 inner membrane / cristae ; 4 hydrogen released (from reduced, NAD / FAD) ; 5 split into electrons and protons ; 6 electrons pass along, ETC / carriers / cytochromes ; 7 energy released pumps protons into intermembrane space ; 8 proton gradient is set up ; 9 protons <u>diffuse</u>, (back) through membrane / down gradient ; 10 ATP synthase / stalked particles / protein channels ; 11 (ATP produced from) ADP and (inorganic) phosphate ; 12 *idea of* oxygen as final electron acceptor ; 13 addition of proton (to oxygen) to form water / (oxygen) reduced to water ;	**8**

© UCLES 2019

Question	Answer	Marks
10(b)	*any **seven** from:* 1 detail of placing larvae in respirometer **;** e.g. on gauze / use spoon 2 use and role of, KOH / AW**;** 3 water bath / maintain temperature **;** 4 choose 4 different temperatures **;** 5 mark initial position of liquid drop **;** 6 leave for set time **;** 7 measure distance moved by drop (in set time) **;** 8 (use tap to) reset respirometer **;** 9 (at least 3) replicates **;** 10 calculate mean values **;** 11 calculate rate as distance ÷ time **;** 12 plot graph of rate v temperature **;**	**7**

© UCLES 2019