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 **October/November 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.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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.

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

Question	Answer	Marks
1(a)(i)	*any three from* **1** habitat destruction **;** **2** competition for food / food shortage **;** **3** predation / predators **;** **4** disease / infection **;** **5** AVP **;** e.g. pollution **/** pesticide use / removed from wild (to zoos) to conserve species / problems finding a mate	**3**
1(a)(ii)	*any two from* **1** (captive) breeding **;** **2** release into wild / insurance populations **;** **3** education / increase awareness (of illegal bird trade) **;** **4** research**,** diet / habitat / breeding / behaviour / genetic diversity **;** **5** raise money / work with (Bali) government, to set up reserves **;** **6** veterinary / health, care **;**	**2**
1(b)	*any four from* **1** low / little / less / decreased (genetic) (bio)diversity / variation **;** **2** low / little / less / decreased, heterozygosity **;** **3** harmful recessive alleles may come together **;** **4** inbreeding depression **;** **5** no / less / decreased, hybrid vigour **;** **6** not / less, able to adapt to, new / changed, selection pressure **/** disease **/** environment **;**	**4**

Question	Answer	Marks
2(a)	chi-squared / χ^2 (test) **;** 9 **:** 3 **:** 3 **:** 1 **;**	**2**
2(b)	*parents:* **GgRr** x **ggrr** *gametes:* **GR Gr gR gr** x **gr** **;** *offspring:* **GgRr Ggrr ggRr ggrr** **;** *phenotypes:* grey (body) red (eyes); grey (body) brown (eyes); black (body) red (eyes); black (body) brown (eyes) **;**	**4**
2(c)	*any five from* **1** expect (ratio) / (ratio) not, 1 **:** 1 **:** 1 **:** 1 **;** **2** get, many / more / most / majority / large numbers of, grey(body)-red(eye) and black(body)-brown(eye) (flies / offspring) **;** **3** majority resemble (original) parents / have parental phenotypes **;** **4** 1 **:** 1 ratio of two parental types and 1 **:** 1 ratio of recombinant types **;** **5** genes / loci / eye colour and body colour, are, linked / on same chromosome **;** **6** (alleles) **G**+**R** linked and **g**+**r** linked (in, F1 / heterozygotes) **;** **7** no, random / independent, assortment **;** **8** crossing over (produces recombinants / minority phenotypes) **;** **9** low numbers of recombinants show, genes / loci, close together **;**	**5**

Question	Answer	Marks
3(a)(i)	metaphase, **II** / **2** **;**	**1**
3(a)(ii)	*any two from* **1** spindle (fibres) / microtubules, contract / shorten **;** **2** chromosome(s), move / pulled, to pole(s) / centriole(s) **;** **3** centromeres, move / lead / pulled, first **;** **4** homologous chromosomes separate **or** pair (of chromosomes) / bivalent, pulled apart **;**	**2**

Question	Answer	Marks
3(a)(iii)	*any two from* **1** non-sister chromatids **;** **2** swap / exchange, alleles / sections of DNA **;** **3** chiasmata **;** **4** (giving) new / different, allele combinations **or** recombination **;**	**2**
3(b)(i)	*any two from* **1** test (leaves / population / group) takes, longer / higher time or test group degrades mesotrione more slowly **;** **2** so test group, less resistant / fewer have resistance **;** **3** test standard deviation is, larger / higher, so (population) more variable **;**	**2**
3(b)(ii)	*any two from* **1** can, adapt / evolve / survive long term **;** **2** resistant / mutant, plants / hemp, have selective advantage **;** **3** in areas where / when, mesotrione is used **;** **4** resistant / mutant, plants survive and reproduce **;**	**2**
3(b)(iii)	*any one from* **1** lets farmer choose, different / correct / effective / best, herbicide **;** **2** less money wasted due to, wrong herbicide / reduced crop yield **;**	**1**
3(c)(i)	*numerator working* 17.4 **;** *denominator working* $\sqrt{3.76 + 0.91}$ **OR** $\sqrt{4.67}$ **OR** 2.16 **;**	**2**
3(c)(ii)	*any two from* **1** reject because, ***t* /** calculated value / it, is, higher / greater / more, than, 2.23 / critical value **;** **2** probability of result by chance **is less than**, 0.05 / 5% **or** $p <$ 0.05 **;** **3** there is a significant difference between the, means / populations / test and control **;**	**2**

Question	Answer	Marks
4(a)(i)	(O'ahu) 0.013 **;**	**1**
4(a)(ii)	*any two from* **1** Hawai'i is youngest island / formed only 0.4 million years ago **;** **2** less / little, time for, *Mecyclothorax* / beetles / them, to, colonise / arrive / speciate **;** **3** Hawai'i has large area so, density / number of species per km^2, is low **;** **4** early stage of succession / low habitat diversity **;**	**2**
4(a)(iii)	*any two from* **1** O'ahu is further away from Maui (than Moloka'i) **;** **2** fewer, *Mecyclothorax* / beetles / species, reached O'ahu **;** **3** O'ahu was colonised later **;** **4** less time for speciation **;**	**2**
4(b)	*any four from* **1** allopatric speciation **;** **2** geographical isolation / population became divided **;** **3** different, mutations / alleles / gene pools, in different, populations **;** **4** *ref. to* different selection pressures **;** **5** no, gene flow / interbreeding, between populations **;** **6** genetic differences accumulated **;** **7** natural selection **;** **8** genetic drift / founder effect **;**	**4**

Question	Answer	Marks
5(a)(i)	*any four from* **1** synthesise / obtain, therapeutic / correct / normal / dominant, allele / (c)DNA **;** **2** from, mRNA / (cells of) healthy person / gene library **;** **3** *ref. to* probe / electrophoresis / sequencing, for identification **;** **4** *ref. to* PCR to amplify, gene / DNA **;** **5** restriction, enzyme / endonuclease, **+** role **;** **6** (DNA) ligase **+** role **;** **7** *ref. to* add promoter **;**	**4**
5(a)(ii)	*any two from* **1** (can) add / insert, correct / normal / therapeutic / dominant / functional, DNA / allele **;** **2** (only) need one, allele / copy, per cell **;** **3** to, cure disease / correct phenotype / restore function / restore vision **;** **4** to, make / synthesise, correct / functional, protein **;** **5** no need to, edit / knock out / remove / delete, faulty allele (as would be the case if faulty allele was dominant) **;**	**2**
5(a)(iii)	*any two from* **1** LCA patients already, blind / have lost vision / cannot see **;** **2** less likely to, harm / add to problem / worsen vision, for LCA patients **;** **3** AVP **;** e.g. other age-related diseases may involve, many genes / dominant alleles	**2**
5(b)(i)	*any three from* **1** wrong base added / wrong bases pair up / base pair mismatch **;** **2** with / to, template, DNA / strand(s) **;** **3** *Taq* polymerase, inaccurate / no proofreading **;** **4** in, extension / elongation, stage **;** **5** mistake / mutation, replicated / copied, (many times) **;** **6** AVP **;** e.g. high temperature speeds up replication and increases chance of more mistakes	**3**
5(b)(ii)	*any two from* **1** AAV / 7m8 / virus / vector, crossed fluid / reached photoreceptors / reached retina **;** **2** (virus) delivered (new / *GFP*) gene / DNA, to photoreceptors / retina cells **;** **3** (*GFP*) gene / DNA, expressed in, photoreceptors / retina cells **;** **4** GFP / protein product, is fluorescent **;**	**2**
5(b)(iii)	(7m8) will decrease risk of / increase treatment by, gene therapy **;**	**1**

Question	Answer	Marks
6(a)(i)	cytoplasm **;**	**1**
6(a)(ii)	*phosphorylation:* **1** (and) **3** **;** *oxidation:* **5** **;** *reaction in step 5:* substrate-linked phosphorylation **;**	**3**
6(b)	*any two from* *cancer cells* **1** need / use, more glucose **;** **2** need / use, less oxygen **;** **3** get, little energy / 2 ATP / small amount of ATP, per glucose (molecule) / from glycolysis **;**	**2**

Question	Answer	Marks
7(a)	compound or structure / location ATP synthase – **C** rubisco – **B** starch grain – **A** phospholipid bilayer – **C** **;;;**	**3**

Question	Answer	Marks
7(b)	*any three from* *description* **1** high(est) / peaks, at, 450 nm and 650 nm / blue and red **or** lowest at, 545 nm / 535–555 nm / green **;** *explanations for blue / red* **2** *Elodea* / plant / chloroplasts / (named) pigments, absorb / use, this, (specified) wavelength / (named) colour of light **;** **3** light / wavelengths, used for, photosynthesis / photophosphorylation **;** **4** so more oxygen, produced / released, from photolysis **;** **5** AVP **;** e.g. ref. non-cyclic / light-dependent stage / Z-scheme	**3**
7(c)	*any two from* **1** pass, energy / light / photons, to, chlorophyll *a* / primary pigment / reaction centre **;** **2** absorb different wavelengths to, chlorophyll *a* / primary pigment / reaction centre **;** **3** form / in, light-harvesting cluster / photosystem / antenna complex **;**	**2**

Question	Answer	Marks
8(a)	*any three from* **1** detect / respond to, (change in) stimulus / stimuli **;** **2** *two examples from* – light / heat / sound / touch / pressure / pain / chemicals / taste / smell / tension **;;** **3** (act as) transducers / convert stimulus energy to electrical energy **;** **4** produce, generator / receptor / action, potential **;** **5** passes impulse, to / along, sensory neurone **;**	**3**
8(b)(i)	*Na+/K+ pump:* **C** or **D** and **E** **;** *Na+ channels open:* **C** **;** *K+ channels open:* **D** **;**	**3**
8(b)(ii)	*for A (**ora** for B)* **1** generator / receptor, potential **;** **2** threshold not, reached / exceeded / crossed **;**	**2**

Question	Answer	Marks
8(b)(iii)	*any two from* **1** limits / controls, (maximum) frequency of action potentials **;** **2** (action potentials / impulses) travel in one direction **;**	**2**
8(b)(iv)	*any four from* **1** local circuit / movement of ions from positive to negative region **;** **2** (causes) opening of Na^+ channels **;** **3** at next, node (of Ranvier) / gap in myelin sheath **;** **4** causing next / new, action potential / depolarisation **;** **5** saltatory conduction **;** **6** one-way transmission **;** **7** AVP **;** e.g. myelin (sheath) / Schwann cells, insulate axon / prevent (named) ion movement / impermeable to (named) ions / speed up transmission / lengthens local circuits	**4**

Question	Answer	Marks
9(a)	*any eight from* **1** no, nucleus / nuclear envelope **;** **2** circular DNA **;** **3** histone-like / HU / HN-S / INF, proteins associated with DNA **;** **4** no membrane-bound organelles **;** **5** named example of absent organelle **;** **6** 70S / 18 nm, ribosomes **;** **7** cell wall made of, peptidoglycan / murein **;** **8** binary fission **;** **9** unicellular **;** **10** spherical / rod / spiral / comma / corkscrew, shape **or** may form, pairs / tetrads / strings / filaments / clusters / palisades **;** **11** size detail **;** **12** Gram-negative have, extra / second / outer, membrane **;** **13** AVP **;** (other structural feature) **14** AVP **;** (other non-structural feature)	**8**
9(b)	*any seven from* **1** collect / take, plants / seeds, from the wild **;** **2** (from) many countries / international effort **;** **3** (especially from) areas at risk from climate change **;** **4** grow / cultivate / plant, seeds / plants (in botanic gardens) **;** **5** increase, plant / seed, number **;** **6** tissue culture / cloning **;** **7** (store in) seed bank **;** **8** maintain / measure, genetic diversity **or** *ref. to* gene bank **;** **9** cooperate with, governments / charities / agencies / universities **;** **10** for research **;** **11** to conserve habitats **;** **12** to restore habitats **;** **13** to reintroduce species (to wild) **;** **14** educate (public) / raise awareness **;** **15** raise funds **;** **16** AVP **;** e.g. prepare suitable habitats / growing conditions	**7**

Question	Answer	Marks
10(a)	*any eight from* **1** capillary / glomerulus, endothelium **;** **2** has, many / large, gaps / pores / holes / fenestrations **;** **3** afferent arteriole wider than efferent arteriole **;** **4** high, blood / hydrostatic, pressure in glomerulus **;** **5** fluid forced, out of glomerulus / into Bowman's capsule **;** **6** podocytes **;** **7** have interdigitating, processes / extensions **;** **8** that form, filtration slits / slit pores **;** **9** basement membrane **;** **10** (mesh of) collagen / glycoprotein (fibres) **;** **11** acts as (main), selective barrier / filter **;** **12** large / RMM > 68 000, proteins / molecules, do not pass through **;** **13** (red / white blood) cells, do not pass through **;** **14** water / solutes / ions, pass through **;**	**8**
10(b)	*any seven from* **1** *two examples from:* liver / muscle / adipose **;** **2** increases glucose uptake **;** **3** increases permeability of cells to glucose **;** **4** more, transport / GLUT (4), proteins (added to membrane) **;** **5** by vesicles fusing with cell surface membrane **;** **6** stimulates, glycogen synthesis / glycogenesis **;** **7** glucokinase / hexokinase / glycogen synthase **;** **8** lipid / triglyceride / fatty acid, synthesis stimulated **;** **9** increase in respiration **;** **10** (so) more (facilitated) diffusion of glucose into (liver) cells **;** **11** decreases, glycogenolysis / lipolysis / gluconeogenesis **;** **12** decreases blood glucose concentration **;**	**7**