Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **March 2017**

MARK SCHEME

Maximum Mark: 100

Published

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Question	Answer	Marks
1(a)(i)	the longer the loop of Henle the lower the water potential of the urine **;**	**1**
1(a)(ii)	1 dry environment / AW **;** 2 need to conserve water / AW **;**	**2**
1(b)	*microvilli:* 1 large(r) surface area **;** 2 for absorption of, Na^+ / glucose / amino acids **;** *many mitochondria:* 3 provide, energy / ATP **;** **R** produce energy 4 for, Na^+ / K^+, pumps **;** OR for active transport of, Na^+ / K^+ **;** *tight junctions between cells:* 5 hold adjacent cells together **;** 6 fluid cannot pass between cells / substances must pass through cells **;**	**6**

Question	Answer	Marks
2(a)(i)	*4 correct = 2 marks* *2 / 3 correct = 1 mark* *glycolysis:* 1 cytoplasm / cytosol / sarcoplasm **;** *link reaction:* 2 mitochondrial matrix **;** *Krebs cycle:* 3 mitochondrial matrix **;** *oxidative phosphorylation:* 4 inner (mitochondrial) membrane / cristae **;**	**2**
2(a)(ii)	*two from:* 1 too big to pass through (membrane / glucose's protein channel) **;** 2 polar / AW **;** 3 no specific, transport / carrier / channel, protein (for phosphorylated glucose) **;**	**2 max**

Question	Answer	Marks
2(b)	*five from:* *in anaerobic conditions:* 1 only, glycolysis / conversion of glucose into pyruvate, occurs **;** 2 (only) produces 2 molecules of ATP (net) **;** 3 (only) substrate-linked phosphorylation (occurs) **;** 4 pyruvate converted to lactate **;** 5 lactate is energy-rich / AW **;** 6 oxygen not available as final electron acceptor **;** 7 electron transport chain / chemiosmosis / oxidative phosphorylation, does not occur **;** 8 most ATP is produced (in aerobic conditions) in, electron transport chain / chemiosmosis / oxidative phosphorylation **;**	**5 max**
2(c)	*three from:* 1 reference oxygen debt **;** 2 converts lactate to, pyruvate / glucose **;** 3 in liver (cells) **;** 4 re-oxygenate, haemoglobin / myoglobin **;** 5 meet demands of continued increased metabolic rate / AW **;**	**3 max**

Question	Answer	Marks
3(a)(i)	**A** – aleurone layer **;** **B** – endosperm **;** **C** – embryo **;**	**3**

Question	Answer	Marks
3(a)(ii)	*six from:* 1 embryo / **C**, produces / releases, gibberellin **;** 2 (arrow 1) gibberellin moves into, aleurone layer / **A ;** 3 gibberellin stimulates production of amylase **;** 4 (arrow 2) amylase moves into, endosperm / **B** 5 hydrolyses / breakdown, starch to maltose **;** 6 (arrow 3) maltose / glucose, moves into, embryo / **C ;** 7 for respiration / to release energy / for ATP production **;** 8 for, germination / growth **;**	**6 max**
3(b)(i)	3.6 **;** µm min^{-1} OR µm / min **;**	**2**
3(b)(ii)	*two from:* 1 auxin binds with receptor (on cell surface membrane) **;** 2 proton pumps activated **;** 3 H^+ pumped into cell wall **;**	**2 max**

Question	Answer	Marks
3(b)(iii)	*three from:* 1 expansins activated / AW **;** **A** optimum pH for expansins 2 loosens bonds in cellulose microfibrils **;** 3 K^+ ions enter cells (lower water potential) **;** 4 (so) cells take in water by osmosis / AW **;** 5 (increase in turgor causes) cell walls to stretch **;**	**3 max**

Question	Answer	Marks
4(a)(i)	*three from:* 1 reference to limiting factors **;** 2 (limiting factor) not carbon dioxide **;** 3 (limiting factor possibly) light intensity / temperature **;**	**2 max**
4(a)(ii)	*three from:* *sugar cane:* ORA barley 1 (rate of photosynthesis) higher rate, at lower concentrations of CO_2 / initially **;** 2 levels off / becomes constant, at lower rate of photosynthesis **;** 3 levels off / becomes constant, at a lower carbon dioxide concentration **;** 4 data quote to support mp2 or mp3 **;** e.g. mp2 – sugar cane at 7–7.5 au **and** barley at 14 au OR mp3 – sugar cane at 60–70 au **and** barley at 500 au	**3 max**

Question	Answer	Marks
4(a)(iii)	*four from:* 1 sugar cane / C4 plants, can reduce photorespiration **;** 2 correct ref. to adaptation to reduce photorespiration **;** e.g. RuBP and rubisco, in bundle sheath cells / kept away from air OR tightly packed mesophyll cells 3 enzymes in, sugar cane / C4 plants, have high(er) optimum temperature **;** 4 carbon dioxide absorbed by mesophyll cells **;** 5 carbon dioxide, fixed by PEP carboxylase / combines with PEP **;** 6 PEP carboxylase has higher affinity for carbon dioxide than rubisco **;**	**4 max**
4(b)	*conditions (max two):* 1 low light intensity **; A** at night / in the dark 2 dry conditions **;** 3 high temperatures **;** 4 high light intensity **;** 5 high wind speed / AW **;** *benefits (max two):* 6 reduce transpiration (rate) **;** 7 (so) conserves water **;** 8 retains turgidity of cells **;** 9 (physical) support of plant **/** prevents wilting **;**	**4 max**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>having identical alleles (of a gene) ;</td><td>1</td></tr>
<tr><td>5(b)</td><td>MmDd ;</td><td>1</td></tr>
<tr><td>5(c)</td><td>
<table>
<tr><td>gametes</td><td>MD</td><td>Md</td><td>mD</td><td>md</td></tr>
<tr><td>MD</td><td>MMDD
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order D/d followed by M/m, or M/m followed by D/d are both acceptable

one mark for gametes ;

two marks for genotypes ; ;

two marks for phenotypes linked to genotypes ; ;

ratio = 9 dark purple : 3 purple : 4 white ;
</td><td>6</td></tr>
</table>

Question	Answer	Marks
6(a)	46.5 – 47 **;;;** *if answer incorrect allow marks for working* $q^2 = 0.4$ **;** p = 0.368 OR p = 0.37 **;**	**3**
6(b)	*four from:* 1 mutation **;** 2 migration (into, or out of, the population) **;** 3 non-random mating occurs **;** 4 the population is small **;** 5 selective pressure occurs against one of the, alleles / genotypes **;** 6 reproduction is asexual **;** 7 organism is haploid **;**	**4 max**

Question	Answer	Marks
7(a)	sensory neurone – receives, input / impulses, from receptor **;** relay / intermediate / internuncial, neurone – passes impulses on to motor neurone **;** motor neurone – sends impulses / output, to the effector **;**	**3**
7(b)	*six from:* **A:** 1 Na^+ cannot enter post-synaptic neurone **;** 2 no, depolarisation / action potential, (in post-synaptic neurone) **;** **B** 3 Ca^{2+} cannot enter pre-synaptic neurone **;** 4 vesicles cannot, move towards / fuse with, pre-synaptic membrane **;** **C** 5 ACh cannot be released **;** 6 into synaptic cleft **;** **D** 7 ACh not broken down **;** 8 continuous depolarisation / action potential, of post-synaptic neurone **;**	**6 max**

Question	Answer	Marks
8(a)	6 **;** 18 **;**	**2**
8(b)(i)	*three from:* 1 inbreeding depression / lack of hybrid vigour **;** 2 more chance that harmful recessive alleles may be expressed **;** 3 decrease in heterozygosity / increase in homozygosity **;** 4 less genetic variation **;**	**3 max**
8(b)(ii)	*three from:* 1 use sustainable palm oil plantations **;** 2 create / leave, corridors between family groups in different parts of the forest **;** 3 ban hunting **;** 4 create national parks **;** 5 educate local people **;** 6 re-locate orangutans **;** 7 reforestation **;**	**3 max**

Question	Answer	Marks
8(b)(iii)	*three from:* 1 captive breeding **;** 2 detail e.g. IVF / ICSI / sperm banks **;** 3 education **;** 4 release back into the wild **;** 5 research **;** 6 health monitoring **;**	**3 max**

Question	Answer	Marks
9(a)	*seven from:* *ecosystem:* 1 self-sustaining unit **;** 2 self-contained / defined, area **;** 3 community of organisms **;** 4 living and non-living / biotic and abiotic **;** 5 reference to, interactions / interdependence **;** 6 reference to, energy flow / food webs **;** *niche:* 7 role of organism / how it fits in, (in an ecosystem) **;** 8 (including) where it lives **;** 9 how it obtains its energy / reference trophic level **;**	**7 max**

Question	Answer	Marks
9(b)	*eight from:* 1 random (sampling) ; 2 (frame) quadrat ; 3 use cover scale ; 4 estimate % cover ; 5 species frequency ; 6 systematic sampling ; 7 line / belt, transect ; 8 sample at set distances ; 9 mark – release – recapture ; 10 method of, capture / marking ; 11 returned to habitat and left ; 12 population estimate = $\frac{\text{no of individuals in first sample} \times \text{no of individuals in second sample}}{\text{no of individuals marked in second sample}}$; 13 appropriate mathematical / statistical technique ;	**8 max**

Question	Answer	Marks
10(a)	*nine from:* 1 production of a large number of copies of a length of DNA / amplification of DNA **;** 2 rapid **;** 3 only small sample of DNA needed **;** 4 DNA, denatured / separated into two strands, by heat / at 95 °C **;** 5 primer (DNA) added **;** 6 reference to annealing at, 60–65, °C **;** 7 reference complementary base pairing **;** 8 DNA / Taq, polymerase **;** 9 replicates (template) strand at, 70–75, °C **;** 10 heated again to separate strands / process repeated **;** 11 Taq polymerase, is heat stable / has high optimum temperature **;** 12 does not need replacing each cycle **;** 13 efficient process **;**	**9 max**

Question	Answer	Marks
10(b)	*six from:* 1 small / circular, piece of (double-stranded) DNA **;** 2 replicate independently / multiple origins of replication **;** 3 high copy number **;** 4 easy to extract from bacteria **;** 5 can be cut using restriction, enzyme / endonuclease **;** 6 gene / DNA, can be inserted **;** 7 can be taken up by bacteria **;** 8 may contain genes for antibiotic resistance / can carry marker genes **;** 9 helps in identifying transformed bacteria **;** 10 acts as a vector **;** 11 may carry promoter **;**	**6 max**