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BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **October/November 2017**

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.

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Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	alternative valid point

Question	Answer	Marks
1(a)	*two from:* 1 variation in / diversity of, ecosystems / habitats **;** 2 number of / (how) many / variety of / diversity of, species **;** 3 the (relative) abundance of each species **;** 4 genetic diversity / range of alleles, within a species **;**	**2**
1(b)(i)	genes **and** environment **;**	**1**
1(b)(ii)	*one from:* 1 whales, mobile / swim / migrate **;** 2 (they inhabit) large, area / distances **;** 3 live, underwater / at great depths **;**	**1**
1(c)	*two from:* 1 (water) pollution from, industry / boats **;** 2 accidents involving / damaged by, boats / fishing gear **;** 3 lack of / competition for, food / krill / prey **;** 4 noise / vibration, disturbs whale, communication / behaviour / mating **;** 5 illegal, whaling / hunting **;** 6 reproduction rate is slow / one offspring at a time / long gestation **;**	**2**

Question	Answer	Marks
1(d)	*two from:* *toxins (PCBs / DDT) are* 1 present in, water / river / sea **;** 2 ingested / absorbed by, producers / phytoplankton / algae **;** 3 bioaccumulation **or** toxins, pass up / accumulate up, food chain **;** 4 persistent / long-lasting / not broken down (in environment / whale) **;** 5 fat / lipid, soluble **;**	**2**
1(e)(i)	*two from:* 1 sodium ions do not enter (neurones / nerve cells / axons) **;** 2 (neurones) cannot depolarise **or** cannot, generate / transmit, impulses / action potentials **;** 3 reason for death **;**	**2**
1(e)(ii)	*one from:* unicellular / not multicellular **;** motile / have flagella **;**	**1**

Question	Answer	Marks
2(a)(i)	1 reduces, GP / glycerate (3) phosphate **;** 2 to, TP / triose phosphate **;**	**2**
2(a)(ii)	RuBP, decreases / less **either** because it, reacts / is used up / is converted **or** because it is not, replaced / regenerated **; AW**	**1**
2(b)	*any four in total**:*** *tube A* 1 for comparison / to compare **;** 2 to see, end-point / when all DCPIP has been reduced, in **B** **;** *foil (max 3)* 3 to, stop / limit, light entering (the beaker / mixture) **or** to stop light reaching chlorophyll **;** 4 to, stop / limit, light dependent reaction occurring **;** 5 to, stop / limit, DCPIP, decolourising / being reduced **;** 6 so all tests start with same colour (of DCPIP–chloroplast mixture) **;**	**4**
2(c)(i)	22.2 **;**	**1**

Question	Answer	Marks
2(c)(ii)	*five from:* *description of rate of, photosynthesis / light (dependent) reaction (max 2)* 1 (it is) highest / fastest / most, in purple **/** at 425 nm **;** 2 (it is) lowest / slowest / least, in green **/** at 525 nm **;** *explanation (max 3)* 3 chlorophyll absorbs purple and orange (best) but does not absorb green **;** 4 accessory pigments **;** 5 light, excites electrons / triggers electron transport **;** 6 non-cyclic photophosphorylation **;** 7 action spectrum **;**	**5**

Question	Answer	Marks
3(a)	(interspecific) competition (with greys) **;** virus / disease / infection, passed, from greys / to reds **;**	**2**
3(b)	*three from:* 1 DNA / base / nucleotide, sequences **;** 2 mitochondrial / mt, DNA **;** 3 protein / polypeptide / amino acid, sequences **;** 4 genetic fingerprinting / DNA profiling **;** 5 compare (sequences from reds and greys) **;**	**3**
3(c)	*three from:* 1 pine marten / predation, is / was, selection pressure **;** 2 red squirrel better adapted (to pine marten predation) **; ora** 3 detail **/** suggestion **;** e.g. red squirrel, faster / better camouflaged **ora** 4 (two squirrel species arose by) allopatric speciation / AW **;** 5 different, selection pressures / predators (in two places / for two species) **;** 6 red squirrels and pine martens co-existed for, 10 000 years / long time **;**	**3**

Question	Answer	Marks
4(a)(i)	*two from:* 1 (only) kills / targets / acts on, specific / some, insects / pests **;** 2 does not kill, beneficial / useful, insects **;** 3 (such as) pollinators / bees / predators of pests **;** 4 to conserve / protect, biodiversity / food web **; ora** 5 *idea that* other Cry proteins might not kill, right pests / bollworm **;**	**2**
4(a)(ii)	*two from:* 1 (so, new / foreign / inserted) gene(s) are, expressed / switched on / transcribed (and translated) **;** 2 RNA polymerase binds (at promoter) **;** 3 *ref. to* correct / template, strand **;** 4 to control quantity of Cry(1Ac / protein) made **;** 5 to control, where / which part(s) of plant, make Cry(1Ac / protein) **;**	**2**
4(a)(iii)	*three from:* 1 insert, herbicide resistance gene / it, next to, Bt / Cry(1Ac), gene **;** 2 spray / add, herbicide on (transformed) plants / protoplasts / cells **;** 3 survivors have, Bt / Cry(1Ac), gene **;** 4 to identify, successful / GM / insect-resistant, plants **;**	**3**

Question	Answer	Marks
4(b)(i)	*two from:* 1 Bt seed costs more but insecticide costs less **;** 2 total cost is more for Bt than for non-GM **;** 3 manipulated figure(s) comparing both Bt and non-GM **;**	**2**
4(b)(ii)	*one from:* non-GM seeds are cheap(er) / (more) affordable **;** non-GM / it, is cheap(er), overall / to grow **;**	**1**
4(c)	*three from:* 1 selective breeding / artificial selection **;** 2 cross Bt cotton with a (Bt) variety that grows well in, dry / drought **;** 3 select / choose, offspring with Bt (trait / gene) **and** grow well in, dry / drought **;** 4 repeat (crossing / selection) for several generations **;**	**3**

Question	Answer	Marks
5(a)	*four from:* 1 insulator / ions cannot pass through it **;** 2 depolarisation / action potentials, occur at nodes of Ranvier (only) **;** 3 long(er) local, circuits / currents **;** 4 action potential jumps from node to node / saltatory conduction **;** 5 transmission / conduction, fast(er) **;**	**4**
5(b)	*five from:* 1 action potential / depolarisation, at <u>presynaptic membrane</u> **;** 2 Ca^{2+} channels open / increased permeablity to Ca^{2+} **;** 3 Ca^{2+} enter, (presynaptic) neurone / knob / axoplasm / AW **;** 4 by (facilitated) diffusion / down concentration gradient **;** 5 vesicles, of acetylcholine / neurotransmitter, fuse with membrane **;** 6 ACh / neurotransmitter, enters / exocytosed into, <u>synaptic cleft</u> **;**	**5**

Question	Answer	Marks
6(a)	<table><tr><th>contents of dishes</th><th>ATP produced</th></tr><tr><td>mitochondria + ADP + Pi + acetyl CoA + oxygen</td><td>✓</td></tr><tr><td>mitochondria + ADP + Pi + acetyl CoA</td><td>×</td></tr><tr><td>mitochondria + ADP + Pi + low concentration of protons (H^+)</td><td>×</td></tr><tr><td>mitochondria + ADP + Pi + high concentration of protons (H^+)</td><td>✓</td></tr></table> **;** **;** *2 or 3 correct = 1 mark* *4 correct = 2 marks*	**2**
6(b)	*two from:* water enters (mitochondrion / matrix) **;** by osmosis / down the water potential gradient **;** membranes ruptured / mitochondrion bursts **;**	**2**
6(c)	final <u>electron</u> (and proton) acceptor (in ETC) **;**	**1**
6(d)	ATP synth(et)ase **;**	**1**

Question	Answer	Marks
6(e)	*four from:* 1 (site of) electron transport chain **;** 2 moves / pumps, protons / H^+, to inter-membrane space **;** 3 electrochemical / proton / H^+, gradient **;** 4 protons / H^+, diffuse to matrix **;** 5 through**,** stalked particles / ATP synth(et)ase **;** 6 ADP + Pi → ATP **;** 7 oxidative phosphorylation **;**	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)(i)</td><td>consume, less / no, milk / lactose / (named) dairy products ;</td><td>1</td></tr>
<tr><td>7(a)(ii)</td><td>four from:
1 changes / different, base / nucleotide (sequence), in, DNA / gene ;
2 changes / different, <u>mRNA</u>, codon / triplet ;
3 changes / different, primary structure of, polypeptide / protein / enzyme ;
4 changes / different, tertiary structure (of, polypeptide / protein / enzyme) ;
5 changes / different, allosteric / active, site ;
6 enzyme, non-functional / does not convert galactose (to glucose) ;</td><td>4</td></tr>
<tr><td>7(b)</td><td><table><tr><th>parent 1</th><th>parent 2</th><th>% prob. affected child</th><th>% prob. unaffected child</th><th>% prob . carrier child</th></tr><tr><td>unaffected</td><td>carrier</td><td>0</td><td>50</td><td>50</td></tr><tr><td>carrier</td><td>carrier</td><td>25</td><td>25</td><td>50 ;</td></tr><tr><td>unaffected</td><td>affected</td><td>0</td><td>0</td><td>100 ;</td></tr><tr><td>carrier</td><td>affected</td><td>50</td><td>0</td><td>50</td></tr></table></td><td>2</td></tr>
<tr><td>7(c)</td><td>two from:
<u>gene</u>tic <u>screening</u> ;
obtain fetal, cells / DNA ;
by, amniocentesis / chorionic villus sampling ;
electrophoresis + probe ;</td><td>2</td></tr>
</table>

Question	Answer	Marks
8(a)	*four from:* 1 change in factor away from, the norm / set-point **;** 2 detected / sensed by, receptor **;** 3 hormone released **or** (nerve) impulse sent **;** 4 (hormone / impulse) reaches, target organ / effector **;** 5 (effector) performs corrective action **;** 6 (factor) returns to, norm / set-point **;**	**4**
8(b)	*four from:* 1 hypothalamus detects change in blood glucose concentration **;** 2 autonomic / motor / nerve, impulses **;** 3 (so) β cells secrete insulin when blood glucose increases **;** 4 (so) α cells secrete glucagon when blood glucose decreases **;** 5 (so) adrenal gland secretes adrenaline **either** when blood glucose decreases **or** due to fear / shock / excitement / stress **;** 6 nervous control supplements, endocrine control / control by pancreas **;**	**4**

Question	Answer	Marks
8(c)	*four from:* *vasoconstriction* 1 arterioles in skin get narrow(er) **;** 2 less blood flow through (skin / surface) capillaries **;** 3 (so) less heat lost (to surroundings) **;** *shivering* 4 muscle contraction **;** 5 releases / provides / gives, heat / thermal energy **;** *increasing secretion of adrenaline* 6 increases, rate of respiration / metabolic rate **;** 7 more heat, released / provided / given (by respiration) **;**	**4**

Question	Answer	Marks
9(a)	*six from:* 1 aerenchyma **;** 2 in stem **and** roots **;** 3 help oxygen to, move / diffuse, to roots **;** 4 shallow roots **;** 5 air (film) trapped on underwater leaves **;** 6 fast internode growth **;** 7 (modified) growth regulated by, gibberellin **/** ethene **;** 8 anaerobic respiration, underwater / when submerged **;** 9 tolerant to high ethanol concentration / high tolerance to ethanol **;** 10 ethanol dehydrogenase (switched on in anaerobic conditions) **;** 11 AVP **;** e.g. growth stops / carbohydrates conserved / quiescence, in short-term (flash) floods	**6**

Question	Answer	Marks
9(b)	*nine from:* 1 RuBP / rubisco, in bundle sheath (cells) **;** 2 away from, oxygen / air **;** 3 to avoid photorespiration **;** 4 carbon dioxide combines with PEP **;** 5 (catalysed by) PEP carboxylase **;** 6 in mesophyll (cells) **;** 7 forms oxaloacetate **;** 8 converted to malate **;** 9 malate passes to bundle sheath (cells) **;** 10 (malate) releases (high concentration of) carbon dioxide **;** 11 RuBP, carboxylated / reacts with carbon dioxide **;** 12 PEP carboxylase / enzyme(s), has high optimum temperature / tolerate high temperatures **;**	**9**

Question	Answer	Marks
10(a)	*six from:* 1 base / nucleotide, substitution **;** 2 missense / silent, mutation **;** 3 base / nucleotide, insertion / addition **;** 4 base / nucleotide, deletion **;** 5 may cause frameshift **;** 6 alters triplets of following, base / nucleotide, sequence **;** 7 (premature) stop codon gives shortened polypeptide **;** 8 does not code for amino acid **;** 9 nonsense mutation **;**	**6**

Question	Answer	Marks
10(b)	*nine from:* 1 homozygous for, mutant allele / Hb^S ; 2 altered β polypeptide in haemoglobin ; 3 haemoglobin / β-globin, less soluble ; 4 in low(er) oxygen (concentration) ; 5 (Hb) forms long fibres ; 6 red blood cells, sickle / form crescent shape ; 7 (RBCs) carry less oxygen ; 8 (RBCs) get stuck in <u>capillaries</u> ; 9 blocks <u>blood</u> flow ; 10 causes pain ; 11 sickle cell crisis ; 12 RBCs break down faster / lack of RBCs ; 13 protection against, malaria / *Plasmodium* infection ;	**9**