

**BIOLOGY****9700/41**

Paper 4 A Level Structured Questions

**October/November 2017**

MARK SCHEME

Maximum Mark: 100

**Published**

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**Mark scheme abbreviations**

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

Question	Answer	Marks
1(a)	<p><i>two from:</i></p> <ol style="list-style-type: none"> <li>1 variation in / diversity of, ecosystems / habitats ;</li> <li>2 number of / (how) many / variety of / diversity of, species ;</li> <li>3 the (relative) abundance of each species ;</li> <li>4 genetic diversity / range of alleles, within a species ;</li> </ol>	<b>2</b>
1(b)(i)	genes <b>and</b> environment ;	<b>1</b>
1(b)(ii)	<p><i>one from:</i></p> <ol style="list-style-type: none"> <li>1 whales, mobile / swim / migrate ;</li> <li>2 (they inhabit) large, area / distances ;</li> <li>3 live, underwater / at great depths ;</li> </ol>	<b>1</b>
1(c)	<p><i>two from:</i></p> <ol style="list-style-type: none"> <li>1 (water) pollution from, industry / boats ;</li> <li>2 accidents involving / damaged by, boats / fishing gear ;</li> <li>3 lack of / competition for, food / krill / prey ;</li> <li>4 noise / vibration, disturbs whale, communication / behaviour / mating ;</li> <li>5 illegal, whaling / hunting ;</li> <li>6 reproduction rate is slow / one offspring at a time / long gestation ;</li> </ol>	<b>2</b>

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

Question	Answer	Marks
2(a)(i)	1 reduces, GP / glycerate (3) phosphate ; 2 to, TP / triose phosphate ;	2
2(a)(ii)	RuBP, decreases / less <b>either</b> because it, reacts / is used up / is converted <b>or</b> because it is not, replaced / regenerated ; <b>AW</b>	1
2(b)	<i>any four in total:</i>  <i>tube A</i> 1 for comparison / to compare ;  2 to see, end-point / when all DCPIP has been reduced, in <b>B</b> ;  <i>foil (max 3)</i> 3 to, stop / limit, light entering (the beaker / mixture) <b>or</b> 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)	<u>22.2</u> ;	1

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

Question	Answer	Marks
3(a)	(interspecific) <u>competition</u> (with greys) ; virus / disease / infection, passed, from greys / to reds ;	<b>2</b>
3(b)	<i>three from:</i> 1 DNA / base / nucleotide, <u>sequences</u> ; 2 mitochondrial / mt, DNA ; 3 protein / polypeptide / amino acid, <u>sequences</u> ; 4 genetic fingerprinting / DNA profiling ; 5 <u>compare</u> (sequences from reds and greys) ;	<b>3</b>
3(c)	<i>three from:</i> 1 pine marten / predation, is / was, <u>selection pressure</u> ; 2 red squirrel better <u>adapted</u> (to pine marten predation) ; <b>ora</b> 3 detail / suggestion ; e.g. red squirrel, faster / better camouflaged <b>ora</b> 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 ;	<b>3</b>

Question	Answer	Marks
4(a)(i)	<p><i>two from:</i></p> <ol style="list-style-type: none"> <li>1 (only) kills / targets / acts on, specific / some, insects / pests ;</li> <li>2 does not kill, beneficial / useful, insects ;</li> <li>3 (such as) pollinators / bees / predators of pests ;</li> <li>4 to conserve / protect, biodiversity / food web ; <b>ora</b></li> <li>5 <i>idea that</i> other Cry proteins might not kill, right pests / bollworm ;</li> </ol>	<b>2</b>
4(a)(ii)	<p><i>two from:</i></p> <ol style="list-style-type: none"> <li>1 (so, new / foreign / inserted) <u>gene(s)</u> are, expressed / switched on / transcribed (and translated) ;</li> <li>2 <u>RNA polymerase</u> binds (at promoter) ;</li> <li>3 <i>ref. to</i> correct / template, strand ;</li> <li>4 to control quantity of Cry(1Ac / protein) made ;</li> <li>5 to control, where / which part(s) of plant, make Cry(1Ac / protein) ;</li> </ol>	<b>2</b>
4(a)(iii)	<p><i>three from:</i></p> <ol style="list-style-type: none"> <li>1 insert, herbicide resistance gene / it, next to, Bt / Cry(1Ac), gene ;</li> <li>2 spray / add, herbicide on (transformed) plants / protoplasts / cells ;</li> <li>3 survivors have, Bt / Cry(1Ac), gene ;</li> <li>4 to identify, successful / GM / insect-resistant, plants ;</li> </ol>	<b>3</b>



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

Question	Answer	Marks
5(a)	<p><i>four from:</i></p> <ol style="list-style-type: none"> <li>1 insulator / ions cannot pass through it ;</li> <li>2 depolarisation / action potentials, occur at nodes of Ranvier (only) ;</li> <li>3 long(er) local, circuits / currents ;</li> <li>4 action potential jumps from node to node / saltatory conduction ;</li> <li>5 transmission / conduction, fast(er) ;</li> </ol>	<b>4</b>
5(b)	<p><i>five from:</i></p> <ol style="list-style-type: none"> <li>1 action potential / depolarisation, at <u>presynaptic membrane</u> ;</li> <li>2 Ca<sup>2+</sup> channels open / increased permeability to Ca<sup>2+</sup> ;</li> <li>3 Ca<sup>2+</sup> enter, (presynaptic) neurone / knob / axoplasm / AW ;</li> <li>4 by (facilitated) diffusion / down concentration gradient ;</li> <li>5 vesicles, of acetylcholine / neurotransmitter, fuse with membrane ;</li> <li>6 ACh / neurotransmitter, enters / exocytosed into, <u>synaptic cleft</u> ;</li> </ol>	<b>5</b>

Question	Answer		Marks										
6(a)	<table border="1" data-bbox="589 220 1644 608"> <thead> <tr> <th data-bbox="589 220 1117 304">contents of dishes</th> <th data-bbox="1117 220 1644 304">ATP produced</th> </tr> </thead> <tbody> <tr> <td data-bbox="589 304 1117 389">mitochondria + ADP + Pi + acetyl CoA + oxygen</td> <td data-bbox="1117 304 1644 389">✓</td> </tr> <tr> <td data-bbox="589 389 1117 440">mitochondria + ADP + Pi + acetyl CoA</td> <td data-bbox="1117 389 1644 440">x</td> </tr> <tr> <td data-bbox="589 440 1117 525">mitochondria + ADP + Pi + low concentration of protons (H<sup>+</sup>)</td> <td data-bbox="1117 440 1644 525">x</td> </tr> <tr> <td data-bbox="589 525 1117 608">mitochondria + ADP + Pi + high concentration of protons (H<sup>+</sup>)</td> <td data-bbox="1117 525 1644 608">✓</td> </tr> </tbody> </table> <p data-bbox="1653 627 1675 683">;</p> <p data-bbox="1653 659 1675 683">;</p> <p data-bbox="320 727 622 791"><i>2 or 3 correct = 1 mark</i> <i>4 correct = 2 marks</i></p>		contents of dishes	ATP produced	mitochondria + ADP + Pi + acetyl CoA + oxygen	✓	mitochondria + ADP + Pi + acetyl CoA	x	mitochondria + ADP + Pi + low concentration of protons (H <sup>+</sup> )	x	mitochondria + ADP + Pi + high concentration of protons (H <sup>+</sup> )	✓	2
contents of dishes	ATP produced												
mitochondria + ADP + Pi + acetyl CoA + oxygen	✓												
mitochondria + ADP + Pi + acetyl CoA	x												
mitochondria + ADP + Pi + low concentration of protons (H <sup>+</sup> )	x												
mitochondria + ADP + Pi + high concentration of protons (H <sup>+</sup> )	✓												
6(b)	<p data-bbox="320 826 450 858"><i>two from:</i></p> <p data-bbox="320 895 815 927">water enters (mitochondrion / matrix) ;</p> <p data-bbox="320 963 943 995">by osmosis / down the water potential gradient ;</p> <p data-bbox="320 1032 909 1064">membranes ruptured / mitochondrion bursts ;</p>		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)	<p><i>four from:</i></p> <ol style="list-style-type: none"><li>1 (site of) electron transport chain ;</li><li>2 moves / pumps, protons / H<sup>+</sup>, to <u>inter-membrane space</u> ;</li><li>3 electrochemical / proton / H<sup>+</sup>, <u>gradient</u> ;</li><li>4 protons / H<sup>+</sup>, <u>diffuse</u> to <u>matrix</u> ;</li><li>5 through, stalked particles / ATP synth(et)ase ;</li><li>6 ADP + Pi → ATP ;</li><li>7 oxidative phosphorylation ;</li></ol>	4

Question	Answer	Marks																									
7(a)(i)	consume, less / no, milk / lactose / (named) dairy products ;	1																									
7(a)(ii)	<p><i>four from:</i></p> <p>1 changes / different, base / nucleotide (sequence), in, DNA / gene ;</p> <p>2 changes / different, <u>mRNA</u>, codon / triplet ;</p> <p>3 changes / different, primary structure of, polypeptide / protein / enzyme ;</p> <p>4 changes / different, tertiary structure (of, polypeptide / protein / enzyme) ;</p> <p>5 changes / different, allosteric / active, site ;</p> <p>6 enzyme, non-functional / does not convert galactose (to glucose) ;</p>	4																									
7(b)	<table border="1" data-bbox="607 756 1664 1077"> <thead> <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> </thead> <tbody> <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> </tbody> </table>	parent 1	parent 2	% prob. affected child	% prob. unaffected child	% prob. carrier child	unaffected	carrier	0	50	50	carrier	carrier	25	25	50 ;	unaffected	affected	0	0	100 ;	carrier	affected	50	0	50	2
parent 1	parent 2	% prob. affected child	% prob. unaffected child	% prob. carrier child																							
unaffected	carrier	0	50	50																							
carrier	carrier	25	25	50 ;																							
unaffected	affected	0	0	100 ;																							
carrier	affected	50	0	50																							
7(c)	<p><i>two from:</i></p> <p><u>genetic screening</u> ;</p> <p>obtain fetal, cells / DNA ;</p> <p>by, amniocentesis / chorionic villus sampling ;</p> <p>electrophoresis + probe ;</p>	2																									

Question	Answer	Marks
8(a)	<p><i>four from:</i></p> <ol style="list-style-type: none"> <li>1 change in factor away from, the norm / set-point ;</li> <li>2 detected / sensed by, <u>receptor</u> ;</li> <li>3 <u>hormone</u> released <b>or</b> (nerve) impulse sent ;</li> <li>4 (hormone / impulse) reaches, target organ / effector ;</li> <li>5 (effector) performs corrective action ;</li> <li>6 (factor) returns to, norm / set-point ;</li> </ol>	<b>4</b>
8(b)	<p><i>four from:</i></p> <ol style="list-style-type: none"> <li>1 <u>hypothalamus</u> detects change in <u>blood glucose concentration</u> ;</li> <li>2 autonomic / motor / nerve, impulses ;</li> <li>3 (so) <u><math>\beta</math> cells</u> secrete <u>insulin</u> when blood glucose increases ;</li> <li>4 (so) <u><math>\alpha</math> cells</u> secrete <u>glucagon</u> when blood glucose decreases ;</li> <li>5 (so) <u>adrenal gland</u> secretes <u>adrenaline</u> <b>either</b> when blood glucose decreases <b>or</b> due to fear / shock / excitement / stress ;</li> <li>6 nervous control supplements, endocrine control / control by pancreas ;</li> </ol>	<b>4</b>

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

Question	Answer	Marks
9(a)	<p><i>six from:</i></p> <ol style="list-style-type: none"> <li>1 <u>aerenchyma</u> ;</li> <li>2 in stem <b>and</b> roots ;</li> <li>3 help oxygen to, move / diffuse, to <u>roots</u> ;</li> <li>4 shallow roots ;</li> <li>5 air (film) trapped on underwater leaves ;</li> <li>6 fast internode growth ;</li> <li>7 (modified) growth regulated by, gibberellin / ethene ;</li> <li>8 anaerobic respiration, underwater / when submerged ;</li> <li>9 tolerant to high <u>ethanol</u> concentration / high tolerance to <u>ethanol</u> ;</li> <li>10 ethanol dehydrogenase (switched on in anaerobic conditions) ;</li> <li>11 AVP ; e.g. growth stops / carbohydrates conserved / quiescence, in short-term (flash) floods</li> </ol>	6



Question	Answer	Marks
9(b)	<p><i>nine from:</i></p> <ol style="list-style-type: none"><li>1 RuBP / rubisco, in bundle sheath (cells) ;</li><li>2 away from, oxygen / air ;</li><li>3 to avoid photorespiration ;</li><li>4 carbon dioxide combines with PEP ;</li><li>5 (catalysed by) PEP carboxylase ;</li><li>6 in mesophyll (cells) ;</li><li>7 forms oxaloacetate ;</li><li>8 converted to malate ;</li><li>9 malate passes to bundle sheath (cells) ;</li><li>10 (malate) releases (high concentration of) carbon dioxide ;</li><li>11 RuBP, carboxylated / reacts with carbon dioxide ;</li><li>12 PEP carboxylase / enzyme(s), has high optimum temperature / tolerate high temperatures ;</li></ol>	9

Question	Answer	Marks
10(a)	<p><i>six from:</i></p> <ol style="list-style-type: none"><li>1 base / nucleotide, substitution ;</li><li>2 missense / silent, mutation ;</li><li>3 base / nucleotide, insertion / addition ;</li><li>4 base / nucleotide, deletion ;</li><li>5 may cause frameshift ;</li><li>6 alters triplets of following, base / nucleotide, sequence ;</li><li>7 (premature) stop codon gives shortened polypeptide ;</li><li>8 does not code for amino acid ;</li><li>9 nonsense mutation ;</li></ol>	<b>6</b>

Question	Answer	Marks
10(b)	<p><i>nine from:</i></p> <ol style="list-style-type: none"> <li>1 homozygous for, mutant allele / <math>Hb^S</math> ;</li> <li>2 altered <math>\beta</math> polypeptide in haemoglobin ;</li> <li>3 haemoglobin / <math>\beta</math>-globin, less soluble ;</li> <li>4 in low(er) oxygen (concentration) ;</li> <li>5 (Hb) forms long fibres ;</li> <li>6 red blood cells, sickle / form crescent shape ;</li> <li>7 (RBCs) carry less oxygen ;</li> <li>8 (RBCs) get stuck in <u>capillaries</u> ;</li> <li>9 blocks <u>blood</u> flow ;</li> <li>10 causes pain ;</li> <li>11 sickle cell crisis ;</li> <li>12 RBCs break down faster / lack of RBCs ;</li> <li>13 protection against, malaria / <i>Plasmodium</i> infection ;</li> </ol>	9