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BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **May/June 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)	maintain / keep / restore, constant / stable / set-point / within narrow limits, internal environment / in body **;**	**1**
1(b)(i)	**A** – pelvis **;** *note if labelled medulla as affects ecf in part (ii)* **B** – ureter **;**	**2**
1(b)(ii)	**A** *full labels instead of letters* *if region **A** (pelvis) was mislabelled as medulla in (i) can apply:* ***ecf** for **L** placed in pelvis* ***ecf U** placed in medulla **only if** word cortex also written by **U** / ultrafiltration* **U** – pointing to the cortex **;** **L** – pointing to the medulla **;** **C** – pointing to the renal vein **;**	**3**

Question	Answer	Marks
1(c)	*max 5 of:* 1 hypothalamus detects (changes in) water potential (of the blood) **;** 2 osmoreceptors shrink when, low / less, water in blood **; ora** 3 ADH, produced / made, in hypothalamus **;** 4 if low, water / Ψ, ADH secreted from posterior pituitary **; ora** **R** ADH *produced* in posterior pituitary 5 *ref. to* neurosecretory cells **or** impulse / ADH transported, from hypothalamus to posterior pituitary **;** 6 aquaporins **;** 7 ADH increases permeability of, distal convoluted tubule / collecting duct **; ora** 8 ADH causes, more water reabsorption / smaller volume of urine / more concentrated urine **; ora** **A** both with and without ADH compared	**5**

Question	Answer	Marks
2(a)	1 high / increased / better / not limiting, carbon dioxide / temperature / (named) mineral ions **;** **I** nutrients 2 (from) coral / polyp, respiration / metabolism **or** for algae, Calvin cycle / light independent reactions **;** **A** correct use of mineral ions	**2**
2(b)	*max 4 of:* 1 (paper / thin layer) chromatography / chromatogram **;** 2 place spot of, extract / pigments, on pencil mark / at base of, paper / TLC plate **;** 3 dry and repeat (to concentrate spot) **;** 4 dip, paper / chromatogram, in solvent / so solvent travels up paper **;** **A** named organic solvent (**I** water) **R** if spot submerged 5 measure distance travelled by solvent (front) and pigment (spot) **;** 6 (calculate) R_f value $= \frac{\text{distance travelled by pigment}}{\text{distance travelled by solvent (front)}}$ **;** 7 look up / compare results with, known R_f values (to identify pigments) **;**	**4**
2(c)	*max 3 of:* 1 pigments absorb, violet-blue / 400–490 nm / lamp colours, well / best / most / at 8 out of 10 peaks **;** 2 <u>rate of photosynthesis</u> of **algae** increases with more light absorbed **;** 3 **coral** growth (increases) with more (algal) photosynthesis **;** **R** products respond to give growth 4 chlorophyll a and peridinin are, most abundant pigments / most important **;** 5 AVP **;** e.g. violet-blue / 400–490 nm, predominate at the depths where corals live	**3**

Question	Answer	Marks
3(a)	*max 2 of:* 1 can, kill / control, weeds **;** **R** kill, insects / pests 2 reduce competition / increase yield (of rape) **;** 3 AVP **;** e.g. manual weeding / hoeing, difficult / expensive *ref. to* glufosinate converted to non-toxic compound	**2**
3(b)(i)	circle of / circular, DNA **;** **I** loop **R** single-stranded small / supplementary **;**	**2**
3(b)(ii)	*max 3 of:* 1 small so can be taken up by, cells / bacteria **;** 2 replicate, independently / fast **;** **A** have *ori* / origin of replication / high copy number 3 (DNA) has restriction site(s) / can be cut by restriction enzymes **;** **A** have polylinker 4 have, marker genes / genes for resistance (for screening) **;** 5 AVP **;** e.g. circular so, increased stability / reduced host cell degradation	**3**
3(b)(iii)	*max 2 of:* 1 <u>RNA polymerase</u> binds **;** 2 so, transcription / mRNA synthesis, begins / occurs / allowed **;** 3 AVP **;** e.g. correct / template, strand is transcribed *ref. to* tissue-specific / inducible, expression	**2**
3(c)(i)	28 **;**	**1**

Question	Answer	Marks
3(c)(ii)	*max 1 of:* spray with herbicide **and**, those that die did not have the *bar* gene / those that survive did have the *bar* gene **;** add gene for fluorescence with *bar* gene and test plants under UV / use PCR with primer complementary to *bar* gene / use (gene) probe (on Southern blot) of electrophoresis gel **;**	**1**
3(c)(iii)	*max 3 of:* *advantage of male sterile GM variety* 1 avoid transferring, *bar* / resistance, gene to wild, radish / relations **; ora** 2 avoid superweeds **; ora** 3 avoid <u>type 2</u> hybrids **; ora** *disadvantage of **type 2 hybrids** (from GM variety that produces pollen)* 4 taller (than wild radish) **; A** very tall / 88 cm / 95 cm 5 produce, more / many, seeds (than wild radish) **; A** 3958 / 443 more 6 may (out)compete, wild radish / crops **;**	**3**

Question	Answer	Marks
4(a)	<table><tr><th>stage of respiration</th><th>ATP used</th><th>ATP produced</th></tr><tr><td>glycolysis</td><td>yes</td><td>yes</td></tr><tr><td>link reaction</td><td>no</td><td>no</td></tr><tr><td>Krebs cycle</td><td>no</td><td>yes</td></tr><tr><td>oxidative phosphorylation</td><td>no</td><td>yes</td></tr></table> **;;** *4 correct = 2 marks, 2 or 3 rows correct = 1 mark* *If ticks and crosses used need all 4 correct for maximum 1 mark*	**2**

Question	Answer	Marks
4(b)	*max 5 of:* *group **A** (accept ora for group **B** throughout) **accept** 'they' = group **A*** 1 higher ratio **;** 2 larger / more, inner membrane / cristae (than **B**) **;** 3 more, ETCs / cytochromes / ATP synth(et)ase / stalked particles **; I** ATPase 4 oxidative phosphorylation **;** 5 more ATP produced **;** 6 muscles can contract for, longer / more time / without getting tired **; I** exercise longer **I** muscles contract faster 7 AVP **;** e.g. chemiosmosis or detail thereof: H^+ move, down gradient / through ATP synth(et)ase **I** ATPase *If **B** and **A** switched round penalise once only*	**5**

Question	Answer	Marks
5(a)	***A*** *all figures ± 1%* ***I*** *increase or decrease 'by x%' when difference from start time to end calculated* *max 4 of:* 1 decrease in daisies **and** normal poppies, overall / in 6 years / after 1999–2000 **;** 2 (decrease in, daisies / normal poppies) from 50% to 15% **;** 3 increase in poppy biotype X from 1% to 70% **;** 4 increase in, total / combined, poppies from 52% to 85% **;** 5 daisies and normal red poppies are **always** equal in % frequency **; A** remain equal 6 steep / huge / dramatic, decrease in daisies and normal red poppy after 2001 **or** increase in X, is steeper after 2001 **;**	**4**
5(b)(i)	*max 3 of:* 1 change in <u>primary</u> structure **;** 2 change in, tertiary / 3D / globular, structure **;** 3 <u>active site</u>, binds substrate / forms ESC **;** 4 metsulfuron-methyl does not, inhibit / bind to, enzyme **;** 5 enzyme, functions / forms amino acids **;**	**3**

Question	Answer	Marks
5(b)(iii)	*max 3 of:* *in 2003 (compared to 1998)* 1 more, weeds / poppies, **and** less wheat / higher proportion of weeds in wheat **; I** wheat yield 2 most weeds are now, poppy biotype X / resistant to herbicide **;** 3 poppy biotype X, not killed by / resistant to herbicide **;** 4 <u>wheat</u> have, more competition for / less access to, space / light / water / minerals **; I** nutrients	**3**
5(c)	*max 3 of:* 1 (biotype X) poppies, die / do not survive / do not breed **;** 2 their, numbers / abundance. would decrease **;** 3 selection pressure, removed / changed / new **;** 4 (biotype X) mutant / resistance, <u>allele</u> no longer, advantageous / selected for / passed on **;** 5 possibility of beneficial mutation in gene for different enzyme **or** could adapt / evolve resistance, to new herbicide **; R** if new herbicide causes mutation	**3**

Question	Answer	Marks
6(a)(i)	*max 2 of:* 1 tropomyosin / it, covers / uncovers, myosin binding sites on actin **; R** inhibits **R** active site 2 when calcium ions bind to troponin, tropomyosin / it, moves / changes shape **;** 3 allows myosin to, bind to actin / form cross-bridges **; ora**	**2**

Question	Answer	Marks
6(a)(ii)	*max 4 of:* 1 ATP hydrolysis / ATP → ADP + Pi **;** 2 (causes myosin) head to, pivot / rotate / tilt / stand up **;** 3 myosin / head, binds to actin / forms cross-bridges with actin **; R** active site 4 ADP and Pi detach **;** 5 (myosin) head, swings back / returns to previous position **;** 6 actin is moved / power stroke occurs **;** 7 (new) ATP binds **;** 8 myosin / head, detaches from actin / cross-bridges break **;** ***A*** *mps in any order apart from 1, 4 and 7 which must be linked to correct action*	**4**
6(b)(i)	*max 2 of:* 1 to, supply / provide, (enough / plenty of) glucose **;** 2 for glycolysis **;** 3 as little ATP is produced by anaerobic respiration **;** 4 as few capillaries are present (to supply glucose directly) **;**	**2**
6(b)(ii)	*max 2 of:* 1 to, supply / provide, (enough / plenty of) oxygen **;** 2 aerobic respiration / oxidative phosphorylation **;** 3 to remove, carbon dioxide / lactate **; A** lactic acid 4 to, avoid fatigue **or** promote, stamina / endurance (for exercise / work) **;**	**2**

Question	Answer	Marks
7(a)	**Aabb** – pink **;** **aaBB** – green **;**	**2**
7(b)	1 parents phenotypes **red** **green ;** 2 gametes **AB** **Ab** **aB** **ab** × **ab ;** 3 offspring genotypes **AaBb** **Aabb** **aaBb** **aabb ;** 4 offspring phenotypes red spines pink spines green spines green spines **;** *(must be linked)* 5 ratio 1 : 1 : 2 **;** **ecf** mp 3 derived from incorrect 2 mp 4 matching incorrect 3 mp 5 matching incorrect 4	**5**
7(c)	*max 2 of:* 1 genes would be, linked / inherited together **;** 2 no independent assortment **;** 3 ratio 1:1 / only two classes (of phenotypes) **; A** red and green **or** pink and green 4 rare cross-over events / recombination (gives small numbers of third phenotype) **;**	**2**

Question	Answer	Marks
8(a)	*max 4 of:* 1 different habitats ; 2 different niches ; 3 many (different) species / large variety of species ; 4 *ref. to* (much) genetic diversity within a species ; 5 different selection pressures ; 6 *ref. to* adaptation ; 7 different, climate / rainfall / temperature / soil / topography / conditions ;	**4**
8(b)(i)	both sites are the same / no (significant) difference between two sites ;	**1**
8(b)(ii)	*genera* 2 **and** *species* 4 ;	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(b)(iii)</td><td>
all figures to 3 d.p. to score but only penalise extra d.p. or rounding error associated with extra d.p. once
<table>
<tr><th>species</th><th>number on grassland not grazed</th><th>n / N</th><th>(n / N)^2</th></tr>
<tr><td>Onthophagus pennsylvanicus</td><td>6641</td><td>0.873</td><td>0.762</td></tr>
<tr><td>Canthon ebenus</td><td>774</td><td>0.102</td><td>0.010</td></tr>
<tr><td>Canthon pilularius</td><td>108</td><td>0.014</td><td>0.000</td></tr>
<tr><td>Onthophagus hecate</td><td>85</td><td>0.011</td><td>0.000</td></tr>
<tr><td>total</td><td>7608</td><td></td><td>0.772</td></tr>
</table>
n / N figures correct / numbers of each species divided by total ;
(n / N)^2 calculated and added up ; ecf from incorrect column 1 including figures with fewer / more than 3 d.p.
0.228 ; ecf total figure subtracted from 1
</td><td>3</td></tr>
<tr><td>8(b)(iv)</td><td>
greater species evenness on grazed grassland ; ora A mostly, one species / O. pennsylvanicus, on not grazed
grazing increases (dung beetle species) (bio)diversity ; ora
if opposite conclusion reached check answer for (iii) and apply ecf for mp2 if D > 0.521
</td><td>2</td></tr>
</table>

Question	Answer	Marks
9(a)	*max 8 of:* 1 stick has, pad containing / immobilised, enzymes **;** 2 glucose oxidase **;** 3 peroxidase **;** 4 stick dipped in urine **; A** person, urinates / AW, on stick 5 glucose reacts to give hydrogen peroxide **;** 6 (hydrogen peroxide reacts with) colourless substance / chromogen **; R** dye / pigment 7 to give, colour change / coloured substance **; A** change to any named colour 8 compare with colour chart **;** 9 more glucose gives darker colour **;** 10 specific / only detects glucose **;** 11 AVP **;** e.g. does not give current <u>blood</u> glucose concentration not numerical	**8**

Question	Answer	Marks
9(b)	*max 7 of:* *high blood glucose concentration* 1 detected by β cells **;** **I** alpha cells **I** receptors 2 in, islets of Langerhans / pancreas **;** 3 (more) insulin secreted **;** **I** produced 4 into blood **;** 5 increases glucose absorption in liver (by phosphorylating glucose) **;** 6 increases permeability to glucose in, muscle / fat, cells **or** adds GLUT 4 proteins to cell surface membranes of, muscle / fat, cells **;** 7 increases (rate of) respiration of glucose **;** 8 conversion of glucose to glycogen / glycogenesis **;** 9 inhibits secretion of glucagon / decreases gluconeogenesis **;** 10 negative feedback **;**	**7**

Question	Answer	Marks
10(a)	*max 6 of:* 1 dendrites (lead to cell body) **;** **R** at both ends 2 nucleus in, cell body / soma **;** **R** if cell body not at one end 3 many mitochondria (in cell body) **;** 4 much RER / Nissl's granules (in cell body) **;** 5 long / one, axon **;** **A** an axon 6 synaptic, knobs / termini / boutons, at end furthest from cell body **;** 7 Schwann cells / myelin **;** 8 nodes of Ranvier **;** *accept points on labelled diagram*	**6**

Question	Answer	Marks
10(b)	*max 9 of:* 1 Na^+ / sodium ion, channels open **;** **I** ligand or voltage gated 2 Na^+ enters, cell / axon **;** **A** Na ions / sodium ions 3 inside / p.d., becomes, less negative / positive / +40 mV **or** causes depolarisation (in correct context) **;** 4 Na^+ / sodium ion, channels close **;** **ecf** from mp1 **I** ligand or voltage-gated 5 K^+ / potassium ion, channels open **;** **ecf** from mp1 **I** ligand or voltage-gated 6 K^+ moves out (of cell) **;** **A** K ions / potassium ions 7 inside / p.d., becomes negative / **A** negative figure **or** causes repolarisation (in correct context) **;** 8 <u>local circuits</u> **;** 9 myelin (sheath) / Schwann cells, insulate / prevent ion movement **;** 10 action potential / depolarisation, <u>only</u> at, nodes (of Ranvier) **;** 11 saltatory conduction / action potential jumps from node to node **;** **A** impulse for AP 12 one-way / unidirectional, transmission **;** 13 AVP **;** e.g. hyperpolarisation / refractory period	**9**