

Cambridge  
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AS & A Level

**Cambridge International Examinations**  
Cambridge International Advanced Subsidiary and Advanced Level

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**BIOLOGY**

**9700/42**

Paper 4 A Level Structured Questions

**May/June 2017**

MARK SCHEME

Maximum Mark: 100

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**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><u>underline</u></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

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	<b>R</b> – pyruvate ; <b>S</b> – carbon dioxide ;	<b>2</b>
1(a)(ii)	<i>idea that</i> , hydrogen(s) / protons <b>and</b> electrons, are released ; <b>A</b> (reduced NAD), oxidised / dehydrogenated at ETC / (for) oxidative phosphorylation ;	<b>2</b>
1(b)	1. lactate (produced) ; <b>A</b> lactic acid 2. (lactate) taken to liver ; 3. converted to pyruvate ; 4. (pyruvate) converted to, glucose / glycogen ; 5. carbon dioxide (produced) ; 6. <i>ref. to</i> carbon dioxide / pH, receptors ; 7. (carbon dioxide) goes into alveoli ; 8. increased breathing (rate) ; 9. <i>ref. to</i> haemoglobin acts as a buffer for carbon dioxide ;	<b>max 5</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	<p><i>Example 1</i> rate increases <b>as</b>, chlorophyll / chloroplasts, for light dependent reaction / described ;</p> <p><i>Example 2</i> rate decreases <b>as</b>, fewer thylakoids / less chlorophyll / fewer chloroplasts, for light dependent reaction / described ;</p>	<b>2</b>
2(b)	<ol style="list-style-type: none"> <li>1. chromatography / <i>ref. to chromatogram</i> ;</li> <li>2. place, extract / sample / AW, on base line of, (paper / TLC plate) ;</li> <li>3. dry and repeat ;</li> <li>4. place paper in solvent ;</li> <li>5. measure distance travelled by solvent and pigment ;</li> <li>6. (calculate) <math>R_f</math> value = distance travelled by pigment divided by distance travelled by solvent ;</li> <li>7. compare <math>R_f</math> values against published values to identify pigments ;</li> </ol>	<b>max 4</b>
2(c)	<ol style="list-style-type: none"> <li>1. (generally) those (pre-treated) in fluorescent light have greater absorbance than those grown in red light ; <b>ora</b></li> <li>2. (except) those (pre-treated) in red light have, greater absorbance in 580 – 660nm / a peak at 625nm ; <b>ora</b></li> <li>3. (because) during pre-treatment (with fluorescent or red light) different (named) pigments are made ;</li> </ol>	<b>3</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)(i)	decreases / shortens / AW ;	<b>1</b>
3(a)(ii)	stays the same / nothing ;	<b>1</b>
3(b)	<ol style="list-style-type: none"> <li>1. (when) sarcoplasmic reticulum / SR, depolarised ;</li> <li>2. calcium (ion) channels / voltage-gated channels, open ;</li> <li>3. calcium ions, diffuse / move down a concentration gradient, (through open channels) ;</li> <li>4. bind to troponin which changes shape ;</li> <li>5. tropomyosin moves ;</li> <li>6. binding sites exposed ;</li> <li>7. allows myosin to bind (to actin) / cross bridge formation ;</li> <li>8. <i>ref. to power stroke</i> / AW ;</li> </ol>	<b>max 4</b>
3(c)	<ol style="list-style-type: none"> <li>1. no detachment of myosin heads ;</li> <li>2. so no, energy transferred to myosin / ATPase activity / hydrolysis of ATP ;</li> <li>3. so no, cross bridge formation ;</li> <li>4. so no, power stroke / pulling of actin ;</li> <li>5. so no recovery stroke / myosin head does not return to original position ;</li> <li>6. no pumping of calcium ions into SR ;</li> </ol>	<b>max 3</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)(i)	1. no resistance to any herbicide at start of use ; 2. resistant to photosystem II inhibitors – increases, to 101–103 <b>or</b> from 1969 to 2013 ; 3. resistant to ALS inhibitors – increase to 153 – 155 <b>or</b> from 1981 to 2014 ; 4. resistant to glyphosate - increase to 32 / 33 <b>or</b> from 1993 - 1995 to 2014 ; 5. comparative point described ; e.g. ALS steepest gradient / ALS has highest number of species	<b>max 3</b>
4(a)(ii)	1. random / spontaneous, mutation ; 2. herbicide is selection pressure ; 3. mutant / resistant, individuals, survive / reproduce ; ora 4. pass on, mutant / resistance, allele ; ora 5. (mutant / resistance) allele increases in frequency (in population) ; ora 6. <i>ref. to</i> many generations ;	<b>max 4</b>
4(b)(i)	$(668 \times 3) + 3$ (stop codon) = 2007 bp <b>or</b> $668 \times 3 = 2004$ bp ;	<b>1</b>
4(b)(ii)	1. after folding substituted amino acids are close together ; 2. <i>ref. to</i> different bonding ; 3. (substituted amino acids) causes change to protein, 3D / tertiary / quaternary / globular, structure ; 4. herbicide / inhibitor, unable to bind to, active / allosteric, site ;	<b>max 2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(c)	<p><i>method 1 benefits max 3</i></p> <ol style="list-style-type: none"><li>1. hybrid vigour / reduces inbreeding depression ;</li><li>2. increase in, genetic variation / gene pool / variety of alleles ;</li><li>3. increase in heterozygosity ; ora</li><li>4. <i>idea that</i> low tech / easy to do / cheaper ;</li></ol> <p><i>method 2 benefits</i></p> <ol style="list-style-type: none"><li>5. no need to find a suitable (wild) plant / can proceed even if no resistant (wild) plant exists ;</li><li>6. will not introduce, unwanted alleles / poor characteristics, from (wild) plant ;</li><li>7. no chance of disease transfer ;</li></ol>	<b>max 4</b>

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Question	Answer	Marks
5(a)	1. individual 8 or 11 has, BRCA2 / allele, but does not have cancer ; 2. no evidence / unknown, that individuals (apart from 15) with cancer have, <i>BRCA2</i> / allele <b>or</b> individuals with cancer (apart from 15) may have a different mutation ; 3. no children of individual 15, (known to) have the allele / have cancer ; 4. individuals in fourth generation / children of individual 15, may develop cancer later in life ; 5. individual 15 has cancer and, <i>BRCA2</i> / allele ; 6. (some) individuals with cancer in third generation had a parent with cancer <b>or</b> (some) individuals with cancer in third generation had a parent with, <i>BRCA2</i> / allele ; ora 7. individual 3 or 4 may have had the, <i>BRCA2</i> / allele <b>or</b> any individual from 8 to 11 may have inherited, <i>BRCA2</i> / allele, from 3 or 4 ; 8. <i>idea that</i> overall data inconclusive ;	<b>max 4</b>
5(b)(i)	all the, DNA / genetic material (in a person's cell) ;	<b>1</b>
5(b)(ii)	(named) white cell, <b>because</b> it contains a nucleus ;	<b>1</b>



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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(b)(iii)	<ol style="list-style-type: none"> <li>1. <i>ref. to</i> probes are (short) lengths of ssDNA ;</li> <li>2. complementary to the, alleles / DNA, being tested for ;</li> <li>3. many copies of one type of probe placed in each cell (of the microarray) ;</li> <li>4. (target), alleles / DNA, made single-stranded <b>or</b> single-stranded DNA made from mRNA ;</li> <li>5. (target), alleles / DNA, labelled, (with fluorescent 'tags') ;</li> <li>6. (target), alleles / DNA, hybridises / binds, with, probes / ssDNA ;</li> <li>7. unbound (target), alleles / DNA, washed off <b>or</b> bound (target), alleles / DNA, will not be washed off ;</li> <li>8. laser / UV light, used to detect presence of, fluorescence / hybridised probes / alleles / DNA ;</li> </ol>	<b>max 4</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(b)(iv)	<p><i>advantage</i> max 1</p> <ol style="list-style-type: none"> <li>1. if present, enables lifestyle change / early treatment / regular check-ups ;</li> <li>2. if not present removes worry ;</li> <li>3. preventative treatment may be cheaper than treating disease itself ;</li> </ol> <p><i>disadvantage</i> max 1</p> <ol style="list-style-type: none"> <li>4. if present may cause worry ;</li> <li>5. if present person may not develop cancer ;</li> <li>6. test is expensive ;</li> <li>7. may have implications for life insurance / AW ;</li> <li>8. may decide to not have children / may be tested after they have children ;</li> </ol>	<b>max 2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)	<p><b>E</b> – pointing to the vessel on the left ;</p> <p><b>G</b> – pointing to capillaries ;</p> <p><b>P</b> – pointing to the inner epithelium of the capsule ;</p>	<b>3</b>
6(b)	<ol style="list-style-type: none"> <li>1. microvilli ;</li> <li>2. <b>many</b> mitochondria ;</li> <li>3. tight junctions / described ;</li> <li>4. folded, basal membrane / described ;</li> <li>5. <b>many</b>, transport proteins / cotransporters / pumps ;</li> <li>6. aquaporins ;</li> <li>7. AVP ; e.g. more ER for increased protein synthesis</li> </ol>	<b>max 5</b>
6(c)	<p>osmoreceptors ;</p> <p>ADH / antidiuretic hormone ;</p> <p>posterior pituitary (gland) ;</p> <p>negative feedback ; <b>A</b> homeostatic</p>	<b>4</b>

Question	Answer	Marks																									
7(a)	<p><i>parental genotypes</i> <b>AaBb</b> x <b>AaBb</b> ;</p> <p><i>gametes</i> <b>AB</b> <b>Ab</b> <b>aB</b> <b>ab</b> x <b>AB</b> <b>Ab</b> <b>aB</b> <b>ab</b> ;</p> <p><i>offspring</i></p> <table border="1" data-bbox="748 384 1482 847"> <thead> <tr> <th></th> <th><b>AB</b></th> <th><b>Ab</b></th> <th><b>aB</b></th> <th><b>ab</b></th> </tr> </thead> <tbody> <tr> <th><b>AB</b></th> <td><b>AABB</b> white</td> <td><b>AABb</b> white</td> <td><b>AaBB</b> white</td> <td><b>AaBb</b> white</td> </tr> <tr> <th><b>Ab</b></th> <td><b>AABb</b> white</td> <td><b>AAbb</b> white</td> <td><b>AaBb</b> white</td> <td><b>Aabb</b> white</td> </tr> <tr> <th><b>aB</b></th> <td><b>AaBB</b> white</td> <td><b>AaBb</b> white</td> <td><b>aaBB</b> black</td> <td><b>aaBb</b> black</td> </tr> <tr> <th><b>ab</b></th> <td><b>AaBb</b> white</td> <td><b>Aabb</b> white</td> <td><b>aaBb</b> black</td> <td><b>aabb</b> brown</td> </tr> </tbody> </table> <p style="text-align: right;">∴</p> <p><i>max 2 for all offspring correct</i> <i>max 1 if one error</i> <i>max 0 if more than one error</i></p> <p><i>offspring phenotype correctly linked to genotype</i> ;</p> <p><i>ratio</i> 12 white : 3 black : 1 brown ;</p>		<b>AB</b>	<b>Ab</b>	<b>aB</b>	<b>ab</b>	<b>AB</b>	<b>AABB</b> white	<b>AABb</b> white	<b>AaBB</b> white	<b>AaBb</b> white	<b>Ab</b>	<b>AABb</b> white	<b>AAbb</b> white	<b>AaBb</b> white	<b>Aabb</b> white	<b>aB</b>	<b>AaBB</b> white	<b>AaBb</b> white	<b>aaBB</b> black	<b>aaBb</b> black	<b>ab</b>	<b>AaBb</b> white	<b>Aabb</b> white	<b>aaBb</b> black	<b>aabb</b> brown	<b>6</b>
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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(b)	<ol style="list-style-type: none"> <li>1. example of, gene interaction / epistasis ;</li> <li>2. <i>ref. to</i> blocking (one step in) pathway to pigment production ;</li> <li>3. (allele <b>A</b>) product / protein, inhibits enzyme (producing pigment) ;</li> <li>4. (allele <b>A</b>) product / protein, is a repressor ;     <b>A</b> allele codes for a repressor</li> <li>5. (which) blocks transcription / RNA polymerase cannot bind / switches off allele (coding for pigment) ;</li> <li>6. (by), binding to / blocking, operator / promoter ;</li> <li>7. (allele <b>A</b>) product / protein, prevents transcription factor complex formation / AW ;</li> </ol>	<b>max 3</b>

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Question	Answer	Marks																								
8(a)	1. <u>random sampling</u> ; 2. (using) random number generator for coordinates ; 3. in both sites ; 4. measure, percentage cover / (Braun-Blanquet / ACFOR) scale cover ; 5. using (square frame) quadrats ; 6. repeat sampling ;	<b>max 4</b>																								
8(b)(i)	family / sub-family ;	<b>1</b>																								
8(b)(ii)	that there is no significant difference (between the two sites) ;	<b>1</b>																								
8(b)(iii)	<table border="1" data-bbox="331 783 1211 1098"> <thead> <tr> <th>animal taxon</th> <th>number present in soil under brambles</th> <th><math>\frac{n}{N}</math></th> <th><math>(\frac{n}{N})^2</math></th> </tr> </thead> <tbody> <tr> <td>pseudoscorpion</td> <td>21</td> <td>0.512</td> <td>0.262</td> </tr> <tr> <td>wireworm</td> <td>12</td> <td>0.293</td> <td>0.086</td> </tr> <tr> <td>gamasid mite</td> <td>7</td> <td>0.171</td> <td>0.029</td> </tr> <tr> <td>springtail</td> <td>1</td> <td>0.024</td> <td>0.001</td> </tr> <tr> <td>total</td> <td>41</td> <td></td> <td>0.378</td> </tr> </tbody> </table> <p data-bbox="331 1134 1178 1166">n / N figures correct <b>or</b> numbers of each species divided by total ;</p> <p data-bbox="331 1198 770 1230"><math>(n / N)^2</math> calculated <b>and</b> added up ;</p> <p data-bbox="331 1270 1025 1302">total figure subtracted from 1 / 1 – 0.378 = <b>0.622</b> ; <b>ecf</b></p>	animal taxon	number present in soil under brambles	$\frac{n}{N}$	$(\frac{n}{N})^2$	pseudoscorpion	21	0.512	0.262	wireworm	12	0.293	0.086	gamasid mite	7	0.171	0.029	springtail	1	0.024	0.001	total	41		0.378	<b>3</b>
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8(b)(iv)	<p><i>apply ecf from (iii) if D is very different to 0.663 / 0.622</i></p> <ol style="list-style-type: none"><li>1. bracken and bramble / both sites, have similar Simpson's Index of Diversity (D) numbers ; <b>or</b> bracken and bramble / type of vegetation, has little effect on soil organism diversity ;</li><li>2. soil organisms more abundant under bracken ; ora</li></ol>	<b>2</b>

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Question	Answer	Marks
9(a)	<ol style="list-style-type: none"> <li>1. proton pumps in cell surface membranes (of guard cells) ;</li> <li>2. pump H<sup>+</sup> out (of cells) ;</li> <li>3. low(er) H<sup>+</sup> conc inside (cell) ;</li> <li>4. inside of cell more negative (than outside) ;</li> <li>5. K<sup>+</sup> channels open ;</li> <li>6. K<sup>+</sup> move into (cell) ;</li> <li>7. by <u>facilitated</u> diffusion ;</li> <li>8. Cl<sup>-</sup> ions enter ;</li> <li>9. water potential of cell decreases ;</li> <li>10. water moves into cell, by osmosis / down a water potential gradient ;</li> <li>11. <i>ref. to</i> aquaporins ;</li> <li>12. volume of (guard) cells increases ; <b>A</b> expands</li> <li>13. (guard) cells become turgid / increase in turgor pressure of (guard) cells ;</li> <li>14. <i>ref. to</i> unequal thickness of cell wall (of guard cell) ;</li> </ol>	<b>max 9</b>



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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(b)	<p><i>open</i></p> <ol style="list-style-type: none"><li>1. increase in light (intensity) / high light (intensity) ;</li><li>2. gains CO<sub>2</sub> for photosynthesis ;</li><li>3. allows oxygen out ;</li><li>4. allows transpiration (stream) to occur ;</li><li>5. (which) brings water / mineral ions, in ;</li><li>6. (for) photosynthesis / turgidity ;</li></ol> <p><i>close</i></p> <ol style="list-style-type: none"><li>7. in darkness / decrease in light (intensity) / low light (intensity) ;</li><li>8. carbon dioxide not required as no photosynthesis ;</li><li>9. in, low humidity / high temperature / high wind speed / water stress ;</li><li>10. to maintain (cell) turgidity / to prevent wilting / to prevent water loss (by transpiration) ;</li></ol>	<b>max 6</b>

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Question	Answer					Marks
10(a)	<i>Differences</i>					<b>max 8</b>
		<i>nervous</i>		<i>endocrine</i>		
1	communication	action potential / impulse	<b>and</b>	hormone ;		
2	nature of communication	electrical (and chemical)	<b>and</b>	chemical ;		
3	mode of transmission	neurone / nerve cell	<b>and</b>	blood ;		
4	response destination	muscle / gland	<b>and</b>	target, organs / tissue / cells ;		
5	transmission speed	fast(er)	<b>and</b>	slow(er) ;		
6	effects	specific / localised	<b>and</b>	(can be) widespread ;		
7	response speed	fast(er)	<b>and</b>	slow(er) ;		
8	duration	short-lived / temporary	<b>and</b>	can be long-lasting / permanent ;		
9	receptor location	on cell surface membrane	<b>and</b>	either on cell surface membrane <b>or</b> within cell ;		
	<i>Similarities</i>					
10	cell signalling	both involve cell signalling ;				
11	detail	both involve signal molecule binding to receptor ;				
12	chemicals	both involve chemicals ;				

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
10(b)	<ol style="list-style-type: none"> <li>1. chemicals act as a stimulus ;</li> <li>2. <i>ref. to</i> specificity of chemoreceptors ;</li> <li>3. sodium ions diffuse into cell ;</li> <li>4. via microvilli ;</li> <li>5. membrane depolarised ;</li> <li>6. receptor potential / generator potential ;</li> <li>7. stimulates opening of calcium (ion) channels ;</li> <li>8. calcium ions enter cell ;</li> <li>9. causes movement of vesicles containing neurotransmitter ;</li> <li>10. neurotransmitter released by exocytosis / described ;</li> <li>11. neurotransmitter stimulates, action potential / impulses, in sensory neurone ;</li> <li>12. <i>ref. to</i> (chemoreceptors are) transducers / description ;</li> <li>13. AVP ; e.g. threshold / all or nothing law / papilla</li> </ol>	<b>max 7</b>