Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

BIOLOGY **9700/42**

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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2017 series for most Cambridge IGCSE®, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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

Question	Answer	Marks
2(a)	*Example 1* rate increases **as**, chlorophyll / chloroplasts, for light dependent reaction / described **;** *Example 2* rate decreases **as**, fewer thylakoids / less chlorophyll / fewer chloroplasts, for light dependent reaction / described **;**	**2**
2(b)	1. chromatography / *ref. to* chromatogram **;** 2. place, extract / sample / AW, on base line of, (paper / TLC plate) **;** 3. dry and repeat **;** 4. place paper in solvent **;** 5. measure distance travelled by solvent and pigment **;** 6. (calculate) R_f value = distance travelled by pigment divided by distance travelled by solvent **;** 7. compare R_f values against published values to identify pigments **;**	**max 4**
2(c)	1. (generally) those (pre-treated) in fluorescent light have greater absorbance than those grown in red light **; ora** 2. (except) those (pre-treated) in red light have, greater absorbance in 580 – 660nm / a peak at 625nm **; ora** 3. (because) during pre-treatment (with fluorescent or red light) different (named) pigments are made **;**	**3**

Question	Answer	Marks
3(a)(i)	decreases / shortens / AW **;**	**1**
3(a)(ii)	stays the same / nothing **;**	**1**
3(b)	1. (when) sarcoplasmic reticulum / SR, depolarised **;** 2. calcium (ion) channels / voltage-gated channels, open **;** 3. calcium ions, diffuse / move down a concentration gradient, (through open channels) **;** 4. bind to troponin which changes shape **;** 5. tropomyosin moves **;** 6. binding sites exposed **;** 7. allows myosin to bind (to actin) / cross bridge formation **;** 8. *ref. to* power stroke / AW **;**	**max 4**
3(c)	1. no detachment of myosin heads **;** 2. so no, energy transferred to myosin / ATPase activity / hydrolysis of ATP **;** 3. so no, cross bridge formation **;** 4. so no, power stroke / pulling of actin **;** 5. so no recovery stroke / myosin head does not return to original position **;** 6. no pumping of calcium ions into SR **;**	**max 3**

Question	Answer	Marks
4(a)(i)	1. no resistance to any herbicide at start of use **;** 2. resistant to photosystem II inhibitors – increases, to 101–103 **or** from 1969 to 2013 **;** 3. resistant to ALS inhibitors – increase to 153 – 155 **or** from 1981 to 2014 **;** 4. resistant to glyphosate - increase to 32 / 33 **or** from 1993 - 1995 to 2014 **;** 5. comparative point described **;** e.g. ALS steepest gradient / ALS has highest number of species	**max 3**
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. *ref. to* many generations **;**	**max 4**
4(b)(i)	(668 × 3) + 3 (stop codon) = 2007 bp **or** 668 × 3 = 2004 bp **;**	**1**
4(b)(ii)	1. after folding substituted amino acids are close together **;** 2. *ref. to* 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 **;**	**max 2**

Question	Answer	Marks
4(c)	*method 1 benefits max 3* 1. hybrid vigour / reduces inbreeding depression **;** 2. increase in, genetic variation / gene pool / variety of alleles **;** 3. increase in heterozygosity **;** ora 4. *idea that* low tech / easy to do / cheaper **;** *method 2 benefits* 5. no need to find a suitable (wild) plant / can proceed even if no resistant (wild) plant exists **;** 6. will not introduce, unwanted alleles / poor characteristics, from (wild) plant **;** 7. no chance of disease transfer **;**	**max 4**

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, *BRCA2* / allele **or** 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, *BRCA2* / allele **;** 6. (some) individuals with cancer in third generation had a parent with cancer **or** (some) individuals with cancer in third generation had a parent with, *BRCA2* / allele **;** ora 7. individual 3 or 4 may have had the, BRCA2 / allele **or** any individual from 8 to 11 may have inherited, *BRCA2* / allele, from 3 or 4 **;** 8. *idea that* overall data inconclusive **;**	**max 4**
5(b)(i)	all the, DNA / genetic material (in a person's cell) **;**	**1**
5(b)(ii)	(named) white cell, **because** it contains a nucleus **;**	**1**

Question	Answer	Marks
5(b)(iii)	1. *ref. to* probes are (short) lengths of ssDNA **;** 2. complementary to the, alleles / DNA, being tested for **;** 3. many copies of one type of probe placed in each cell (of the microarray) **;** 4. (target), alleles / DNA, made single-stranded **or** single-stranded DNA made from mRNA **;** 5. (target), alleles / DNA, labelled, (with fluorescent 'tags') **;** 6. (target), alleles / DNA, hybridises / binds, with, probes / ssDNA **;** 7. unbound (target), alleles / DNA, washed off **or** bound (target), alleles / DNA, will not be washed off **;** 8. laser / UV light, used to detect presence of, fluorescence / hybridised probes / alleles / DNA **;**	**max 4**

Question	Answer	Marks
5(b)(iv)	*advantage* max 1 1. if present, enables lifestyle change / early treatment / regular check-ups **;** 2. if not present removes worry **;** 3. preventative treatment may be cheaper than treating disease itself **;** *disadvantage* max 1 4. if present may cause worry **;** 5. if present person may not develop cancer **;** 6. test is expensive **;** 7. may have implications for life insurance / AW **;** 8. may decide to not have children / may be tested after they have children **;**	**max 2**

Question	Answer	Marks
6(a)	**E** – pointing to the vessel on the left **;** **G** – pointing to capillaries **;** **P** – pointing to the inner epithelium of the capsule **;**	**3**
6(b)	1. microvilli **;** 2. **many** mitochondria **;** 3. tight junctions / described **;** 4. folded, basal membrane / described **;** 5. **many**, transport proteins / cotransporters / pumps **;** 6. aquaporins **;** 7. AVP **;** e.g. more ER for increased protein synthesis	**max 5**
6(c)	osmoreceptors **;** ADH / antidiuretic hormone **;** posterior pituitary (gland) **;** negative feedback **; A** homeostatic	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)</td><td>
parental genotypes AaBb x AaBb ;

gametes AB Ab aB ab x AB Ab aB ab ;

offspring
<table>
<tr><th></th><th>AB</th><th>Ab</th><th>aB</th><th>ab</th></tr>
<tr><th>AB</th><td>AABB
white</td><td>AABb
white</td><td>AaBB
white</td><td>AaBb
white</td></tr>
<tr><th>Ab</th><td>AABb
white</td><td>AAbb
white</td><td>AaBb
white</td><td>Aabb
white</td></tr>
<tr><th>aB</th><td>AaBB
white</td><td>AaBb
white</td><td>aaBB
black</td><td>aaBb
black</td></tr>
<tr><th>ab</th><td>AaBb
white</td><td>Aabb
white</td><td>aaBb
black</td><td>aabb
brown</td></tr>
</table>
;;
max 2 for all offspring correct
max 1 if one error
max 0 if more than one error

offspring phenotype correctly linked to genotype ;

ratio 12 white : 3 black : 1 brown ;
</td><td>6</td></tr>
</table>

Question	Answer	Marks
7(b)	1. example of, gene interaction / epistasis **;** 2. *ref. to* blocking (one step in) pathway to pigment production **;** 3. (allele **A**) product / protein, inhibits enzyme (producing pigment) **;** 4. (allele **A**) product / protein, is a repressor **;** **A** allele codes for a repressor 5. (which) blocks transcription / RNA polymerase cannot bind / switches off allele (coding for pigment) **;** 6. (by), binding to / blocking, operator / promoter **;** 7. (allele **A**) product / protein, prevents transcription factor complex formation / AW **;**	**max 3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>8(a)</td><td>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 ;</td><td>max 4</td></tr>
<tr><td>8(b)(i)</td><td>family / sub-family ;</td><td>1</td></tr>
<tr><td>8(b)(ii)</td><td>that there is no significant difference (between the two sites) ;</td><td>1</td></tr>
<tr><td>8(b)(iii)</td><td><table>
<tr><th>animal taxon</th><th>number present in soil under brambles</th><th>$\frac{n}{N}$</th><th>$(n / N)^2$</th></tr>
<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>
</table>
n / N figures correct or numbers of each species divided by total ;
$(n / N)^2$ calculated and added up ;
total figure subtracted from 1 / 1 – 0.378 = 0.622 ; ecf</td><td>3</td></tr>
</table>

Question	Answer	Marks
8(b)(iv)	*apply **ecf** from (iii) if D is very different to 0.663 / 0.622* 1. bracken and bramble / both sites, have similar Simpson's Index of Diversity (D) numbers **;** **or** bracken and bramble / type of vegetation, has little effect on soil organism diversity **;** 2. soil organisms more abundant under bracken **;** ora	**2**

Question	Answer	Marks
9(a)	1. proton pumps in cell surface membranes (of guard cells) **;** 2. pump H^+ out (of cells) **;** 3. low(er) H^+ conc inside (cell) **;** 4. inside of cell more negative (than outside) **;** 5. K^+ channels open **;** 6. K^+ move into (cell) **;** 7. by facilitated diffusion **;** 8. Cl^- ions enter **;** 9. water potential of cell decreases **;** 10. water moves into cell, by osmosis / down a water potential gradient **;** 11. *ref. to* aquaporins **;** 12. volume of (guard) cells increases **; A** expands 13. (guard) cells become turgid / increase in turgor pressure of (guard) cells **;** 14. *ref. to* unequal thickness of cell wall (of guard cell) **;**	**max 9**

Question	Answer	Marks
9(b)	*open* 1. increase in light (intensity) / high light (intensity) **;** 2. gains CO_2 for photosynthesis **;** 3. allows oxygen out **;** 4. allows transpiration (stream) to occur **;** 5. (which) brings water / mineral ions, in **;** 6. (for) photosynthesis / turgidity **;** *close* 7. in darkness / decrease in light (intensity) / low light (intensity) **;** 8. carbon dioxide not required as no photosynthesis **;** 9. in, low humidity / high temperature / high wind speed / water stress **;** 10. to maintain (cell) turgidity / to prevent wilting / to prevent water loss (by transpiration) **;**	**max 6**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>10(a)</td><td>

Differences

<table>
<tr><th></th><th></th><th>nervous</th><th></th><th>endocrine</th></tr>
<tr><td>1</td><td>communication</td><td>action potential / impulse</td><td>and</td><td>hormone ;</td></tr>
<tr><td>2</td><td>nature of communication</td><td>electrical (and chemical)</td><td>and</td><td>chemical ;</td></tr>
<tr><td>3</td><td>mode of transmission</td><td>neurone / nerve cell</td><td>and</td><td>blood ;</td></tr>
<tr><td>4</td><td>response destination</td><td>muscle / gland</td><td>and</td><td>target, organs / tissue / cells ;</td></tr>
<tr><td>5</td><td>transmission speed</td><td>fast(er)</td><td>and</td><td>slow(er) ;</td></tr>
<tr><td>6</td><td>effects</td><td>specific / localised</td><td>and</td><td>(can be) widespread ;</td></tr>
<tr><td>7</td><td>response speed</td><td>fast(er)</td><td>and</td><td>slow(er) ;</td></tr>
<tr><td>8</td><td>duration</td><td>short-lived / temporary</td><td>and</td><td>can be long-lasting / permanent ;</td></tr>
<tr><td>9</td><td>receptor location</td><td>on cell surface membrane</td><td>and</td><td>either on cell surface membrane or within cell ;</td></tr>
</table>

Similarities

<table>
<tr><td>10</td><td>cell signalling</td><td>both involve cell signalling ;</td></tr>
<tr><td>11</td><td>detail</td><td>both involve signal molecule binding to receptor ;</td></tr>
<tr><td>12</td><td>chemicals</td><td>both involve chemicals ;</td></tr>
</table>

</td><td>max 8</td></tr>
</table>

Question	Answer	Marks
10(b)	1. chemicals act as a stimulus **;** 2. *ref. to* specificity of chemoreceptors **;** 3. sodium ions diffuse into cell **;** 4. via microvilli **;** 5. membrane depolarised **;** 6. receptor potential / generator potential **;** 7. stimulates opening of calcium (ion) channels **;** 8. calcium ions enter cell **;** 9. causes movement of vesicles containing neurotransmitter **;** 10. neurotransmitter released by exocytosis / described **;** 11. neurotransmitter stimulates, action potential / impulses, in sensory neurone **;** 12. *ref. to* (chemoreceptors are) transducers / description **;** 13. AVP **;** e.g. threshold / all or nothing law / papilla	**max 7**