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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

9700 BIOLOGY

9700/51 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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;	separates marking points
/	alternatives answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or guidance for examiners)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
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 (examples given as guidance)

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	oxygen production / concentration; (light) transmission / absorbance;	**A** <u>amount</u> **R** oxygen unqualified **A** descriptions e.g. reduction in light passing through **R** light intensity.	[2]
(ii)	2 of: light intensity; carbon dioxide concentration; speed of stirrer; mass of alga (suspension); <u>volume</u> of alga(suspension); distance of light meter from the alga suspension; position of oxygen probe;	**A** light in terms of distance from lamp / same (wattage) bulb ignore size of container / references to quantities of liquid or water **A** weight ignore number of cells ignore amount / concentration / quantity for mass or volume	[max 2]
(b) (i)	subtract the transmission (for each wave length) from 100;	**A** as a formula 100 – transmission (for each wave length) **A** subtracting the transmission from the transmission without any algae / just water **R** subtracting the wave length	[1]
(ii)	oxygen concentration;	*if more than one given, mark the first* **A** production / volume / amount / quantity / meter reading (ignore rate) **R** bubbles	[1]
(c)	2 of: 1. ref. to idea of different movement / spread / partitioning in different solvents ; 2. ref. to idea that some pigments are not soluble / less soluble in some solvents ; 3. ref. to the idea that some pigments have the same solubility in solvent 1 ; 4. ref. to second solvent separates pigments that are not separated by solvent 1 ;	***A*** *marks on Fig. 1.3* 1. **A** if it is clear that the pigments have not been separated by solvent 1 / clump together 2. **A** if refer to pigments 1 and 6 or 4 and 5 3. **A** if refer to 'not knowing' if all the pigments have been found 4. **A** some pigments are separated more easily in one solvent and others by a different solvent	[max 2]

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Question	Expected answer	Extra guidance	Mark
(d)	8 of: *independent variable:* 1. ref. to using (a sample) from each type of alga ; 2. ref. to same quantity / amount (of each) ; *dependent variables:* 3. ref. to observing / measuring / marking / finding the position of the pigments / colours (on the chromatogram) ; *procedure:* 4. ref. to a method of extracting pigments (from the algae) ; 5. ref. to filtering / centrifuging to remove debris / obtain pigments ; 6. ref. to method of concentrating the extract; 7. ref. to a method of applying sample; 8. ref. to suitable placing in the solvent; 9. ref. to running to a set distance of run; 10. ref. to drying before using second solvent; 11. ref. to running in second solvent at 90° to first run; 12. ref. to covering container (to prevent evaporation);	*Ignore reference to leaves for any mp.* 1. need idea of water plant / alga 2. **A** in terms of mass / volume of suspension (of algae) not number 3. **A** results / pattern / ref. to Rf values ignore ref. to locating agents, e.g. ninhydrin 4. **A** any idea of grinding / crushing algae (separately or with solvent / use a blender **A** crushing onto one corner of the paper **A** boiling / heating with ethanol / solvent 5. **A** extract / supernatant for pigments 6. **A** any method, e.g. evaporating, heating, partitioning with different solvents or (many) spots at the same point / crushing several lots of algae in the same spot 7. e.g. capillary tube / fine or small dropper / fine or small paint brush / pin head **A** ref. to a small spot **R** a line or several spots 8. e.g. solvent level below sample / origin. Ignore names of solvent 9. e.g. before solvent front reaches the end / pre-marked line **A** 'same time' for 2 chromatograms, one for each of the strains of alga. Ignore any specific times 11. ignore diagrams with incorrect orientation 12. **A** air tight container	

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Question	Expected answer	Extra guidance	Mark
	reliability: 13. ref. to repeating to compare (chromatograms) / to find anomalies; *safety (max 1):* 14. ref. to solvents / algae + suitable precaution; 15. ref. to safe disposal of solvent;	13. ignore ref. to means unqualified **A** finding means of Rf values / AW 14. e.g. flammable – no naked flames / AW toxic – in fume cupboard / ventilated space / covered containers / gloves / goggles corrosive or allergy to algae / solvents – gloves and goggles Ignore low risk / radiaton	[max 8]
(e) (i)	strain **B and** pigment S / AW;	**A** spot / dot / number 4	[1]
(ii)	2 of: 1. chromatogram for **B** has a pigment / spot / number 4 missing; 2. at about Rf 0.9(1) (in solvent 1); 3. the absorption spectrum for **B** has low(est) absorbance at 490nm; 4. the action spectrum for **B** has low(est) activity at 490nm;	***ecf*** *for incorrect pigment in (i),mp1, 3 or 4* 2. **A** Rf 0.19 / 0.2 (in solvent 2) **A** it has the highest Rf in solvent 1 / a low Rf in solvent 2 3. **A** if the range 470 – 530nm is given 4. **A** if the range 490 – 510nm is given. **A** rate of photosynthesis is low(est) at 490nm	[max 2]
(iii)	1 of: allows the alga to use a greater variety of wave lengths / use blue end of spectrum / short wave length (for photosynthesis); may allow strain **A** to survive better / photosynthesise in deeper water;	***ecf*** *for incorrect pigments **R** or **T** in **(i)***	[1]
		Total:	**[20]**

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Question	Expected answer	Extra guidance	Mark
2 (a)	1 × 2 of: *Mark as prose. One mark for the factor, one mark for a suitable method of controlling the factor* temperature; keep breeding units in temperature controlled room / incubator / thermostatically-controlled water bath; culture medium for larvae; ref. to same composition / idea of sufficient ; oxygen (supply / concentration); ref. to suitable covering / container that allows oxygen / air entry; pH ; ref. to using a buffer ;	 **A** warm / heat **R** air conditioned room **A** food source / nutrient / named food ignore volume / mass **A** ref. to water if in the context of the culture medium **A** air	 [1] [1]
(b)	ref. to a method of magnifying the abdomen;	e.g. microscope / hand lens / binocular / magnifying glass **R** telescope / electron microscope	[1]
(c)	offspring are in approximately 9:3:3:1 ratio / correct description	**A** ref. (offspring with) recombinant phenotypes / varieties / types / combinations that are different from either of the parents / four different phenotypes **A** named recombinants, e.g. grey and short wings / ebony and long wings / ebony and short wings **A** linkage would give 2 phenotypes **R** answers that just copy the figures in the table	[1]
(d) (i)	there is no (significant) difference between the observed and expected ratio ;	**A** no (significant) difference from the ratio 1:1:1:1 the null hypothesis must be in terms of 'there is no (significant) difference between….' ignore any differences are due to chance'	[1]

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Question	Expected answer				Extra guidance	Mark
(ii)	Offspring phenotype	O	E	$\frac{(O-E)^2}{E}$	1 mark for E column 1 mark for $\frac{(O-E)^2}{E}$ column ***ecf*** *from E* **A** as fractions ignore number of decimal places 1 mark correct addition to χ^2 to **2 decimal** places **A** 1.40 from rounded up figures ***ecf*** *from* $\frac{(O-E)^2}{E}$	[3]
	grey bodies long wings	15	**16**	**0.06**		
	grey bodies short wings	19	**16**	**0.56**		
	Ebony bodies long wings	13	**16**	**0.56**		
	Ebony bodies short wings	17	**16;**	**0.06;**		
			χ^2 =	**1.24 (/5);**		
(iii)	one less degree of freedom than number of categories ;				**A** there are four: types of data / types of offspring / phenotypes / rows / (sets of) observations/ categories / (sets of) results/ samples ignore any formula unqualified e.g. 4 – 1	[1]
(iv)	1 of : not significant; results are due to chance ;				ignore references to probability **ecf** of the candidates calculated chi square **R** answers which: quantify significance. e.g. more / less significant qualify significance. e.g. 'there is a significant difference between the means' 'it is significant which improves reliability / accuracy / AW'	[max 1]
					Total:	**[10]**

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9700 BIOLOGY

9700/52 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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Question	Expected answer	Extra guidance	Mark
1 (a) (i)	1. the pigments (present in the leaves) / varieties of leaf / types of leaves / colours of leaves / source of chloroplasts / chloroplasts from different types of leaves / AW ; 2. the wavelength of light ;	1. **A** named pigments. **R** chlorophyll 2. **A** colours of light	[2]
(ii)	time taken for the decolourising of methylene blue / time for loss of blue (colour) ;	**A** idea of allows the methylene blue to work as a hydrogen acceptor **A** rate of photosynthesis	[1]
(iii)	one of: mass of leaves ; volume of methylene blue ; start time of exposure to light ; intensity of light source / distance from lamp / wattage of bulb ; volume / length of extract ; (same) species of plant ;	**R** temperature **A** pH **R** amount for methylene blue or leaves ignore length of capillary **R** mass of extract	[max 1]
(b) (i)	*idea of* keeping the organelles intact / AW ;	**A** explanations in terms of osmosis or water potential or pH or enzymes. ignore ref. to phosphate needed to make ATP	[1]
(ii)	*idea of* inhibiting enzymes / slowing or stopping reactions ;	**R** prevents denaturing **A** if answer in terms of slowing / stopping photosynthesis	[1]
(iii)	*idea of* mesh traps cell debris but allows organelles through / AW ;	**ora** that paper may not let chloroplasts through **R** impurities unqualified / chloroplast molecules / precipitate	[1]

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<table>
<tr><th>Question</th><th>Expected answer</th><th>Extra guidance</th><th>Mark</th></tr>
<tr><td>(c) (i)</td><td>2 of:

<table>
<tr><td></td><td colspan="9">time taken / seconds (s)</td></tr>
<tr><td></td><td colspan="9">source of chloroplasts</td></tr>
<tr><td>wave length of light / nm</td><td colspan="3">dark red leaf</td><td colspan="3">yellow leaf</td><td colspan="3">green and white striped leaf</td></tr>
<tr><td>440</td><td>9</td><td>10</td><td>12</td><td>28</td><td>26</td><td>26</td><td>13</td><td>12</td><td>12</td></tr>
<tr><td>500</td><td>14</td><td>15</td><td>13</td><td>29</td><td>31</td><td>33</td><td>16</td><td>17</td><td>15</td></tr>
<tr><td>530</td><td>45</td><td>44</td><td>43</td><td>52</td><td>45</td><td>44</td><td>45</td><td>43</td><td>52</td></tr>
<tr><td>570</td><td>32</td><td>34</td><td>33</td><td>34</td><td>34</td><td>44</td><td>34</td><td>33</td><td>3</td></tr>
<tr><td>650</td><td>25</td><td>18</td><td>17</td><td>25</td><td>18</td><td>16</td><td>17</td><td>17</td><td>1</td></tr>
<tr><td>750</td><td colspan="9">Remained blue after 100 seconds</td></tr>
</table></td><td>If more than 2 identified :
If all correct, allow both marks
incorrect answers cancel correct e.g. 2 right and 1 wrong = 1 mark</td><td>[max 2]</td></tr>
<tr><td>(ii)</td><td>$\frac{43+45}{2}$ = 44 ;

$\frac{1}{44}$ = 0.023 ;</td><td>A alternative ways of setting out working as long as some correct working shown
correct mean, no working = 1 mark
A 0.021 if 52 is included in the calculation – max 1
A 0.021 in box if no calculation – max 1
A 0.022 for adding 1 divided by each value and then dividing by 3 – max 1</td><td>[2]</td></tr>
</table>

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Question	Expected answer	Extra guidance	Mark
(d) (i)	7 of: *independent variable:* 1. ref. to using (a sample from) all three leaves ; 2. ref to same quantity / amount of each (leaf type) ; *dependent variable:* 3. ref. to observing / measuring / marking / finding, position of the pigments / colours / spots (on the chromatogram) ; *procedure:* 4. ref. to a method of extracting pigments (from the leaves) ; 5. ref. to filtering / centrifuging to, remove debris / obtain pigments ; 6. ref. to method of concentrating extract ; 7. ref. to a method of applying sample ; 8 ref. to suitable placing in solvent ; 9. ref. to using the same solvent (if separate chromatograms) / spots at same level if all on one paper ; 10. ref. to running (chromatograms) to a set distance ; 11. ref. to covering container (prevents evaporation) ;	*Some points might be gained from a diagram e.g. mp 8.* 2. **A** in terms of mass or number **ecf** if only two leaf types mentioned 3. **A** if refer to Rf values or measure distance to the pigments. **A** pattern for position **A** results for pigments, etc. 4. e.g. grind / crush / AW, leaves (separately or with solvent) / use a blender. **A** crushing directly onto paper **A** boil / heat in ethanol / alcohol / solvent 5. **A** 'extract' / supernatant, for pigments 6. e.g. by evaporating ,heating, partitioning with different solvents or (many spots) at the same point or pressing with a coin several times 7. e.g. capillary tube / fine or small dropper / small or fine paint brush / pin head **A** ref to keeping spot small / thin line on origin 8. e.g. solvent level below, sample / origin ignore names of solvents 9. ignore names of solvents including water, but must use water as a solvent for all chromatograms 10. e.g. before solvent front reaches the end / pre-marked line. **A** running for same times for 2 or more chromatograms but not if all on one, ignore any specific time 11. **A** airtight container. close with a stopper / cork	

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Question	Expected answer	Extra guidance	Mark
	reliability: 12. ref. to repeating to, compare / find anomalies **;** *safety (max 1):* 13. ref. to solvents / leaves + suitable precaution **;** 14. ref. to safe disposal of solvent **;**	12. ignore ref. to mean unqualified **A** means of Rf values / AW 13. e.g. flammable – no naked flames / AW toxic – in fume cupboard / ventilated space / covered containers / gloves / goggles corrosive or allergy to leaves or solvent – gloves / goggles ignore low risk / radiation	[max 7]
(ii)	red leaf has pigment 2 (not present the other two leaves) **;** yellow leaf does not have pigment 5 (found in the other two leaves) **;**	**ora** pigment 5 only in red and green and white leaf ignore ref. to pigment 7	[2]
		Total:	**[20]**

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<table>
<tr><th>Question</th><th>Expected answer</th><th>Extra guidance</th><th>Mark</th></tr>
<tr><td>2 (a) (i)</td><td>3 of:
cross 1. offspring of cats 'without tails' (dominant) crossed together have offspring with tails' (recessive) ;
cross 2. offspring of cats 'with tails' (recessive) crossed together are always 'with tails' (recessive) ;</td><td>A cross 1 – always more without tails / AW

A ora 'none without tails'</td><td rowspan="2">[max 3]</td></tr>
<tr><td>(ii)</td><td>idea of 'with tails' (recessive) and 'without tail' (dominant) phenotypes occur in (approximately) equal numbers in each sex / 1:1 ratio in each sex / 1:1:1:1 / AW ;

cross 4: male 'without tail' (dominant) and female 'with tail' (recessive). If it were sex linked all males would be tailed. (This is not so), so not sex linked / AW ;</td><td>must have idea that ratio is between male and female not just that there are the same number (approximately) of 'tail' to 'without tail unqualified as this seems to imply regardless of gender.
1:1:1:1 implies gender so does not need qualifying.
Could apply to either cross 3 or 4
a male 'without tail' cannot pass this allele to the male offspring if it is sex linked</td></tr>
<tr><td>(b) (i)</td><td>1 of:
the data is categoric / discrete ;
looking for a 'goodness of fit' / idea of whether expected and observed results match or not / whether there is a significant difference between the expected and observed results ;</td><td>A discontinuous data / discontinuous distribution / not continuous
R discontinuous <u>variation</u>
R stating there are O and E values, must have idea of matching ratios (of offspring)
Ignore ref. to null hypothesis</td><td>[max 1]</td></tr>
<tr><td>(ii)</td><td>
<table>
<tr><td>offspring phenotype</td><td>O</td><td>E</td><td>$\frac{(O-E)^2}{E}$</td></tr>
<tr><td>offspring with tail</td><td>40</td><td>28</td><td>5.14</td></tr>
<tr><td>offspring without tail</td><td>72</td><td>84 ;</td><td>1.71 ;</td></tr>
<tr><td colspan="3">χ^2 =</td><td>6.85 (/6) ;</td></tr>
</table>
</td><td>1 mark E column
1 mark $\frac{(O-E)^2}{E}$ column. ecf from E
A as fractions
ignore decimal places
1 mark correct addition to χ^2 to 2 decimal places
ecf from column $\frac{(O-E)^2}{E}$</td><td>[3]</td></tr>
</table>

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Question	Expected answer	Extra guidance	Mark
(iii)	*idea of*: one less degree of freedom than the number of categories / AW **;**	**A** there are two, types of data / types of offspring / phenotypes / rows / (sets of) observations / categories / (sets of) results / samples ignore any formula unqualified e.g. 2 – 1	[1]
(iv)	1 of: significant **;** a factor other than chance is causing the deviation from the expected ratio **;**	ignore references to probability **A** reverse argument **A ecf** on candidates calculated chi squared value **R** answers which: quantify significance. e.g. more / less significant qualify significance. e.g. 'there is a significant difference between the means' 'it is significant which improves reliability / accuracy / AW'	[max 1]
(v)	*Idea that* (the homozygous genotype) stops development / lethal gene / AW **;**	**A** any ref. to die during development / will not develop / ref. to specific possible defects e.g. abnormal spine, provided clear they kill *in utero* / gamete incompatibility **R** (gene) mutation **R** infertile	[1]
		Total:	**[10]**

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