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**BIOLOGY**

**9700/52**

Paper 5 Planning, Analysis and Evaluation

**May/June 2017**

MARK SCHEME

Maximum Mark: 30

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**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
<b>R</b>	reject
<b>A</b>	accept (for answers correctly cued by the question, or 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>ecf</b>	error carried forward
<b>l</b>	ignore
<b>mp</b>	marking point (with relevant number)

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Question	Answer	Marks	Guidance
1(a)	<i>independent variable:</i> <u>concentration</u> of caffeine ; <i>dependent variable:</i> number of (heart) beats per unit time / heart rate ;	2	
1(b)(i)	use two tablets ; add 1 dm <sup>3</sup> or 1000 ml / cm <sup>3</sup> or 1 litre (distilled) water ;	2	<b>A</b> any correct proportions of water and tablets whatever the total volume, e.g. one tablet in 500 cm <sup>3</sup> / 0.5 dm <sup>3</sup> water
1(b)(ii)	to keep it in one position / to stop it from moving / swimming (to make it easier to count the heart beat) ;	1	
1(b)(iii)	<i>max 6 of:</i> 1 <i>ref. to a <b>method</b> of diluting 100 mg dm<sup>-3</sup> caffeine solution, e.g. proportional / simple / serial dilution or a description <b>and</b> minimum of 4 additional dilutions ;</i> 2 <i>ref. to concentrations from 100 mg dm<sup>-3</sup> <u>downwards with correct units</u> ; <i>values stated <u>must</u> correspond to the dilution method chosen</i> 3 use of water / 0 mg dm<sup>-3</sup> as a <u>control</u> ; 4 allow <i>Daphnia</i> to acclimatise <b>after</b> adding caffeine / to absorb the caffeine ; 5 <i>ref. to method of counting number of heart beats, e.g. clicker counter / tally counter / record dots on paper and count / video ;</i> 6 use of same period of time (for counting ; 7 same volume / same number of drops of caffeine solution added to each slide ; <i>if a value stated must be max 1 cm<sup>3</sup> or 5 drops</i></i>	6	<i>proportional / simple:</i> (100), 80, 60, 40, 20, (0) mg dm <sup>-3</sup> <i>serial:</i> (100), 50, 25, 12.5, 6.25 / (100), 10, 1, 0.1, 0.01 mg dm <sup>-3</sup> <i>must have a minimum of 3 others between 0.0 and 100.0 mg dm<sup>-3</sup></i>  <i>standardising variables (mp6–mp8) – must be clear that all the concentrations have been tested <b>or</b> one concentration has been tested more than once on <u>Daphnia</u></i>

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	<p>8 use the same organism / same size / same length / same age / same species / same type <i>Daphnia</i> for all caffeine concentrations ;</p> <p>9 <i>ref. to</i> a minimum of three replicates <b>and</b> calculate a <u>mean</u> or identify / eliminate / remove / ignore anomalies or outliers ;</p> <p>10 description of ethical treatment of live <i>Daphnia</i> AW, e.g. careful handling (when being moved) to minimise damage / return to tank promptly after testing / minimum time in caffeine solution ;</p> <p>11 low risk experiment / suitable hazard and safety precaution, e.g. allergy to caffeine <b>and</b> gloves ;</p>																		
1(b)(iv)	<p><i>source of error is max 1 and must be clearly stated</i> <i>improvement is max 1 and must match the source of error</i></p> <table border="1" data-bbox="344 753 1249 1430"> <thead> <tr> <th data-bbox="344 753 797 804">error</th> <th data-bbox="797 753 1249 804">improvement</th> </tr> </thead> <tbody> <tr> <td data-bbox="344 804 797 890">heat from light in microscope ;</td> <td data-bbox="797 804 1249 890">turn lamp on only when needed / heat shield ;</td> </tr> <tr> <td data-bbox="344 890 797 976">evaporation of water from slide ;</td> <td data-bbox="797 890 1249 976">use a cover slip / top up with same solution ;</td> </tr> <tr> <td data-bbox="344 976 797 1094">animals are stressed ;</td> <td data-bbox="797 976 1249 1094">handle only when needed / minimise time in experimental conditions ;</td> </tr> <tr> <td data-bbox="344 1094 797 1181">cumulative effect of caffeine (on one <i>Daphnia</i>) ;</td> <td data-bbox="797 1094 1249 1181">allow recovery time / use different <i>Daphnia</i> ;</td> </tr> <tr> <td data-bbox="344 1181 797 1267">difficulty in counting ;</td> <td data-bbox="797 1181 1249 1267">any suitable improvement, e.g. video and slow down ;</td> </tr> <tr> <td data-bbox="344 1267 797 1353">no time allowed for caffeine absorption ;</td> <td data-bbox="797 1267 1249 1353">have a time delay before counting ;</td> </tr> <tr> <td data-bbox="344 1353 797 1430">drop size varies ;</td> <td data-bbox="797 1353 1249 1430">use a known volume of caffeine solution ;</td> </tr> </tbody> </table>	error	improvement	heat from light in microscope ;	turn lamp on only when needed / heat shield ;	evaporation of water from slide ;	use a cover slip / top up with same solution ;	animals are stressed ;	handle only when needed / minimise time in experimental conditions ;	cumulative effect of caffeine (on one <i>Daphnia</i> ) ;	allow recovery time / use different <i>Daphnia</i> ;	difficulty in counting ;	any suitable improvement, e.g. video and slow down ;	no time allowed for caffeine absorption ;	have a time delay before counting ;	drop size varies ;	use a known volume of caffeine solution ;	2	<p><b>A</b> any other valid source of error and a suitable improvement <b>I</b> <i>ref. to</i> magnification used</p>
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1(c)	<i>Daphnia</i> belong to a different phylum / data collected was not from humans ;	<b>1</b>	<b>A</b> any <i>ref. to</i> differences in heart structure of humans and <i>Daphnia</i>
1(d)(i)	(2.4 mg 100cm <sup>-3</sup> cola, trial 3) <u>228</u> ;	<b>1</b>	
1(d)(ii)	<p><i>max 2 of:</i></p> <p>range of concentration too narrow ;</p> <p>no data for caffeine at 0.0 / below 2.4 / above 6.0 mg cm<sup>-3</sup> ;</p> <p>not enough concentration / only 4 concentrations ;</p> <p>there is overlap between some of data collected for 4.8 and 6.0 mg cm<sup>-3</sup> ;</p> <p><i>idea that</i> proportional increases in concentration should give a proportional increase in heart rate ;</p>	<b>2</b>	

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Question	Answer	Marks	Guidance
2(a)	there is no <u>significant</u> correlation / relationship / association between the percentage / proportion of cyanogenic <i>T. repens</i> and (increasing mean January) temperature ;	1	
2(b)(i)	column 3 completed correctly ; column 6 completed correctly ;	2	ecf for column 6 from errors in column 3

1	2	3	4	5	6	7
location	percentage of cyanogenic <i>T.repens</i> plants	rank of percentage of cyanogenic <i>T.repens</i> plants	mean January temperature /°C	rank of mean January temperature	difference in rank, <i>D</i>	<i>D</i> <sup>2</sup>
Almora	85	8	12.2	8	0	0
Fairbanks	5	2	-23.9	1	1	1
Karaj River	64	5	4.4	6	-1	1
Konosu	50	4	4.2	5	-1	1
Lennoxville	71	7	-10.0	4	3	9
Mandan	33	3	-12.8	3	0	0
Novosibirsk	0	1	-19.4	2	-1	1
Pretoria	68	6	10.0	7	-1	1
Rabat	100	9 ;	12.5	9	0 ;	0
					$\Sigma D^2 =$	14

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Question	Answer	Marks	Guidance
2(b)(ii)	$r_s - 1 - \frac{(6 \times 14)}{(9^3 - 9)} ;$ $r_s - 1 - \frac{(84)}{(720)}$ $r_s = \underline{0.88} ;$	<b>2</b>	<i>max 1 if correct answer is given to more than 2 d.p.</i>
2(b)(iii)	calculated value / <u>0.88</u> , is greater than, the critical value / <u>0.68</u> <b>or</b> critical value / <u>0.68</u> , is less than, the calculated value / <u>0.88</u> ;	<b>1</b>	<b>ecf</b> from incorrect answer in 2(b)(ii)
2(b)(iv)	<i>max 1 of:</i> <i>idea that cyanogenic plants <b>grow</b> better at higher temperature ;</i>  <i>idea that cyanogenic plants more able to survive grazing (by herbivores) ;</i>  <i>idea that cyanogenic plants produce <b>more</b> hydrogen cyanide which, <b>reduces</b> grazing / kills (more), herbivores ;</i>	<b>1</b>	<i>must be comparative</i>

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Question	Answer	Marks	Guidance
3(a)	<p><i>max 3 of:</i>            same location / area used ;            same time of year / same two weeks in August ;            traps were equally spaced (along the transect) ;            along same transects / transects were at the same places ;            numbers calculated per 1000 traps / same number of traps were used ;</p>	<b>3</b>	1 species of vole
3(b)	<p>1 <math>q^2 = 0.16</math> <b>or</b> <math>\frac{8}{50}</math> <b>or</b> <math>\frac{4}{25}</math> <b>or</b> 16%  <b>OR</b> <math>q = 0.4</math> <b>or</b> <math>\frac{2}{5}</math> <b>or</b> 4% ;</p> <p>2 derives <math>2pq</math> correctly from a clearly stated value of <math>p</math> <b>and</b> a clearly stated value of <math>q</math> ;</p> <p>3 in 1997 heterozygous voles = <math>(0.48 \times 60) = 29</math> voles ;</p>	<b>3</b>	<p><i>max 2 if answer not rounded or p is incorrect</i>  <b>A</b> answers in equation as percentages</p> <p>2 <b>ecf</b> if <math>q</math> is incorrect (e.g. <math>q = 0.16</math>) but then correctly used to get <math>2pq</math></p> <p>3 <b>ecf</b> (any number) <math>\times 60</math> (from graph) <b>and</b> a <u>whole</u> number rounded correctly</p>