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BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2017**

MARK SCHEME

Maximum Mark: 30

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 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
ecf	error carried forward
I	ignore
mp	marking point (with relevant number)

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

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>8 use the same organism / same size / same length / same age / same species / same type Daphnia for all caffeine concentrations ;

9 ref. to a minimum of three replicates and calculate a <u>mean</u> or identify / eliminate / remove / ignore anomalies or outliers ;

10 description of ethical treatment of live Daphnia AW, e.g. careful handling (when being moved) to minimise damage / return to tank promptly after testing / minimum time in caffeine solution ;

11 low risk experiment / suitable hazard and safety precaution, e.g. allergy to caffeine and gloves ;</td><td></td><td></td></tr>
<tr><td>1(b)(iv)</td><td>source of error is max 1 and must be clearly stated
improvement is max 1 and must match the source of error

<table>
<tr><th>error</th><th>improvement</th></tr>
<tr><td>heat from light in microscope ;</td><td>turn lamp on only when needed / heat shield ;</td></tr>
<tr><td>evaporation of water from slide ;</td><td>use a cover slip / top up with same solution ;</td></tr>
<tr><td>animals are stressed ;</td><td>handle only when needed / minimise time in experimental conditions ;</td></tr>
<tr><td>cumulative effect of caffeine (on one Daphnia) ;</td><td>allow recovery time / use different Daphnia ;</td></tr>
<tr><td>difficulty in counting ;</td><td>any suitable improvement, e.g. video and slow down ;</td></tr>
<tr><td>no time allowed for caffeine absorption ;</td><td>have a time delay before counting ;</td></tr>
<tr><td>drop size varies ;</td><td>use a known volume of caffeine solution ;</td></tr>
</table></td><td>2</td><td>A any other valid source of error and a suitable improvement
I ref. to magnification used</td></tr>
</table>

Question	Answer	Marks	Guidance
1(c)	*Daphnia* belong to a different phylum / data collected was not from humans **;**	**1**	**A** any *ref. to* differences in heart structure of humans and *Daphnia*
1(d)(i)	(2.4 mg 100 cm^{-3} cola, trial 3) <u>228</u> **;**	**1**	
1(d)(ii)	*max 2 of:* range of concentration too narrow **;** no data for caffeine at 0.0 / below 2.4 / above 6.0 mg cm^{-3} **;** not enough concentration / only 4 concentrations **;** there is overlap between some of data collected for 4.8 and 6.0 mg cm^{-3} **;** *idea that* proportional increases in concentration should give a proportional increase in heart rate **;**	**2**	

Question	Answer	Marks	Guidance
2(a)	there is no significant correlation / relationship / association between the percentage / proportion of cyanogenic *T. repens* 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 *T.repens* plants	rank of percentage of cyanogenic *T.repens* plants	mean January temperature / °C	rank of mean January temperature	difference in rank, *D*	D^2
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
					ΣD^2 =	14

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

Question	Answer	Marks	Guidance
3(a)	*max 3 of:* 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 **;**	**3**	**I** species of vole
3(b)	1 $q^2 = 0.16$ **or** $\frac{8}{50}$ **or** $\frac{4}{25}$ **or** 16% **OR** $q = 0.4$ **or** $\frac{2}{5}$ **or** 4% **;** 2 derives *2pq* correctly from a clearly stated value of *p* **and** a clearly stated value of *q* **;** 3 in 1997 heterozygous voles = (0.48 × 60) = 29 voles **;**	**3**	*max 2 if answer not rounded **or** p is incorrect* ***A** answers in equation as percentages* 2 **ecf** if *q* is incorrect (e.g. *q* = 0.16) but then correctly used to get *2pq* 3 **ecf** (any number) × 60 (from graph) **and** a whole number rounded correctly