Qu	Scheme	Marks	AO
1. (a)	Negative (since gradient of regression line is negative)	B1 **(1)**	1.2
(b)	cm/day (o.e. e.g. cm day^{-1})	B1 **(1)**	2.2a
(c)	$3\times[\pm]1.1$ $\quad\quad$ = decrease of 3.3 [cm]	M1 A1 **(2)**	3.4 1.1b
(d)	19 is (well) outside the range [1, 10] <u>or</u> involves extrapolation (o.e.) $\quad\quad\quad$ so (possibly) unreliable/ inaccurate (o.e.)	B1 **(1)**	2.4
		(5 marks)	

	Notes
	Answers may be written within the question.
(a)	B1 for stating "negative". $\quad$ Allow a correct interpretation e.g. as t increases then p decreases (o.e.) [ignore any values] $\quad$ B0 for contradictory statements e.g. "negative correlation since as t increases p increases"
(b)	B1 for a correct description of the units (allow fraction, /, or "per" and allow "d" for "day")
(c)	M1 for attempt at a calculation (allow use of $t = x$ and $t = x + 3$ followed by subtraction $\quad\quad$ that should lead to 3.3) A1 for correct description must include word "decrease" (o.e.) and value "3.3" $\quad\quad$ Just seeing: $22-1.1\times3=18.7$ is M0A0 BUT going on to subtract 18.7 from 22 scores M1 $\quad\quad$ Reaching 3.3 <u>and</u> stating "decrease" or "reduced" (o.e.) will score the A1 too $\quad\quad$ An answer of -3.3 without a word describing decrease (o.e.) will just score M1A0
(d)	B1 for stating "unreliable" (o.e.) **and** giving a suitable reason based on idea of extrapolation $\quad\quad$ Must have **both** statement about reliability **and** suitable reason e.g. $t = 19$ is too big <u>or</u> $\quad\quad$ (Model is based on) t between 1 and 10 (only) [since this implies $t = 19$ is too big] $\quad\quad$ Allow e.g. (model) "may not work" because of "extrapolation" $\quad$ Just saying "no" since "extrapolation" is B0 but "unreliable"(o.e.) since "extrapolation" is B1

Qu 2	Scheme	Marks	AO
(a)	Negative	B1 **(1)**	1.2
(b)	Marc's suggestion <u>is compatible</u> because it's <u>negative correlation</u>	B1 **(1)**	2.4
(c)	$(r =)\ -0.54458266\ldots$ awrt <u>**– 0.545**</u>	B1 **(1)**	1.1b
(d)	$H_0 : \rho = 0$ $H_1 : \rho < 0$	B1	2.5
	[5% 1-tail cv =] $(\pm)\ 0.4259$ (significant result / reject H_0)	M1	1.1a
	There <u>is</u> evidence of negative <u>correlation</u> between the <u>number of letters</u> in (or <u>length</u> of) a student's last <u>name</u> and their first <u>name</u>	A1 **(3)**	2.2b
		(6 marks)	

	Notes
(a)	B1 for "negative" Allow "slight" or "weak" etc Allow a description e.g. "as *x* increases *y* decreases" or in context e.g. "people with longer last names tend to have shorter first names" A comment of "negative skew" is B0 **Need to see distinct or separate responses for (a) and (b)**

(b)	B1 for a comment that suggests data is compatible with the suggestion **and** a suitable reason
	      such as "there is negative correlation" <u>or</u> a description in *x* and *y* or in context
	 <u>or</u> the points lie close to a line with <u>negative gradient</u>
	 <u>or</u> draw line $y = x$ and state that <u>more points below the line</u> so <u>supports (or is compatible with)</u> his suggestion
	      A reason based on just a **single point** is B0
	          e.g. " 11 letters in last name has only 5 in first name"

(c)	B1 for awrt – 0.545

(d)	B1 for both hypotheses correct in terms of ρ
	 M1 for a critical value compatible with their H_1:
	    1-tail: awrt ± 0.426 (condone ± 0.425) **or** 2-tail (B0 scored for H_1) : awrt ± 0.497
	    If hypotheses are in words and can deduce whether one or two-tail then use their words.
	    If no hypotheses or their H_1 is not clearly one or two tail assume one-tail
	 A1 for compatible signs between cv and *r* **and** a correct conclusion in context mentioning
	    <u>correlation</u> and <u>number of letters</u> or <u>length</u> and <u>name</u> (ft their value from (c))
	     Do NOT award this A mark if contradictory comments or working seen e.g. "accept H_0"
	    or comparison of 0.426 with significance level of 0.05 etc

NB	The M1A1 can be scored independently of the hypotheses

Question		Scheme		Marks	AOs
3(a)		eg As the number of minutes <u>exercise</u> (*m*) increases the resting <u>heart rate</u> (*h*) decreases **or** the gradient of the curve is becoming flatter with increasing *m*: diminishing effect of each <u>additional minute</u> of <u>exercise</u>		B1	2.4
				(1)	
(b)		$H_0 : \rho = 0 \; H_1 : \rho < 0$		B1	2.5
		Critical value -0.3887 (Allow $\pm$)		M1	1.1b
		There is evidence that the product moment **correlation** is **less than 0/ there is a negative correlation**		A1	2.2b
				(3)	
(c)		$\log_{10} h = -0.05 \log_{10} m + 1.92$	$h = am^k \;\rightarrow\; \log_{10} h = \log_{10} am^k$	M1	1.1b
		$\log_{10} h = -\log_{10} m^{0.05} + 1.92$ or $\log_{10} h = \log_{10} m^{-0.05} + 1.92$ or $h = 10^{1.92 - 0.05 \log_{10} m}$ oe	$\log_{10} h = \log_{10} a + \log_{10} m^k$ or $\log_{10} a = 1.92$	M1	2.1
		$\log_{10} hm^{0.05} = 1.92$ or $\log_{10} \left(\dfrac{h}{m^{-0.05}} \right) = 1.92$ or $h = 10^{1.92} \times 10^{-0.05 \log_{10} m}$ oe	$\log_{10} h = \log_{10} a + k \log_{10} m$	M1	1.1b
		$hm^{0.05} = 10^{1.92}$ or $\dfrac{h}{m^{-0.05}} = 10^{1.92}$ or $h = 10^{1.92} \times 10^{\log_{10} m^{-0.05}}$	$\log_{10} a = 1.92$ and $k = -0.05$	M1	1.1b
		$h = 10^{1.92} m^{-0.05}$ or $h = 83.17...m^{-0.05}$ or $a = $ awrt 83.17 **and** $k = -0.05$		A1	1.1b
				(5)	
		Notes:		**(9 marks)**	
(a)	B1	eg Idea as one increases the other decreases (in context). Allow use of *m* and *h* eg As *m* increases *h* decreases. Do not allow negative correlation with no context or $\rho < 0$ Allow there is a negative correlation/association/relationship/exponential between minutes <u>exercise</u>(*m*) and resting <u>heart rate</u> (*h*) oe			
(b)	B1	Both hypotheses correct in terms of ρ (allow p)			
	M1	For the cv of -0.3887 or any cv such that $0.3 < |cv| < 0.5$			
	A1	Independent of hypotheses. Correct conclusion that implies reject H_0 on basis of seeing -0.3887 or if they give 0.3887 we must see the comparison $0.3887 < 0.897$ **and** which mentions "pmcc/correlation/relationship" and less than 0/ negative or $\rho < 0$ A contradictory statement scores A0 eg Accept H_0 therefore negative correlation			
(c)		**In this part once M0 is scored no more marks can be scored. Condone no base**			
	M1	**May be implied by 2nd M1 mark** Method 1: Correct substitution for both *x* and *y* Method 2 : Taking the log of both sides			
	M1	**May be implied by 3rd M1 mark** Method 1: Correct use of the power log rule **or** making *h* the subject Method 2 : Correct use of the addition/subtraction log rule			
	M1	**This line implies M1M1M1** Method 1: Correct use of the addition/subtraction log rule or eqⁿ in the form $h = 10^{1.92} \times 10^{-0.05 \log m}$ Method 2: A second correct step for correct use of the power log rule			
	M1	**This line implies M1M1M1M1** Method 1: Correct removal of logs or $h = 10^{1.92} \times 10^{\log m^{-0.05}}$ Method 2: Log *a* (or *a*) and *k* correct			
	A1	Allow $h = $ awrt $83.2 m^{-0.05}$ NB award 5/5 for $a = $ awrt 83.2 and $k = -0.05$ or $h = $ awrt $83.2...m^{-0.05}$ or $h = 10^{1.92} m^{-0.05}$			