Qu 1	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 **– 0.545**	B1 **(1)**	1.1b
(d)	$H_0 : \rho = 0 \qquad H_1 : \rho < 0$	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 or 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 $\pm$ 0.426 (condone $\pm$ 0.425) **or** 2-tail (B0 scored for H_1) : awrt $\pm$ 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
2(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)**

		Notes	
(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 $0.3 < |\text{cv}| < 0.5$	
	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 eq^n 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 $83.2m^{-0.05}$ NB award 5/5 for $a = $ awrt 83.2 and $k = -0.05$ or $h = $ awrt $83.2...m^{-0.05}$ or $h = 10^{1.92} m^{-0.05}$	