

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)	$(r =) - 0.54458266\dots$ awrt <u>-0.545</u>	B1 (1)	1.1b
(d)	$H_0 : \rho = 0$ $H_1 : \rho < 0$ [5% 1-tail cv =] (+) 0.4259 (significant result / reject H_0)	B1 M1	2.5 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		
NB	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 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 of 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 <u>correlation</u> is <u>less than 0/ there is a negative correlation</u>		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 $\log_{10} \left(\frac{h}{m^{-0.05}} \right) = 1.92$ 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 $\frac{h}{m^{-0.05}} = 10^{1.92}$ 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 $a = \text{awrt } 83.17$ 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 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 $h = \text{awrt } 83.2m^{-0.05}$ NB award 5/5 for $a = \text{awrt } 83.2$ and $k = -0.05$ or $h = \text{awrt } 83.2...m^{-0.05}$ or $h = 10^{1.92} m^{-0.05}$		

Qu 3	Scheme	Marks	AO
(a)	e.g. The <u>height (h)</u> <u>decreases</u> by about <u>1.28 m</u> for <u>each second</u> of the flight	B1	3.4
(b)	$H_0 : \rho = 0$ $H_1 : \rho < 0$ [5% 1-tail cv =] (\pm) 0.5494 [$r = -0.510$ not sig] there is <u>insufficient</u> (o.e.) evidence of a negative <u>correlation</u> between <u>height</u> (or <u>h</u>) and <u>time</u> (or <u>t</u>)	B1 M1 A1	2.5 1.1a 2.2b
(c)	No – since points seem to follow a curve/quadratic (rather than a line) <u>or</u> since points are “non-linear” but regression line/ model is linear <u>or</u> e.g. between ($t = 5$ and 7) height drops by much more than 2.56 m <u>or</u> e.g. gradient is positive up to $t = 3.5$ (line gradient < 0) <u>or</u> e.g. gradient is positive initially (line gradient < 0) <u>or</u> e.g. gradient is positive and then negative	B1	2.4
(d)	[$h = 38.1 - 0.78 (t - k)^2$ with] a suitable k i.e. in the range 3~4.5	B1	3.3
		(1) (1) (6 marks)	
Notes			
(a)	B1 for a suitable interpretation in context [value can be 1.3 <u>or</u> 1.28 <u>or</u> “just over 1”] per sec Must have underlined words (o.e.) and units “m” or metres and “s” or seconds NB “descends” implies “height decreases” Condone e.g. “decreases by -1.28 m”		
(b)	B1 for both hypotheses correct in terms of ρ [accept a p or p but not r or r] Must be attached to H_0 and H_1 M1 for a critical value corresponding to their H_1 : 1-tail: awrt ± 0.549 or 2-tail (B0 scored for H_1): awrt ± 0.632 (tables 0.6319) 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 a correct conclusion in context mentioning <u>correlation</u> and <u>height</u> and <u>time</u> A comparison or statement such as “not sig” is not needed but if seen must be correct. Do NOT award this A mark if contradictory comments or working seen e.g. “reject H_0 ” <u>or</u> comparison of 0.510 with significance level of 0.05 <u>or</u> e.g. $-0.549 > -0.510$		
NB	Can award B0M1A1		
SC	B0 (for 2-tail) M0 (for cv = ± 0.549) scored: Allow 1 mark (score as B0M0A1) for conclusion such as: “ <u>insufficient</u> evidence of (negative) <u>correlation</u> between <u>height</u> and <u>time</u> of flight”		
(c)	B1 for saying no and giving a suitable supporting reason Don’t allow “correlation” on its own instead of “gradient” B0 for simply saying “points don’t lie close to a straight line” Need mention of curve or some other feature of scatter plot that <u>differs</u> from regression line. B0 for just “non-linear” without mention of the model being linear B0 for simply comparing 1 or 2 points – need a comment about general pattern		
(d)	B1 for a value of k in the range [3, 4.5] Do not need $k = \dots$ Accept a value embedded in Jane’s model. ISW any errors in multiplying out bracket.		