

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
1a	$x = 0.26 + 1.198m$	B1	1.1b	2nd
		B1	1.1b	Know how to find the equation of the regression line using a calculator
		(2)		
1b	The increase in extension for each additional gram of mass	B1	3.4	4th
				Know how to interpret the least squares regression line of y on x
		(1)		
1ci	51.175 mm	B1	3.4	3rd
				Know how to apply the least squares regression line of y on x
		(1)		
1cii	90.11 mm	B1	3.4	3rd
				Know how to apply the least squares regression line of y on x
		(1)		

1d	Estimate for 42.5 grams because it is within the range of the data	B1	3.5b	3rd Know how to apply the least squares regression line of y on x
		(1)		

(6 marks)

Notes

- 1a** One mark for each correct value
- 1c** Accept rounded values to 3 sf or better
- 1d** Accept equivalent statements, e.g. 75 is *outside* the range of the data so therefore *less* reliable
Accept: 42.5 since it is interpolation (or *not* extrapolation)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
2a	$S_{mm} = 18.94$ $S_{mv} = 29.82$	B1 B1	1.1b 1.1b	2nd Know how to calculate regression coefficients using standard formulae
		(2)		
2b	$v = 0.592 + 1.57m$	B1 B1	1.1b 1.1b	2nd Know how to calculate regression coefficients using standard formulae
		(2)		
2c	The speed of the sled with zero mass	B1	3.4	4th Know how to interpret the least squares regression line of y on x
		(1)		
2d	9.541 (accept 9.54)	B1	3.4	3rd Know how to apply the least squares regression line of y on x
		(1)		
2e	Reliable as 5.7 is inside the range of the data (allow 'interpolation')	B1	3.5b	3rd Know how to apply the least squares regression line of y on x
		(1)		
				(7 marks)

Notes

2b One mark for each number, accept 3 sf or better

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
3a	$S_{pp} = 3292.8$ $S_{pq} = 2908.4$	B1	1.1b	2nd
		B1	1.1b	Know how to calculate regression coefficients using standard formulae
		(2)		
3b	$q = c + dp \Rightarrow d = \frac{2908.4}{3292.8} = 0.883\dots$	M1	1.1a	2nd
	$c = \bar{q} - 0.883\dots \times \bar{p} \Rightarrow c = \frac{163}{5} - 0.883\dots \times \frac{176}{5} = 1.509\dots$	M1	1.1b	Know how to calculate regression coefficients using standard formulae
	$y - 65 = 1.509 + 0.883 \left(\frac{x - 700}{10} \right) \Rightarrow y = 4.681 + 0.0883x$	A1	1.1b	
		M1	1.1a	
		A1	1.1b	
		(5)		
3c	Increase in the number of tomatoes for each additional gram of nutrient added	B1	3.4	4th
				Know how to interpret the least squares regression line of y on x
		(1)		
(8 marks)				
Notes				
3b Accept working to 3 sf or better. Final answers which round to 4.7 and 0.09.				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
4a	The initial value of the van 'at new', in £1000s	B1	3.4	4th Know how to interpret the least squares regression line of y on x
		(1)		
4b	0.17732 0.05048 -0.08307 0.16996 -0.87701 0.5626	M1 A1	3.4 1.1b	4th Understand the concept of residuals
		(2)		
4c	(3.1, 6.0)	B1ft	2.2b	5th Use residuals to find possible outliers
		(1)		
4d	Yes – could have been a recording error No – could just be a bit more 'used' o.e.	B1	2.4	5th Use residuals to find possible outliers
		(1)		
4e	$P = 12.742 - 1.7832x$	B1 B1	1.1b 1.1b	7th Use residuals to refine mathematical models
		(2)		
4f	£2043	B1ft	3.4	3rd Know how to apply the least squares regression line of y on x
		(1)		

4g	No – 6 is outside the range of the data (allow ‘extrapolation’)	B1	3.5b	3rd Know how to apply the least squares regression line of y on x
		(1)		

(9 marks)

Notes

- 4b** All correct for **A1**
- 4c** Allow follow through from their residuals
- 4d** Allow argument either way with justification
- 4e** One mark for each number, 3 sf or better
- 4f** ft their new model

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
5a	$b = \frac{31.35}{378} = 0.083 \text{ (3 s.f)}$ $a = \bar{y} - 0.083\bar{x} \Rightarrow a = \frac{459}{8} - 0.083\left(\frac{180}{8}\right) = 3.87$ $y = 3.87 + 0.083x$	B1	3.3	2nd Know how to calculate regression coefficients using standard formulae
		M1	1.1b	
		A1	1.1b	
		(3)		
5b	$RSS = S_{yy} - \frac{(S_{xy})^2}{S_{xx}} = 2.63875 - \frac{31.35^2}{378} = 0.0387$	M1	1.1b	6th Know how to calculate the residual sum of squares
		A1	1.1b	
		(2)		
5c	$\sum \text{residuals} = 0 \Rightarrow r = -0.1165$	M1	3.1a	4th Understand the concept of residuals
		A1	1.1b	
		(2)		
5d	Residuals are scattered about zero so a linear fit is suitable.	B1	3.5b	5th Use residuals to check the reasonableness of a linear fit
		B1	3.5b	
		(2)		
(9 marks)				
Notes				
5d B1: Yes; B1: Reason				

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress Descriptor
6a	$RSS = S_{yy} - \frac{(S_{xy})^2}{S_{xx}} = 9.785 - \frac{28.35^2}{82.5} = 0.0429$	M1 A1	1.1b 2.2a	6th Know how to calculate the residual sum of squares
		(2)		
6b	0.004 0.06 0.016 0.072 -0.172 -0.016 0.04 -0.004	M1 A2	3.4 1.1b 1.1b	4th Understand the concept of residuals
		(3)		
6c	(8, 8.0)	B1ft	2.2b	5th Use residuals to find possible outliers
		(1)		
6di	Ignore: Could have been recorded incorrectly Keep: Could be legitimate value	B1	2.4	7th Use residuals to refine mathematical models
		(1)		
6dii	$y = 5.41 + 0.347x$	B1 B1	3.3 1.1b	7th Use residuals to refine mathematical models
		(2)		

6diii	8.19 (3 sf or better)	B1	3.4	7th Use residuals to refine mathematical models
		(1)		
6div	No, 15 is outside the range of the data	B1	3.5b	7th Use residuals to refine mathematical models
		(1)		
				(11 marks)
Notes				
<p>6b A1 for no more than two incorrect.</p> <p>6di Either with reason</p> <p>6dii One mark for each number, 3 sf or better.</p>				