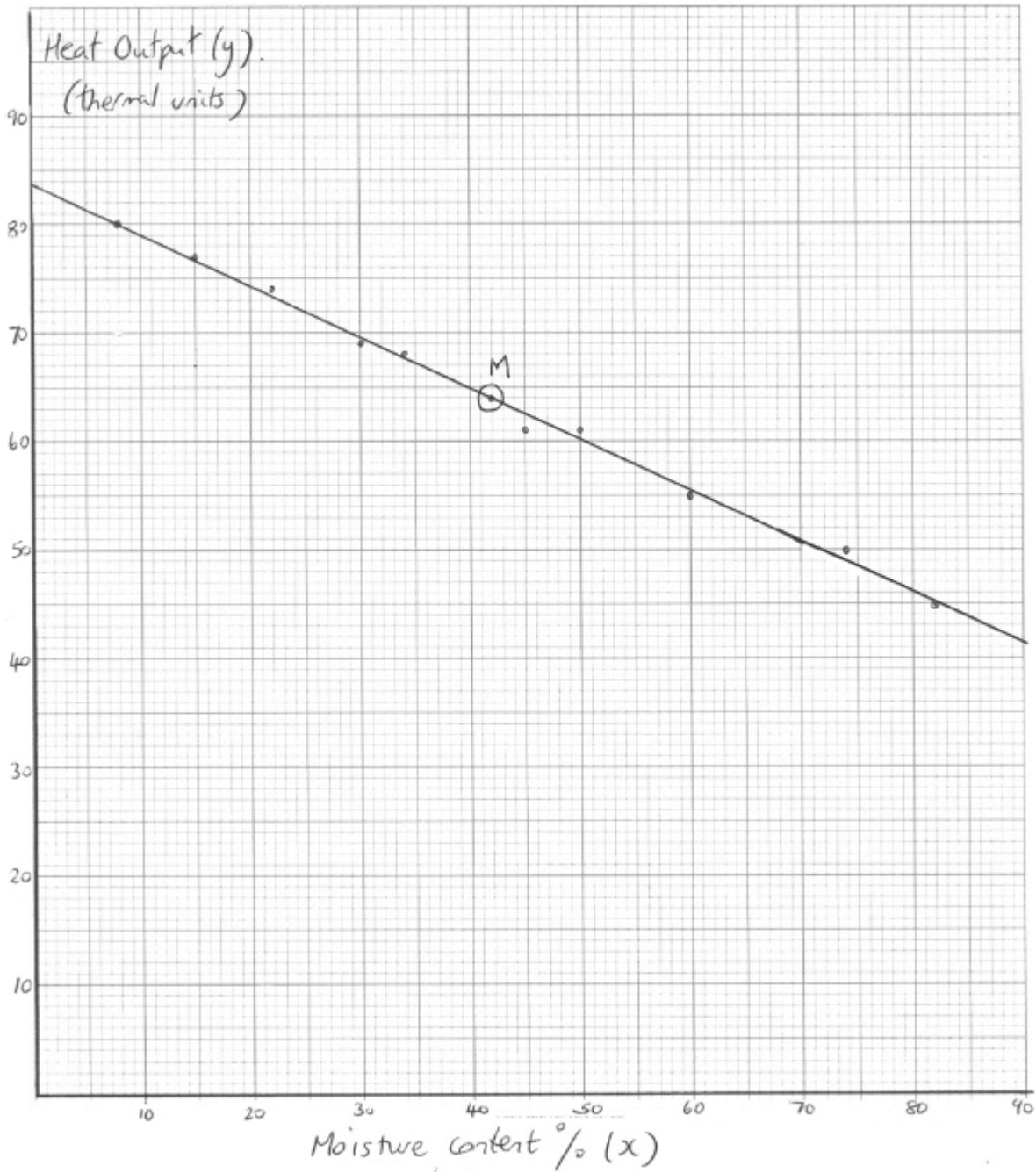


# **Bivariate data MS**

0 min  
0 marks

1. (a)



(A1) for correct scales and labels

(A3) for all ten points plotted correctly

(A2) for eight or nine points plotted correctly

(A1) for six or seven points plotted correctly

(A4)

*Note: Award at most (A0)(A3) if axes reversed.*

(b) (i)  $\bar{x} = 42$

(A1)

(ii)  $\bar{y} = 64$

(A1)

- (c)  $(\bar{x}, \bar{y})$  plotted on graph and labelled, M (A1)(ft)(A1)

*Note:* Award (A1)(ft) for position, (A1) for label.

- (d)  $-0.998$  (G2)

*Note:* Award (G1) for correct sign, (G1) for correct absolute value.

- (e) line on graph (A1)(ft)(A1)

*Notes:* Award (A1)(ft) for line through their M, (A1) for approximately correct intercept (allow between 83 and 85). It is not necessary that the line is seen to intersect the y-axis. The line must be straight for any mark to be awarded.

- (f)  $y = -0.470(25) + 83.7$  (M1)

*Note:* Award (M1) for substitution into formula or some indication of method on their graph.  $y = -0.470(0.25) + 83.7$  is incorrect.

$= 72.0$  (accept 71.95 and 72) (A1)(ft)(G2)

*Note:* Follow through from graph only if they show working on their graph.

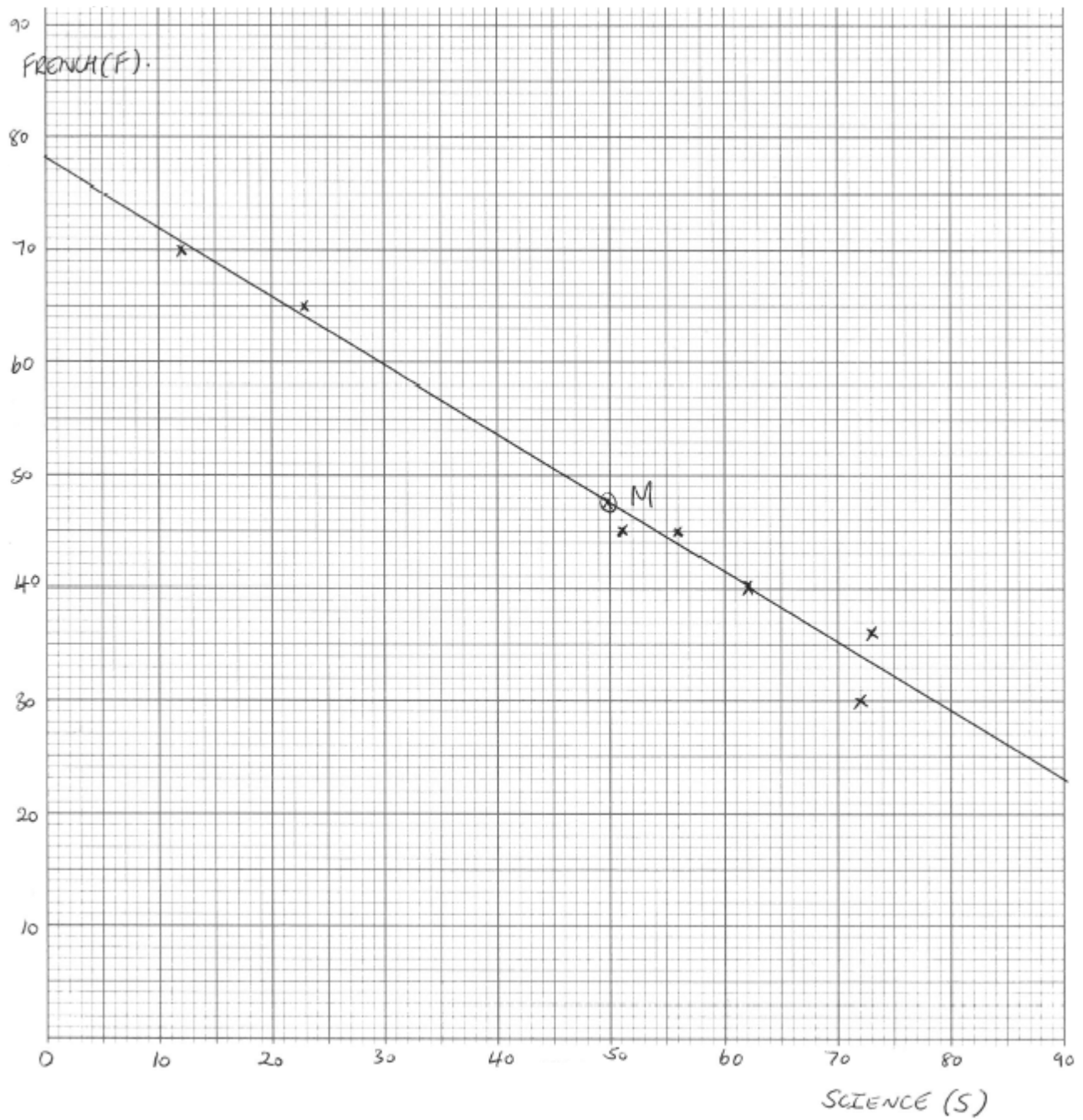
Accept  $72 \pm 0.5$ .

- (g) Yes since 25 % lies within the data set and  $r$  is close to  $-1$  (R1)(A1)

*Note:* Accept Yes, since  $r$  is close to  $-1$

*Note:* Do not award (R0)(A1).

2. (a)



Award (A1) for correct scale and labels.

Award (A3) for all seven points plotted correctly,

(A2) for 5 or 6 points plotted correctly,

(A1) for 3 or 4 points plotted correctly.

(A4)

(b) (i)  $\bar{S} = 49.9$

(G1)

(ii)  $\bar{F} = 47.3$

(G1)

- (c) M(49.9, 47.3) plotted on scatter diagram (A1)(ft)

*Notes: Follow through from (a) and (b).*

- (d)  $F = -0.619S + 78.2$  (G1)(G1)

*Notes: Award (G1) for  $-0.619S$ , (G1) for 78.2.*

*If the answer is not in the form of an equation, award (G1)(G0).*

*Accept  $y = -0.619x + 78.2$*

**OR**

- $F - 47.3 = -0.619(S - 49.9)$  (G1)(G1)

*Note: Award (G1) for  $-0.619$ , (G1) for the coordinates of their midpoint used. Follow through from their values in (b).*

- (e) line drawn on scatter diagram (A1)(ft)(A1)(ft)

*Notes: The drawn line **must** be straight for any marks to be awarded. Award (A1)(ft) passing through their M plotted in (c).*

*Award (A1)(ft) for correct y-intercept.*

*Follow through from their y-intercept found in (d).*

- (f)  $F = -0.619 \times 44 + 78.2$  (M1)

$= 51.0$  (allow 51 or 50.9) (A1)(ft)(G2)(ft)

*Note: Follow through from their equation.*

**OR**

- (M1) any indication of an acceptable graphical method. (M1)

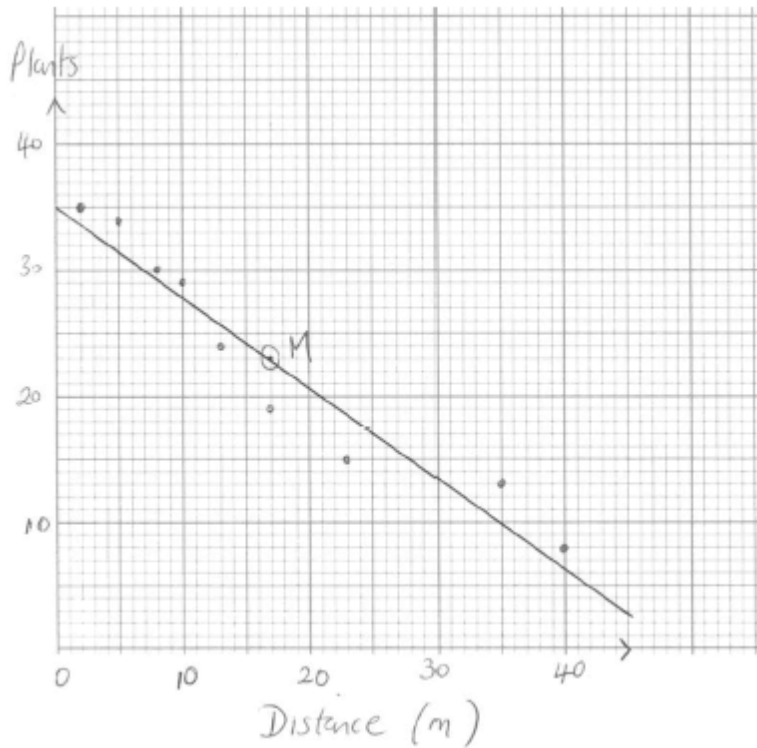
- (A1)(ft) from their regression line. (A1)(ft)(G2)(ft)

- (g) not reliable (A1)

Monique's score in Science is outside the range of scores used to create the regression line. (R1)

*Note: Do not award (A1)(R0).*

3. (a)



(A1)(A3)

**Notes:** Award (A1) for scales and labels (accept x/y).

Award (A3) for all points correct.

Award (A2) for 7 or 8 points correct.

Award (A1) for 5 or 6 points correct.

Award at most (A1)(A2) if points are joined up.

If axes are reversed award at most (A0)(A3)(ft).

(b) Negative (A1)

(c) (i) 17 (G1)

(ii) 23 (G1)

(d) Point correctly placed and labelled M (A1)(ft)(A1)

**Note:** Accept an error of  $\pm 0.5$ .

(e)  $y = -0.708x + 35.0$  (G1)(G1)

**Note:** Award at most (G1)(G0) if  $y =$  not seen. Accept 35.

- (f) Regression line drawn that passes through M and (0, 35) (A1)(ft)(A1)(ft)

*Note: Award (A1) for straight line that passes through M, (A1) for line (extrapolated if necessary) that passes through (0, 35) (accept error of  $\pm 1$ ).  
If ruler not used, award a maximum of (A1)(A0).*

- (g)  $y = -0.708(30) + 35.0$  (M1)  
 $= 14$  (Accept 13) (A1)(ft)(G2)

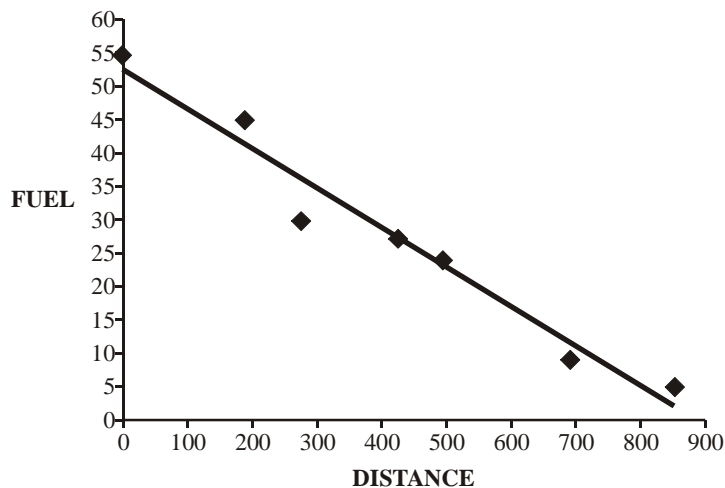
**OR**

Using graph: (M1) for some indication on graph of point, (A1)(ft) (M1)  
 for answers. Final answer must be consistent with their graph. (A1)(ft)(G2)

*Note: The final answer must be an integer.*

[15]

4. (a)



For all 3 points correct (A2) (C2)

*Note: If only 2 points correct award (A1).*

- (b) For straight line **with -ve gradient** for passing through the mean (A1)(A1)  
 For straight line intercept on y-axis between 50 and 55 (A1) (C3)

- (c) 32 (read answer from candidate's line) (A1) (C1)

[6]

5. (a) II (A1) (C1)  
 (b) V (A1) (C1)  
 (c) III (A1) (C1)  
 (d) I (A1) (C1)

[4]

6. Unit penalty (UP) is applicable where indicated.

(a) Total =  $2 + 3 + 5 + 7 + 11 + 5 + 6 + 9 + 2 + 1$  (M1)

*Note: (M1) is for a sum of frequencies.*

= 51 (A1)(G2) 2

(b) (i) modal interval is 60 – 70 (A1)

*Note: Award (A0) for 65*

(ii) median is length of fish no. 26, (M1)

also 60 – 70 (A1)(G2)

*Note: Can award (A1)(ft) or (G2)(ft) for 65 if (A0) was awarded for 65 in part (i).*

UP (iii) mean is  $\frac{2 \times 25 + 3 \times 35 + 5 \times 45 + 7 \times 55 + \dots}{51}$  (M1)

UP = 69.5 cm (3s.f.) (A1)(ft)(G1) 5

*Note: (M1) is for a sum of (frequencies multiplied by mid-point values) divided by candidate's answer from part (a). Accept mid-points 25.5, 35.5 etc or 24.5, 34.5 etc, leading to answers 70.0 or 69.0 (3s.f.) respectively. Answers of 69.0, 69.5 or 70.0 (3s.f.) with no working can be awarded (G1).*

UP (c) (i) standard deviation is 21.8 cm (G1)

*Note: For any other answer without working, award (G0). If working is present then (G0)(AP) is possible.*

(ii)  $69.5 + 3 \times 21.8 = 134.9 > 120$  (M1)

no fish (A1)(ft)(G1) 3

*Note: For 'no fish' without working, award (G1) regardless of answer to (c)(i). Follow through from (c)(i) only if method is shown.*



(d) 5 fish are less than 40 cm in length, (M1)

Award (M1) for any of  $\frac{5}{51}, \frac{46}{51}, 0.098$  or  $9.8\%, 0.902, 90.2\%$

or 5.1 seen.

hence no fine.

(A1)(ft) 2

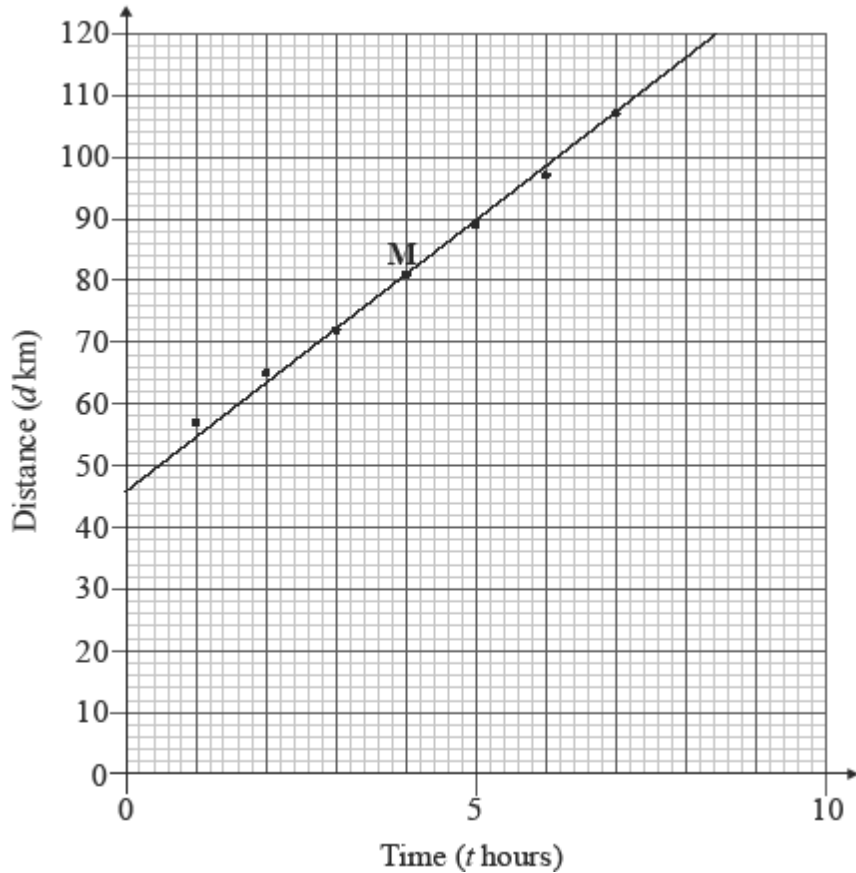
**Note:** There is no G mark here and (M0)(A1) is never allowed.  
The follow-through is from answer in part (a).

(e) (i) and (iii) are correct.

(A1)(A1) 2

[14]

7. (a)



(A1)(A2)

**Notes:** Award (A1) for axes labelled with  $d$  and  $t$  and correct scale, (A2) for 6 or 7 points correctly plotted, (A1) for 4 or 5 points, (A0) for 3 or less points correctly plotted. Award at most (A1)(A1) if points are joined up.  
If axes are reversed award at most (A0)(A2).

(b) (i)  $\bar{t} = 4$

(G1)

(ii)  $\bar{d} = 81.1 \left( \frac{568}{7} \right)$  (G1)

*Note: If answers are the wrong way around award in (i) (G0) and in (ii) (G1)(ft).*

(c) Point marked and labelled with M or  $(\bar{t}, \bar{d})$  on their graph (A1)(ft)(A1)(ft)

(d) Line of best fit drawn that passes through their M and (0, 48) (A1)(ft)(A1)(ft)

*Notes: Award (A1)(ft) for straight line that passes through their M, (A1) for line (extrapolated if necessary) that passes through (0, 48).*

*Accept error of  $\pm 3$ . If ruler not used award a maximum of (A1)(ft)(A0).*

(e) 4.5h (their answer  $\pm 0.2$ ) (M1)(A1)(ft)(G2)

*Note: Follow through from their graph. If method shown by some indication on graph of point but answer is incorrect, award (M1)(A0).*

(f)  $d = 8.25t + 48.1$  (G1)(G1)

*Notes: Award (G1) for 8.25, (G1) for 48.1. Award at most (G1)(G0) if  $d =$  (or  $y =$ ) is not seen. Accept  $d - 81.1 = 8.25(t - 4)$  or equivalent.*

(g) (i)  $d = 8.25 \times 10.3 + 48.1$  (M1)  
 $d = 133 \text{ km}$  (A1)(ft)(G2)

(ii) No (A1)  
 Outside the set of values of  $t$  or equivalent. (R1)

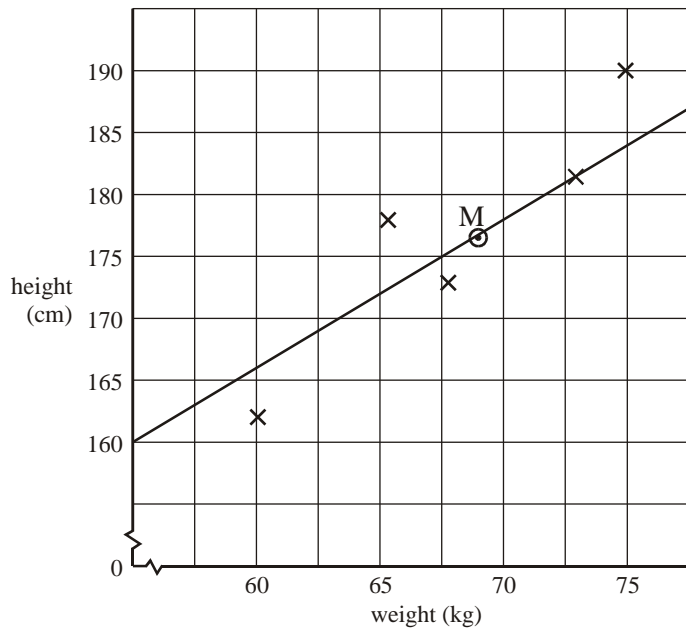
*Note: Do not award (A1)(R0).*

[17]

8. (a) (i)  $\frac{182 + 173 + 162 + 178 + 190}{5} = 177 \text{ cm}$  (A1)

(ii)  $\frac{73 + 68 + 60 + 66 + 75}{5} = 68.4 \text{ kg}$  (A1)

(b)

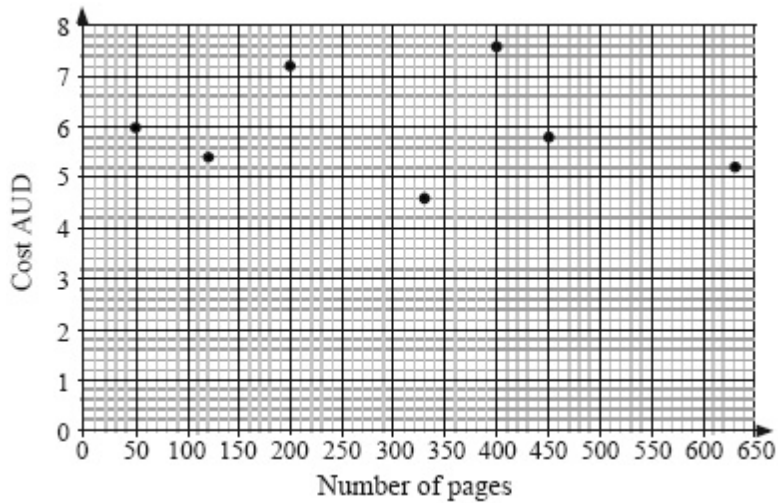


(A1)(A1)

*Note: Award (A1) for at least 3 points plotted correctly;  
(A1) for a line of best fit through (68.4, 177)*

[4]

9. (a)



(A1)(A1)(A1)

*Notes: (A1) for label and scales, (A2) for all points correct, (A1) for 5 or 6 correct.  
Award a maximum of (A2) if points are joined.*

(b)  $r = -0.141$

(G2)

*Note: If negative sign is missing award (G1)(G0).*

- (c) “The coefficient of correlation is too low, (very) weak (linear) relationship”. (R1)  
 Not a sensible thing to do (accept “no”). (A1)

*Note: Do not award (R0)(A1)*

*The correlation coefficient has to be mentioned in their reasoning.*

[7]

10. (a)  $s = 3.56t - 14.6$  (A1)(A1)(A1) (C3)

*Notes: Award (A1) for 3.56*

*(A1) for -14.6*

*(A1) for s and t*

- (b)  $s = 3.56 \times 24 - 14.6$  (M1)  
 $= 70.84$  (70.9) (A1)(ft)  
 $= 71$  ice creams (A1)(ft) (C3)

*Note: (ft) from candidates answer to (a).*

*Note: The last (A1) is for specified accuracy, (ft) from their answer.*

*The (AP) for the paper is not applied here.*

[6]

11. (a) (i) 50 (G1)

- (ii) 16.8 (G1)

- (iii) 30.5 (G1)

- (iv) 12.3 (G1)

*Note: Award (A1)(ft) for 13.0 in (iv) but only if 17.7 seen in (a)(ii).*

- (b)  $r = \frac{188.5}{(16.79 \times 12.33)}$  (M1)

*Note: Award (M1) for using their values in the correct formula*

- $= 0.911$  (accept 0.912, 0.910) (A1)(ft)(G2)

- (c)  $y = 0.669x - 2.95$  (G1)(G1)

*Note: Award (G1) for 0.669x, (G1) for -2.95. If the answer is not in the form of an equation, award at most (G1)(G0).*

(d)  $\text{Depth} = 0.669 \times 55 - 2.95$  (M1)  
 $= 33.8$  (A1)(ft)(G2)(ft)

*Note: Follow through from their (c) even if no working seen.*

(e) (i) 64.0 (accept 63.95, 63.9) (A1)(ft)(G1)(ft)

*Note: Follow through from their (c) even if no working seen.*

(ii) It is not valid. It lies too far outside the values that are given. *Or equivalent.* (A1)(R1)

*Note: Do not award (A1)(R0).*

**[13]**

12. (a)  $a = -0.134, b = 20.9$  (A1)

$y = 20.9 - 0.134x$  (A1) (C2)

(b) 17 objects (A1)(ft) (C1)

*Note: Accept only 17*

(c)  $r = -0.756$  (A1) (C1)

(d) negative and moderately strong (A1)(ft)(A1)(ft) (C2)

**[6]**

13. (a) (i) 19.2 (G1)

(ii) 1.45 (G1)

(b)  $r = 0.942$  (G1)

(c) Strong, positive correlation. (A1)(ft)(A1)(ft)

(d) (i)  $d = 11.5$  (G1)

(ii)  $n = 11.5 \times 19.6 - 100$  (A1)(ft)  
 $= 125$  (accept 126)

*Note: Answer must be a whole number*

(e) It is unreliable to extrapolate outside the values given (outlier). (R1)

[8]

14. (a) (i) 1992 mean = \$1.59, Sd = \$0.727 (or 0.73) (A1) (A1)  
(accept 0.777 or 0.78)

(ii) 2002 mean = \$1.98, Sd = \$0.635 (or 0.64) (A1) (A1) 4  
(accept 0.679 or 0.68)

(b) (i)  $r = \frac{0.3104}{0.73 \times 0.64} = 0.664$  (or  $\frac{0.3104}{0.727 \times 0.635} = 0.672$ )  $\left( \text{or } \frac{0.3104}{0.777 \times 0.679} = 0.588 \right)$

(M1) (A1)

**OR**

$R = 0.672$  (G2)

(ii) There is a **weak positive** correlation (R1) (R1) 4

(c)  $y - 1.98 = \frac{0.3104}{(0.73)^2}(x - 1.59)$  (M1)

$y = 0.582x + 1.05$  (A1) (A1)

**OR**

$y - 1.98 = \frac{0.3104}{(0.727)^2}(x - 1.59)$  (M1)

$y = 0.587x + 1.05$  (A1) (A1)

**OR**

$y = 0.588x + 1.05$  (G3) 3

- (d)  $y = 0.582 \times 2.60 + 1.05$   
 $= \$2.56$  (A1)
- OR**
- $y = 0.587 \times 2.60 + 1.05$   
 $= \$2.58$  (A1)
- OR**
- $y = 0.588 \times 2.60 + 1.05$   
 $= \$2.58$  (A1) 1
- (e) Coffee – because it is the only item to go down in price. (A1) (R1)
- OR**
- Rolls – because the price increased significantly. (A1) (R1) 2

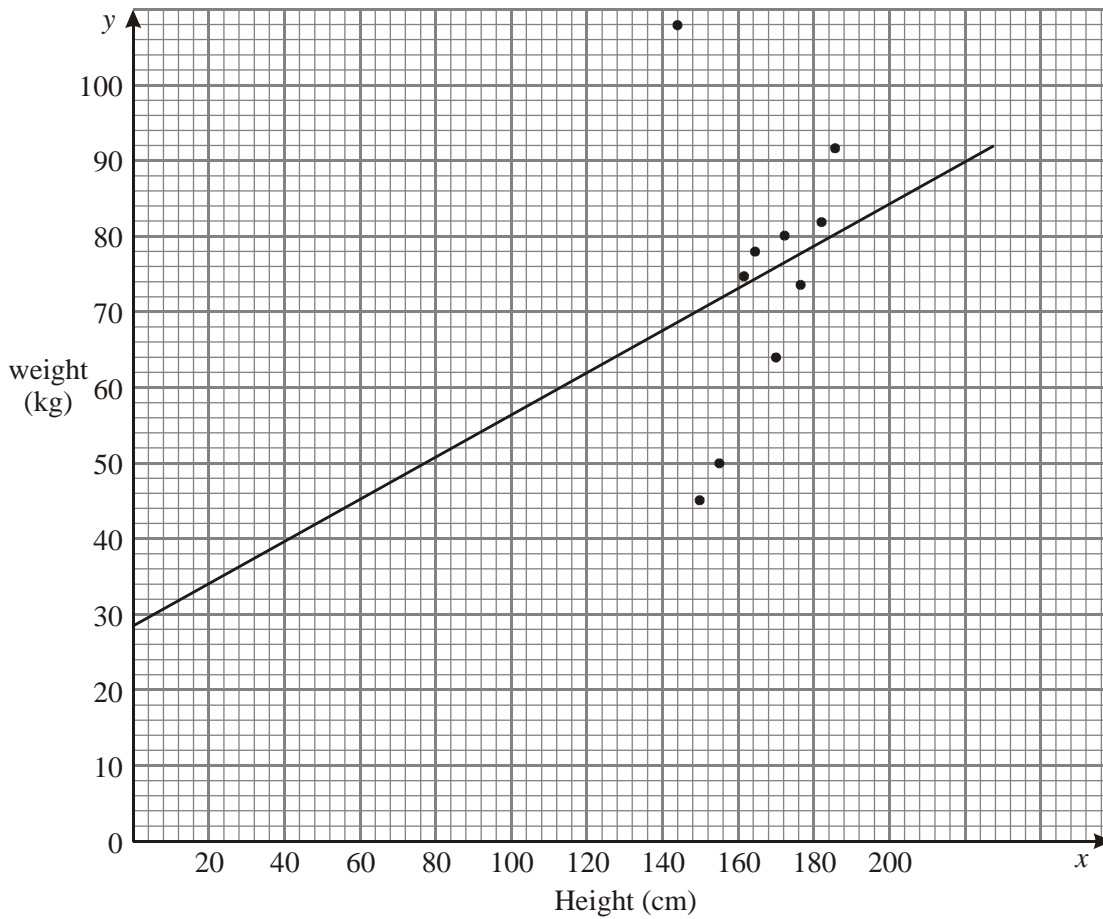
[14]

15. (a)  $r = \frac{S_{xy}}{S_x S_y}$   
 $= \frac{4.16}{(8.96)(0.610)}$  (M1)  
 $= 0.76$  (A1) 2
- (b) There is a fairly strong positive correlation between high school grades and university grades. (A1) (A1) 2
- Note: Award (A1) for strong (or fairly strong) or high, (A1) for positive.*
- (c)  $y - \bar{y} = \frac{S_{xy}}{S_x^2}(x - \bar{x})$   
 $y - 3.04 = \frac{4.16}{8.96^2}(x - 83.5)$  (M1)  
 $y = 0.052x - 1.29$  (3 s.f.) (A1) 2
- Note: Award (C2) for correct answer (from calculator).*

[6]

16. (a)

x	155	161	173	150	182	165	170	185	175	145
y	50	75	80	46	81	79	64	92	74	108



(A2)(A2) 4

*Notes: Award (A1) for axes correctly labelled, and (A1) for correct scales.*

*Award (A1) for 4, 5 6, or 7 correctly plotted points, (A2) for 8 or more.*

(b) Mean height = 166.1 = 166 (3 s.f.) (A1) 1

(c) Mean weight = 74.9 (3 s.f.) (A1) 1

(d) (i)  $S_x = 12.68$  (A1)

$$\text{Gradient} = \frac{S_{xy}}{S_x^2} = \frac{44.31}{(12.68)^2} = 0.276 \quad (\text{M1})(\text{AG})$$

(ii)  $y - 74.9 = 0.276(x - 166)$  (M1)

$$y = 0.276x + 29.1 \quad (\text{A1})$$

**OR**

$$y = 0.276x + 29.1 \quad (\text{G2})$$



(iii) Line on graph. (A2) 6

*Note: Award (A1) for the y-intercept at 29.1, and (A1) for a straight line through (166, 74.9).*

(e) (i)  $y = 0.276 \times 190 + 29.1$  (A1)  
 $= 81.5 \text{ kg}$

(ii)  $72 = 0.276x + 29.1$   
 $x = \frac{72 - 29.1}{0.276}$   
 $= 155 \text{ cm.}$  (A1)

**OR**

From the graph (A1)

(i)  $y = 81 (\pm 1)$  (A1)

(ii)  $x = 155 (\pm 1)$  (A1) 2

*Note: Follow through with candidate's line.*

(f) The "line of best fit" becomes closer to the remaining points. (R1)

**OR**

Gradient becomes steeper and the line is more accurate 'best fit'. (R1)

**OR**

Any reasonable explanation. (Line becomes  $y = 1.10x - 113$ ) (R1) 1

**[15]**

17. (a) 0.965 (A1) (C1)

(b)  $y = 1.15x + 0.976$   
(A1) for 1.15x (A1) for +0.976 (A1)(A1) (C2)

(c)  $y = 1.15 (7) + 0.976$  (M1)  
Chemistry = 9.03 (accept 9) (A1)(ft) (C2)

*Note: Follow through from candidate's answer to (b) even if no working is seen. Award (A2)(ft).*

(d) the correlation coefficient is close to 1  
**OR** strongly correlated variables  
**OR** 7 lies within the range of physics marks. (R1) (C1)

**[6]**