Rewarding Learning

General Certificate of Secondary Education
2012

Additional Mathematics

Paper 2
Mechanics and Statistics

[G0302]

FRIDAY 1 JUNE, AFTERNOON

MARK SCHEME

1

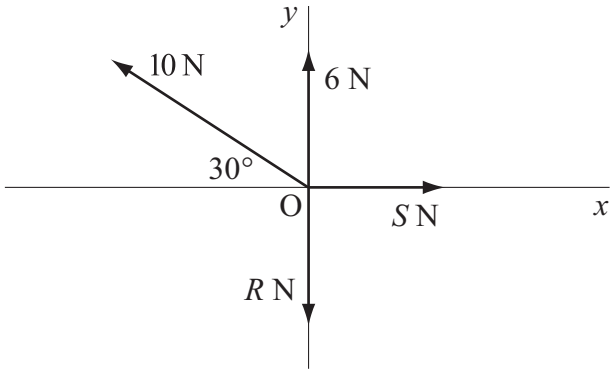


Fig. 1

(i) Resolve vertically

$R = 6 + 10\cos 60$ M1

$\rightarrow \quad R = 6 + 10\left(\frac{1}{2}\right) = 6 + 5 = 11$ W1

(ii) Resolve horizontally

$S = 10\cos 30$ M1

$\rightarrow \quad S = 10(0.866)$

$\rightarrow \quad S = 8.66$ W1 4

2 Median class = 18 – 20 MW1

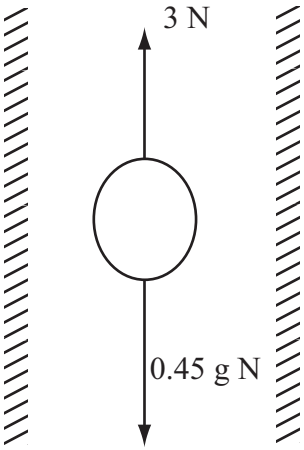
$\text{Median} = 17.5 + \frac{55 - 46}{36} \times 3$ for 17.5+ MW1; for $55 - 46$ MW1; for $\frac{3}{36}$ MW1

$= 18.25$ ans MW1 5

(or 18.21 if 54.5 used instead of 55)

AVAILABLE MARKS

3 **(i)**



Accelerating force = 4.5 – 3 = 1.5 N M1

Accelerating force = ma = 0.45a

$\rightarrow$ 0.45a = 1.5 MW1

$a = \frac{1.5}{0.45} = \frac{10}{3}$ m/s^2 W1

(ii) $v = u + at$

$v = 0 + \frac{10}{3} \times 1.5 = 5$ m/s M1, W1

(iii) $s = ut + \frac{1}{2}at^2$

$S = 0 + \frac{1}{2} \times \frac{10}{3} \times 2.25 = \frac{7.5}{2} = 3.75$ m MW1 6

AVAILABLE MARKS

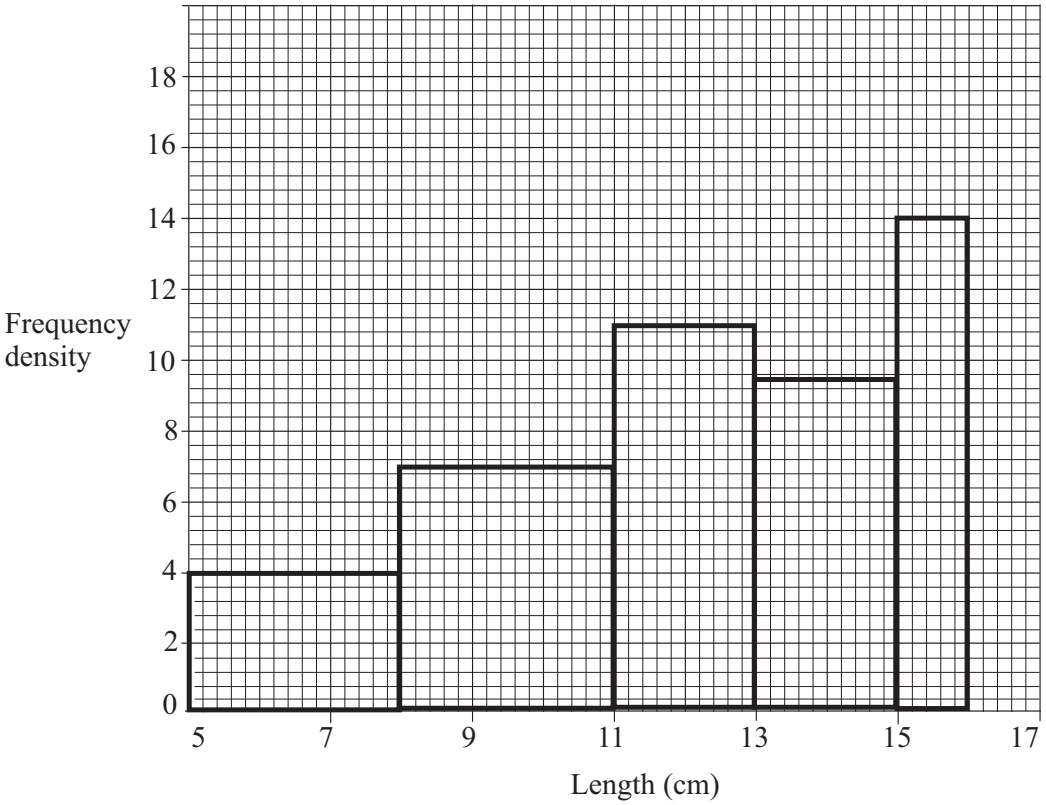
4 **(i)** bar chart height represents frequency – histogram area represents frequency M1

AVAILABLE MARKS

(ii)

Class width	3	3	2	2	1
Frequency density	4	7	11	9.5	14

M1, W1



axes W1

continuous scales at boundaries W1

heights W1 6

5 **(i)** $\dfrac{(30\times 36 - 14\times 40)}{16} = 32.5$ M2, W1

AVAILABLE MARKS

(ii) $8.2^2 = 67.24 = \dfrac{\sum_{30} x^2}{30} - 36^2$ $\qquad$ $7.8^2 = 60.84 = \dfrac{\sum_{14} x^2}{14} - 40^2$

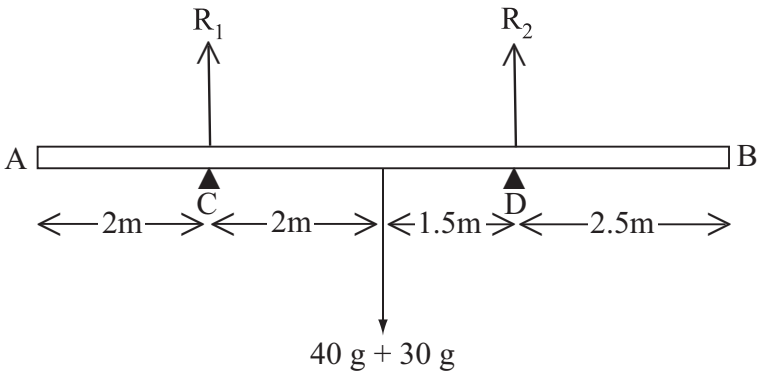
$\sum_{30} x^2 = 40897.2$ $\qquad$ $\sum_{14} x^2 = 23251.76$ M2

$\sum_{16} x^2 = 17645.44$

$\sigma^2 = \dfrac{17645.44}{16} - 32.5^2$

$\sigma = 6.83$ M1, W1 7

6 (i)



W1

(ii) $R_1 + R_2 = 70\text{ g} = 700\text{ N}$ MW1

Take moments at C

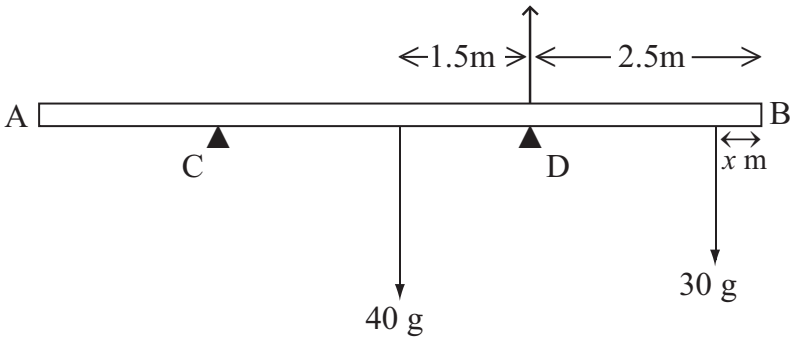
$\rightarrow$ $R_2\,(3.5) = 70\text{ g}\,(2)$ M1

$\rightarrow$ $R_2 = \frac{1400}{3.5} = 400\text{ N}$

$\rightarrow$ $R_1 = 700 - 400 = 300\text{ N}$ W1

(iii) When plank is about to tilt about the support D the reaction at C is zero M1

(iv) Let x m be the distance of the child from B when the plank is about to tilt.



Take moments at D

$40\text{ g}\,(1.5) = 30\text{ g}\,(2.5 - x)$

$\rightarrow$ $60 = 75 - 30x$ M1, W1

$\rightarrow$ $30x = 15$

$\rightarrow$ $x = 0.5$ m W1 8

AVAILABLE MARKS

7 **(i)**

	Poetry	Drama
Hardback	4	2
Paperback	12	6

MW1

(ii) $P(\text{both hardback}) = \frac{6}{24} \times \frac{5}{23}$

$= \frac{5}{92}$ M1, W1

(iii) $P(\text{hardback poetry}) = \frac{4}{24} \times \frac{3}{23}$

$= \frac{1}{46}$ M1, W1

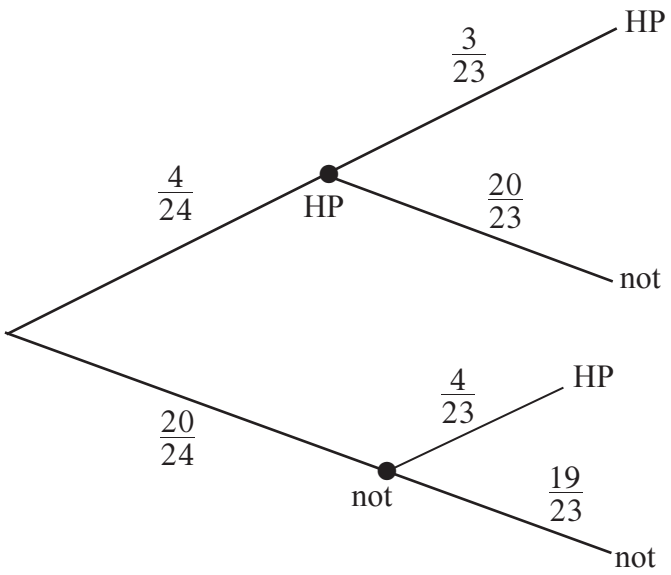
(iv) $P(\text{2nd not hardback poetry} \mid \text{1st hardback poetry}) = \frac{20}{23}$ M2, W1

$P(2\text{nd} \mid 1\text{st}) = \frac{P(1\text{st and } 2\text{nd})}{P(1\text{st})}$

$= \frac{1}{46} \div \frac{4}{24} = \frac{3}{23}$

$1 - \frac{3}{23} = \frac{20}{23}$

or



8

AVAILABLE MARKS

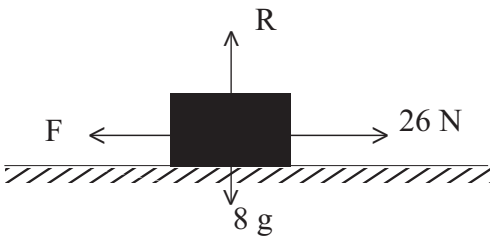
8 **(i)** Using $v^2 = u^2 + 2as$

$9 = 0 + 2 \cdot a \cdot 18$

$9 = 36a$

$\rightarrow \quad a = \frac{9}{36} = \frac{1}{4} = 0.25 \text{ m/s}^2$ MW1

(ii)



Accelerating force = mass × acceleration

$\rightarrow \quad 26 - F = 8 \times \frac{1}{4}$ M1

$\rightarrow \quad 26 - F = 2$

$\rightarrow \quad F = 26 - 2 = 24 \text{ N}$ W1

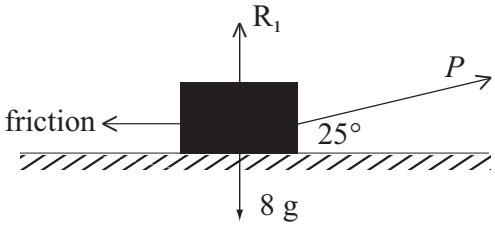
(iii) $F = \mu R, \quad R = 8 g$

$\rightarrow \quad F = \mu(80)$ MW1

$\rightarrow \quad 24 = \mu(80)$

$\rightarrow \quad \mu = \frac{24}{80} = \frac{3}{10} \qquad \mu = 0.3$ W1

(iv)



W1

(v) Resolve horizontally $P \cos 25 = \mu R_1 \quad (1)$ MW1

Resolve vertically $R_1 + P \sin 25 = 8g \quad (2)$ MW1

From (2) $R_1 = 80 - P \sin 25$

Substitute in (1) $P \cos 25 = 0.3\,(80 - P \sin 25)$ M1

$P(\cos 25 + 0.3 \sin 25) = 24$

$\rightarrow \quad P = \frac{24}{(\cos 25 + 0.3 \sin 25)} = 23.2 \text{ N}$

so box moves if $P > 23.2 \text{ N}$ W1

10

AVAILABLE MARKS

9 **(i)** 3-point moving averages: 28

28.3

29.7

31

31.7

32.7

33.7

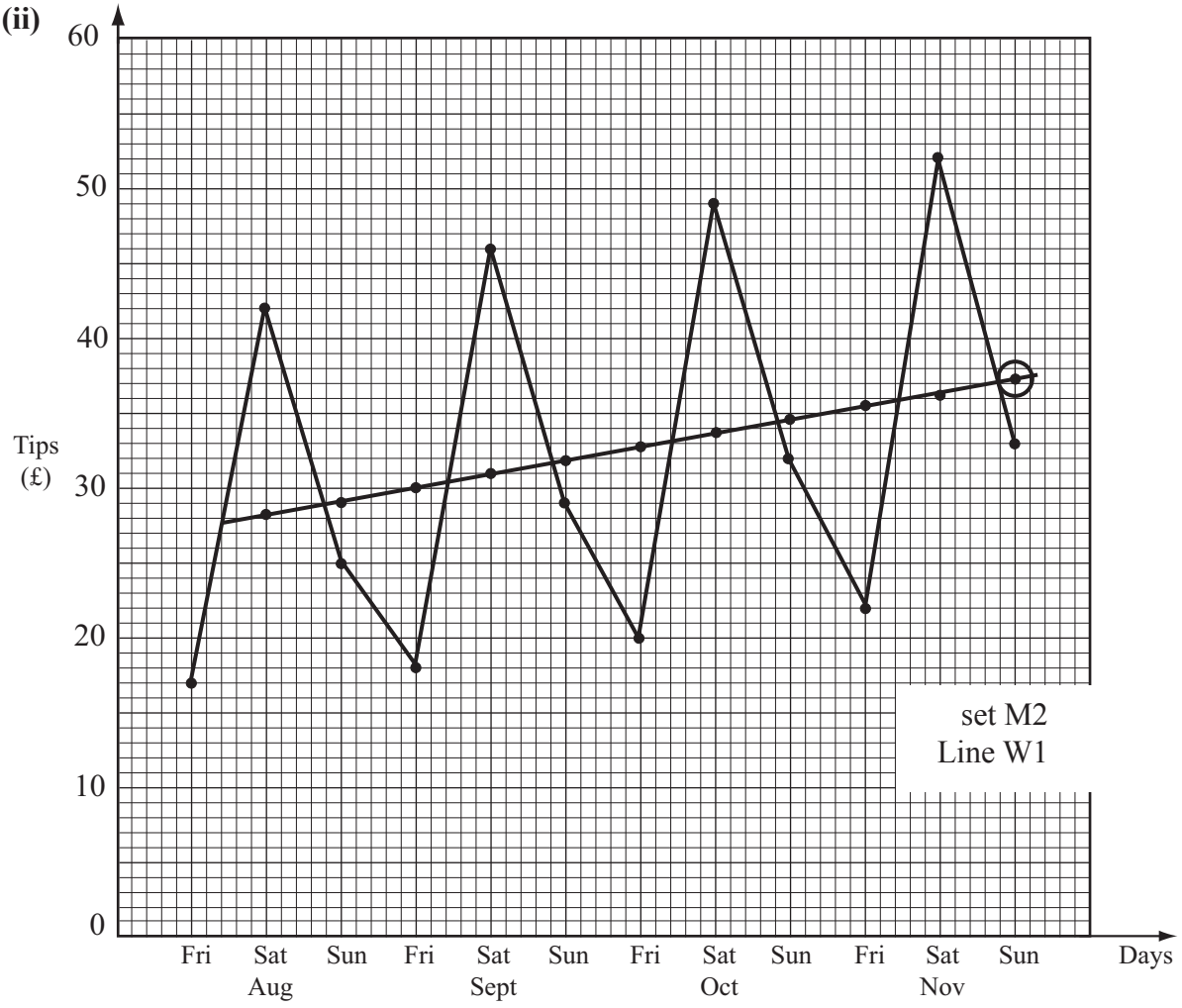
34.3

35.3

35.7 M2, W1

AVAILABLE MARKS

(ii)



(iii) $37 = \frac{x + 33 + 52}{3}$ reading M1, W1

$x = 26$ M1, W1

(iv) Trend continuing as before M1

11

10 (i)

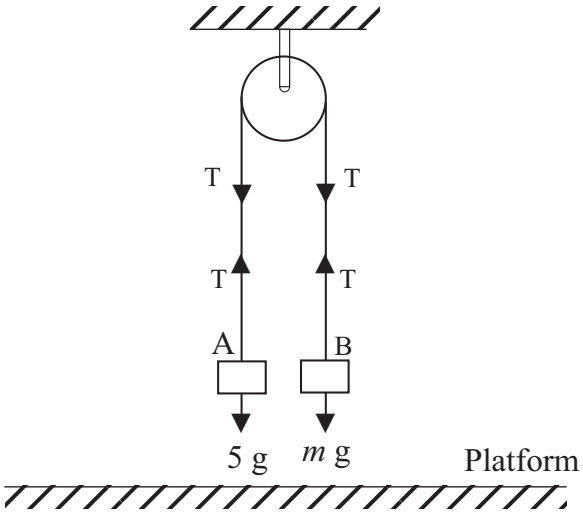


Fig. 5 W1

(ii) $5g - T = 5a$ M1

$50 - T = 12.5$

$T = 50 - 12.5 = 37.5\,N$ W1

(iii) $T - mg = ma$ M1

$\rightarrow \quad 37.5 - 10m = 2.5m$

$\rightarrow \quad m = 3$ W1

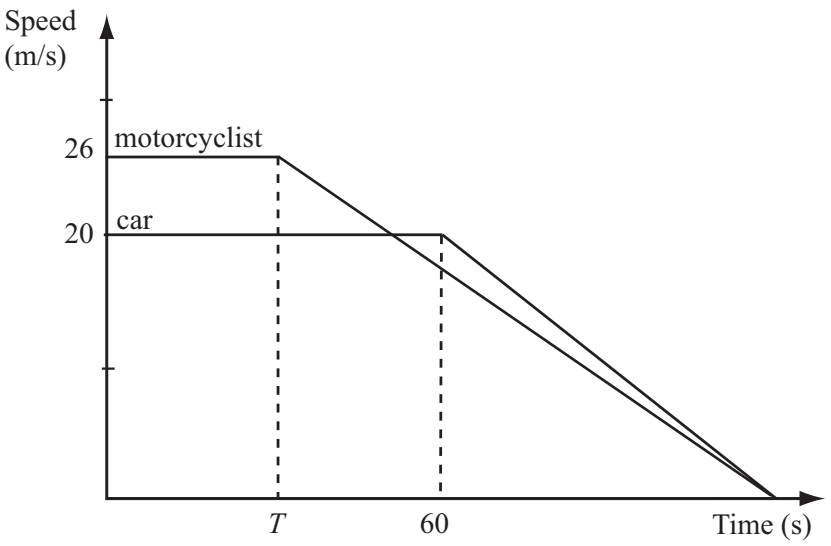
(iv) The force exerted by the string on the pulley = 2T

$\rightarrow$ Force = 2 (37.5) = 75.0 N W1

AVAILABLE MARKS

			AVAILABLE MARKS
(v)	$u = 0 \quad a = 2.5 \quad t = 1.5$		
	Using $v = u + at$		
	→ $v = 0 + (2.5)(1.5)$		
	→ $v = 3.75$ m/s	MW1	
(vi)	$u = 3.75 \quad v = 0 \quad a = -10 \quad s = ?$		
	Using $v^2 = u^2 + 2as$		
	→ $0 = (3.75)^2 - 2(10)s$	MW1	
	→ $20s = 14.0625$		
	→ $s = 0.7$ (to 1 decimal place)	W1	
(vii)	Using $v = u + at$		
	→ $0 = 3.75 - 10t$		
	→ $t = 0.375$ (until B stops)		
	Total time which elapses is 2 (0.375) = 0.75 seconds	M1, W1	11

11 **(i)**



W2

(ii) $S_1 = 20 \times 60 = 1200\,\text{m}$ MW1

(iii) Distance for decelerating = 1300 – 1200 = 100 m MW1

Using $v^2 = u^2 + 2as$

$0 = 20^2 - 2 \cdot a \cdot 100$

$\rightarrow \quad a = \frac{400}{200} = 2\text{m/s}^2$

W1

(iv) Time for deceleration

$v = u - at$

$0 = 20 - 2t$

$\rightarrow$ t = 10 secs MW1

(v) Total time = 60 + 10 = 70 secs W1

(vi) Motorcyclist

time for decelerating = $(70 - T)$ MW1

distance for decelerating $= \frac{(26+0)}{2} \cdot (70 - T)$

$= 13(70 - T)$ MW1

$\rightarrow$ total distance = $26\,T + 13\,(70 - T) = 1300$ MW1

$\rightarrow \quad 26\,T + 910 - 13T = 1300$

$\rightarrow \quad T = 30$ secs W1

AVAILABLE MARKS

11

12 **(i)**

Ranks (hours)	1.5	5	7	4	1.5	3	6	8
Ranks (mm)	7	4	3	6	8	5	2	1
d^2	30.25	1	16	4	42.25	4	16	49

(ii)

Ranks W2

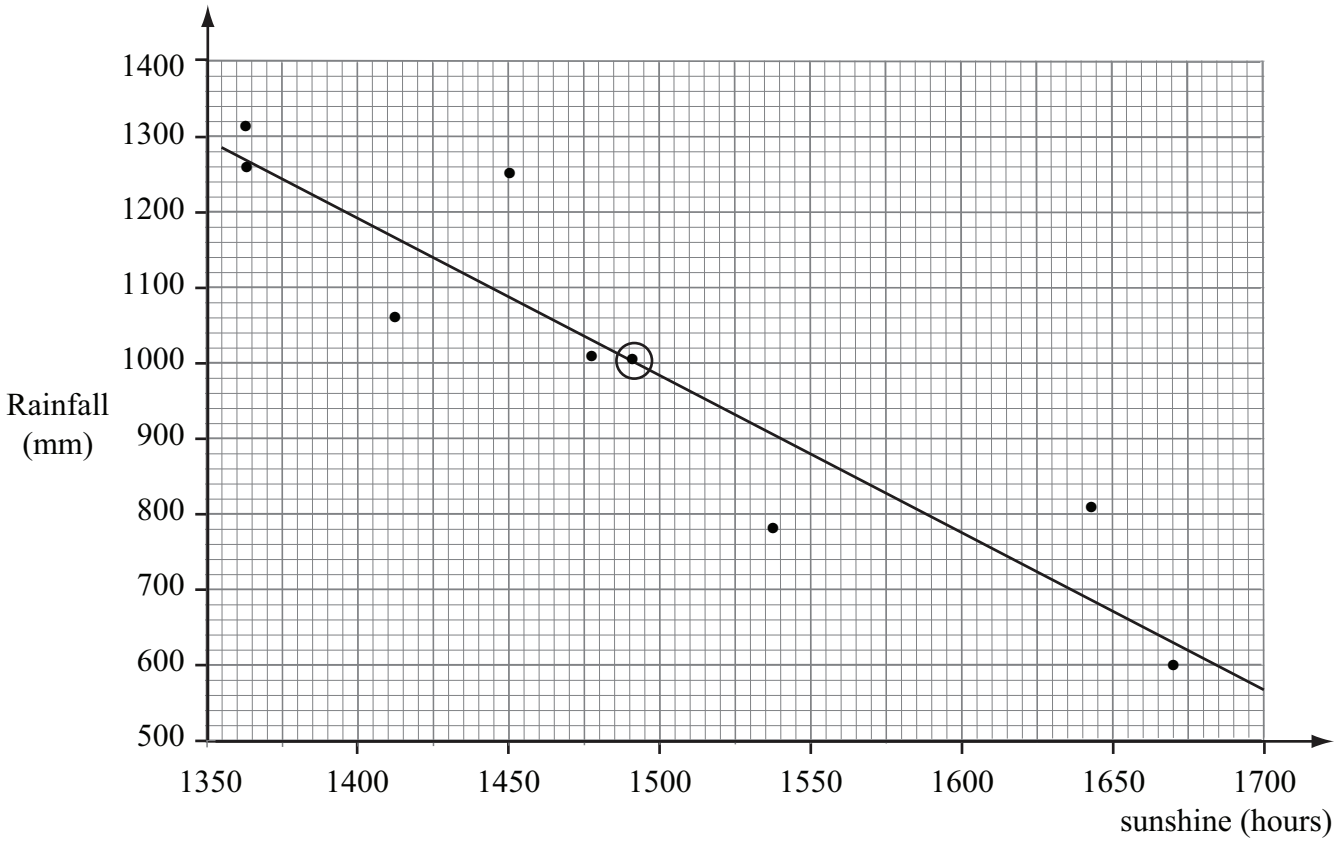
$\Sigma d^2 = 162.5$ M1, W1

$1 - \frac{6(162.5)}{8(63)} = -0.935$ M1, W1

(iii) (strong) negative correlation M1

(iv) Mean sun = 1490, mean rain = 1008 MW1

(v)



through mean M1
slope M1

AVAILABLE MARKS

				AVAILABLE MARKS
(vi)	gradient $= \frac{570 - 1190}{1700 - 1400} = -2.07$	correct method	M1	
	$\therefore y = -2.07x + c$			
	$\therefore 1008 = -2.07(1490) + c$			
	$\therefore c = 4092$	correct method	M1	
	So equation is $y = -2.07x + 4092$	equation	MW1	13
			Total	**100**