Rewarding Learning

General Certificate of Secondary Education
2006

Additional Mathematics

Paper 2
Mechanics and Statistics

[G0302]

THURSDAY 18 MAY, MORNING

MARK SCHEME

GCSE ADDITIONAL MATHEMATICS 2006

Paper 2

Mechanics and Statistics

Mark Scheme

AVAILABLE MARKS

1 **(i)** Resultant = P + Q = $4\mathbf{i} + 5\mathbf{j} + 2\mathbf{i} - 3\mathbf{j}$ MW1

$= \underline{(6\mathbf{i} + 2\mathbf{j})\ \text{N}}$

(ii) Accelerating Force = Mass × Acceleration

$\Rightarrow 6\mathbf{i} + 2\mathbf{j} = 4\mathbf{a}$ MW1

$\Rightarrow \mathbf{a} = (1.5\mathbf{i} + 0.5\mathbf{j})\ \text{m/s}^2$

$\Rightarrow a = \underline{1.5} \quad b = \underline{0.5}$ W1

(iii) $\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$

$\Rightarrow \mathbf{s} = 0 + \frac{1}{2}(1.5\mathbf{i} + 0.5\mathbf{j})\ 16$

$\Rightarrow \mathbf{OA} = 8(1.5\mathbf{i} + 0.5\mathbf{j}) = \underline{(12\mathbf{i} + 4\mathbf{j})\ \text{m}}$ MW1 4

2 **(a)** mean = $9.77 \times 3 - 0.3$

$= 29.01$ MW1

s d = 1.8×3

$= 5.4$ M1, W1

(b) **(ii)** because more values at extremes giving largest spread . . . M1, M1 5

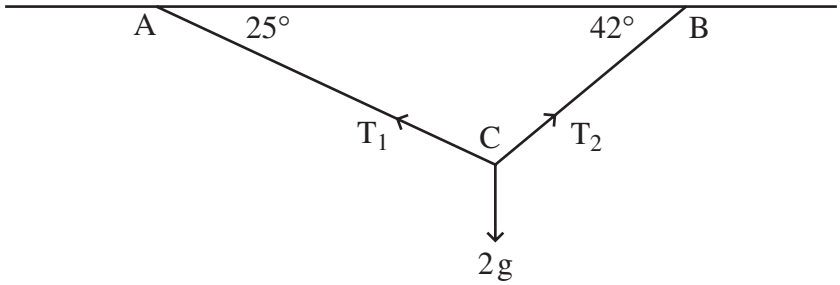
3 23 days : median on 12th day : class 800– MW1

$800 + \dfrac{12 - 10}{10} \times 100$ 800 MW1

12–10 MW1

100/10 MW1

$= 820$ MW1 5

			AVAILABLE MARKS
4	**(i)**	 W1	
	(ii)	$T_1 \cos 25° = T_2 \cos 42°$ (resolve horizontally) MW1	
		$T_1 \sin 25° + T_2 \sin 42° = 2\,g$ (resolve vertically) MW1	
		$\Rightarrow T_2 = T_1 \dfrac{\cos 25°}{\cos 42°}$ MW1	
		$\Rightarrow T_1 \sin 25° + T_1 \dfrac{\cos 25°}{\cos 42°} \sin 42° = 20$ MW1	
		$\Rightarrow T_1 (\sin 25° + \cos 25° \tan 42°) = 20$	
		$\Rightarrow T_1 = 16.14 = \underline{16.1\text{ N}}$ (1 dec. pl.)	
		$T_2 = 16.14 \dfrac{\cos 25°}{\cos 42°} = 19.68$ } W1	
		$\Rightarrow T_2 = \underline{19.7\text{ N}}$ (1 dec. pl.)	6
5	**(i)**	Using $s = ut + \frac{1}{2}at^2$	
		$s_{17} = \frac{1}{2}a(17^2)$ MW1	
		$s_{18} = \frac{1}{2}a(18^2)$ MW1	
	(ii)	$s_{18} - s_{17} = 28$	
		$\Rightarrow \frac{1}{2}a(18^2) - \frac{1}{2}a(17^2) = 28$ M1W1	
		$\Rightarrow \frac{1}{2}a(18^2 - 17^2) = 28$	
		$\Rightarrow a = \dfrac{56}{35} = \underline{1.6\text{ m/s}^2}$ W1	
	(iii)	$v^2 = u^2 + 2as$	
		$v^2 = 0 + 2 \times 1.6 \times 80$ MW1	
		$\Rightarrow v = 16$ m/s	
	(iv)	$v = u + at$	
		$16 = 0 + 1.6t$	
		$\Rightarrow t = 10$ s MW1	7

			AVAILABLE MARKS
6	**(i)** E C W 8 16 12	MW1	
	(ii) P(C) = 16/36		
	= 4/9	MW1	
	(iii) $\frac{1+8+4}{36} = \frac{13}{36}$	M1W1	
	(iv) $1 - (8/36 \times 7/35 + 16/36 \times 15/35 + 12/36 \times 11/35)$	M1, M1	
	$= 1 - 107/315$ [$= 1 - 0.34$]		
	$= 208/315 = 0.66$	W1	7

AVAILABLE MARKS

7 **(i)** 4.8 = f/5

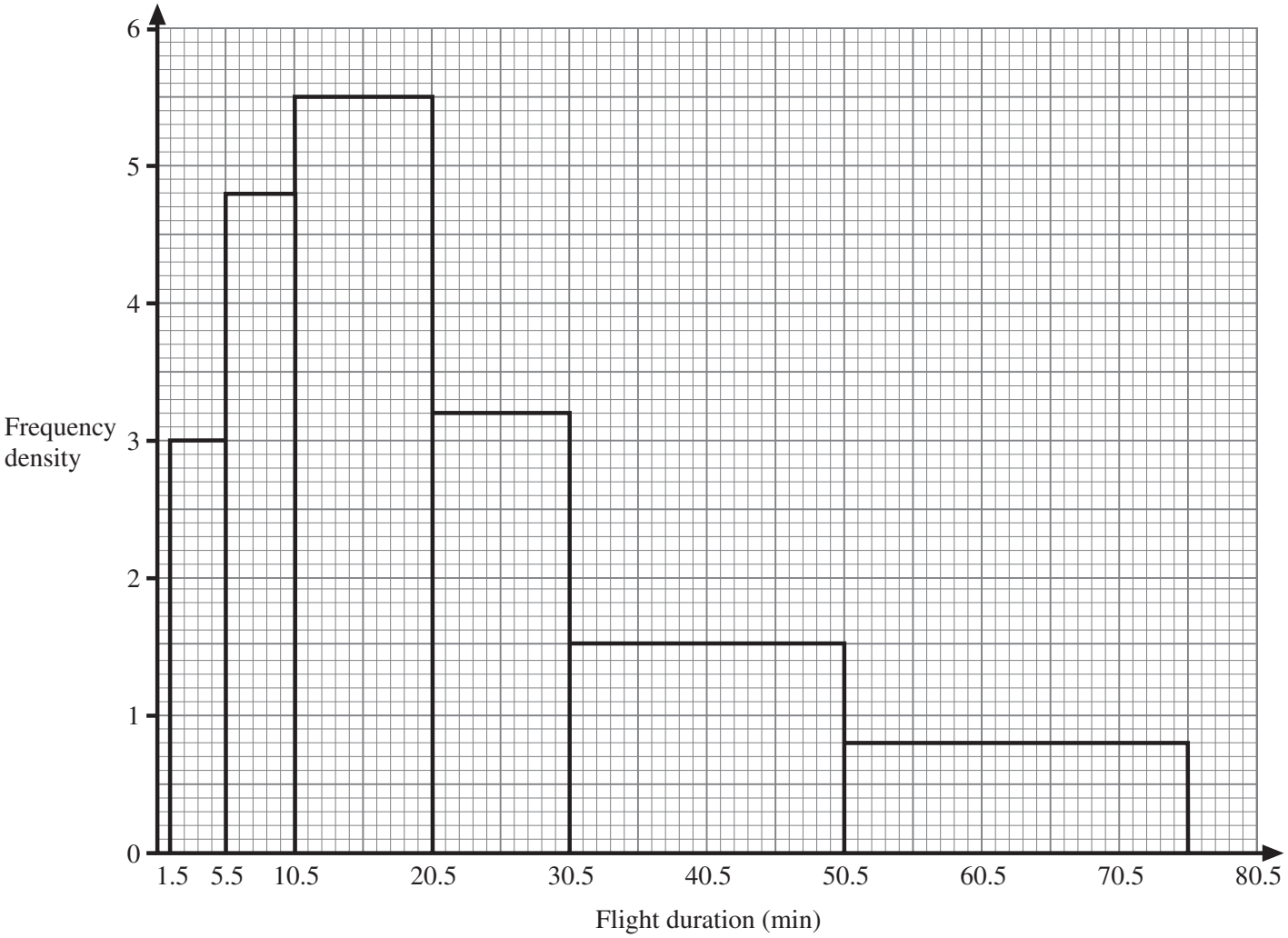
f = 24 M1W1

(ii) 1.5 = f/20

f = 30 M1W1

(iii) f.d. = 12/4 f.d. = 20/25

= 3 = 0.8 MW1, MW1

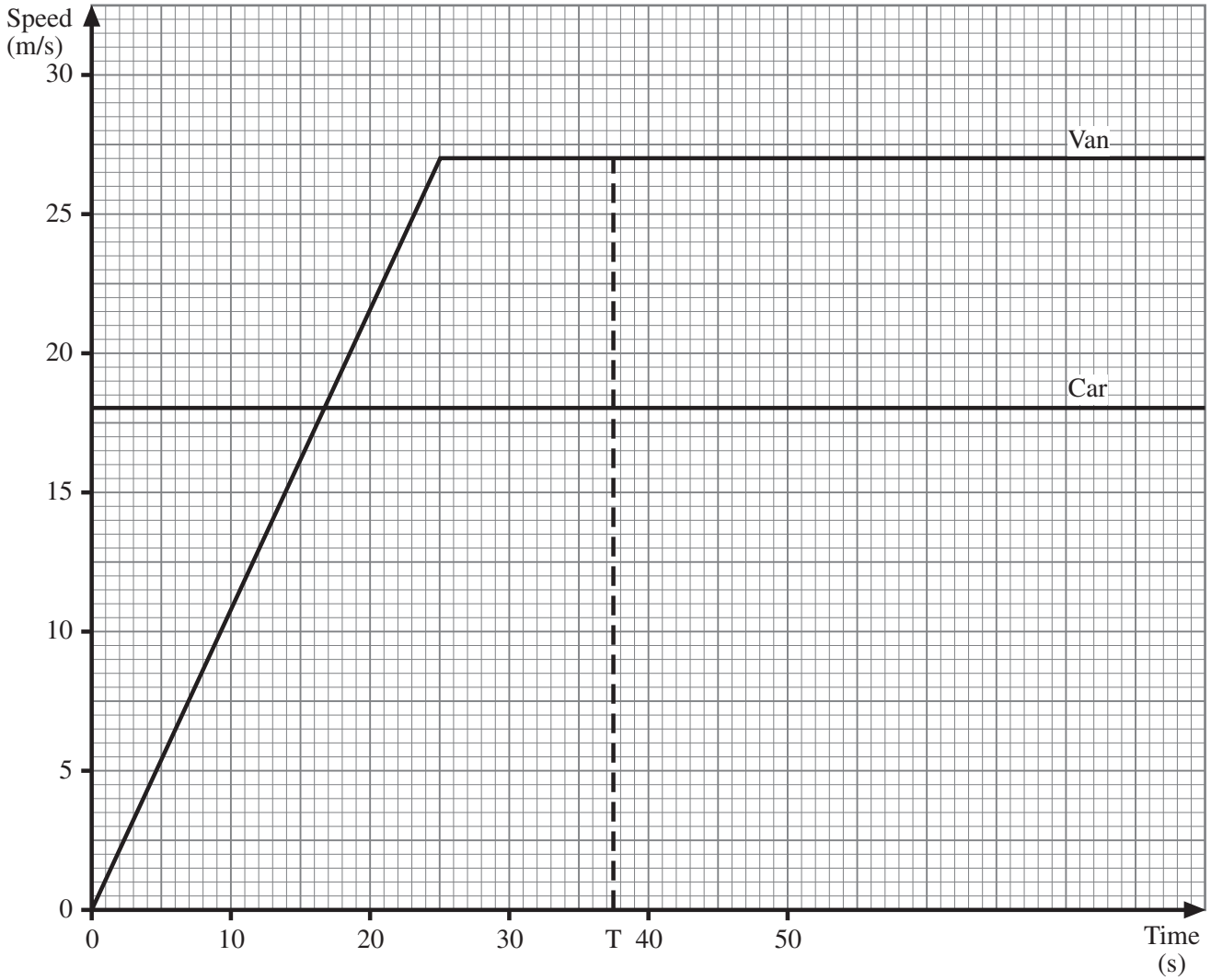


AVAILABLE MARKS
8

W1, W1

AVAILABLE MARKS

8 (i) W2



AVAILABLE MARKS

(ii) Let T s = time taken by van to overtake.

Distance travelled by the van = $\frac{1}{2}(T + (T - 25)) \cdot 27$ M1W1

Distance travelled by the car = 18 T MW1

$\Rightarrow \frac{1}{2}(2T - 25) \cdot 27 = 18T$ M1

$\Rightarrow (2T - 25) \cdot 27 = 36T$

$\Rightarrow 54T - 675 = 36T$

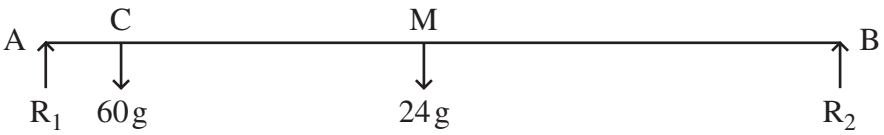
$\Rightarrow 18T = 675$

$\Rightarrow T = \underline{37.5 \text{ s}}$ W1

		AVAILABLE MARKS
or (alternative solution)		
(ii) Let T s = time taken by van to overtake		
Van $v = u + at$		
$27 = 0 + 25a$		
$\Rightarrow a = \frac{27}{25}$ m/s^2		
$s_1 = ut + \frac{1}{2}at^2$		
$s_1 = 0 + \frac{1}{2} \cdot \frac{27}{25} \cdot 25^2 = \frac{675}{2} = 337.5$ m	MW1	
= distance accelerating		
$s_2 = 27(T - 25)$ = distance at 27 m/s		
Total distance by van = $337.5 + 27\,T - 675$		
$= 27\,T - 337.5$	MW1	
Distance for car = $18\,T$	MW1	
$\Rightarrow 27\,T - 337.5 = 18\,T$	M1	
$9\,T = 337.5$		
$\underline{T} = \underline{37.5 \text{ s}}$	W1	
(iii) Distance travelled = $\frac{1}{2}(2 \times 37.5) - 25) \cdot 27$	MW1	
$= \underline{675 \text{ m}}$	W1	9

AVAILABLE MARKS

9



(i) Take moments at B.

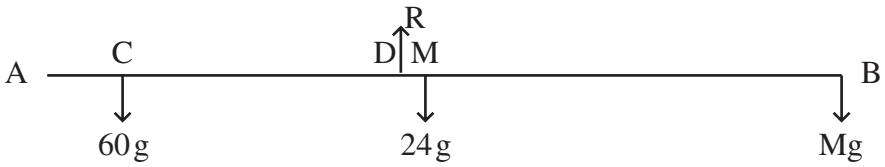
$R_1 \cdot 10 = 60\,g \cdot 9 + 24\,g \cdot 5$ MW1 × 3

$\Rightarrow R_1 = 540 + 120$

$\Rightarrow R_1 = 660\,N$ W1

(ii) $R_1 + R_2 = 60\,g + 24\,g = 840\,N$

$\Rightarrow R_2 = 840 - 660 = \underline{180\,N}$ MW1



(iii) Take moments at D

$60\,g \cdot (3.5) = 24\,g(0.5) + Mg(5.5)$ MW1 × 3

$\Rightarrow 210 = 12 + 5.5\,M$

$\Rightarrow 5.5\,M = 198$

$\Rightarrow M = 36\,kg$ W1

(iv) $R = 60\,g + 24\,g + 36\,g$

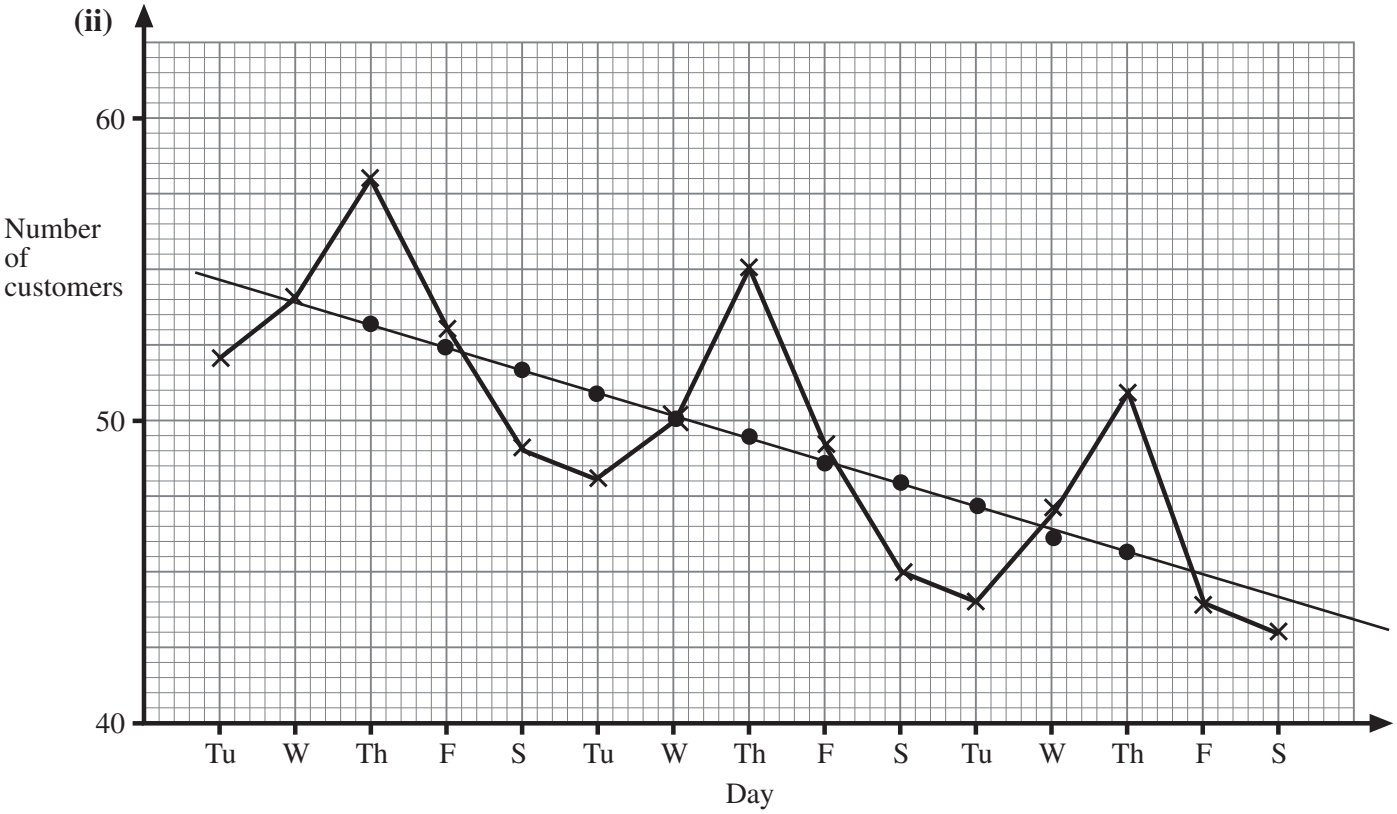
$\Rightarrow R_1 = 120\,g = \underline{1200\,N}$ MW1 10

AVAILABLE MARKS

10 **(i)** averages

53.2
52.4
51.6
51
50.2
49.4
48.6
48
47.2
46.2
45.8 M2W1

(ii)



correct set M2
points W1
line W1

AVAILABLE MARKS

(iii) $45 = \dfrac{x + 43 + 44 + 51 + 47}{5}$ reading M1W1

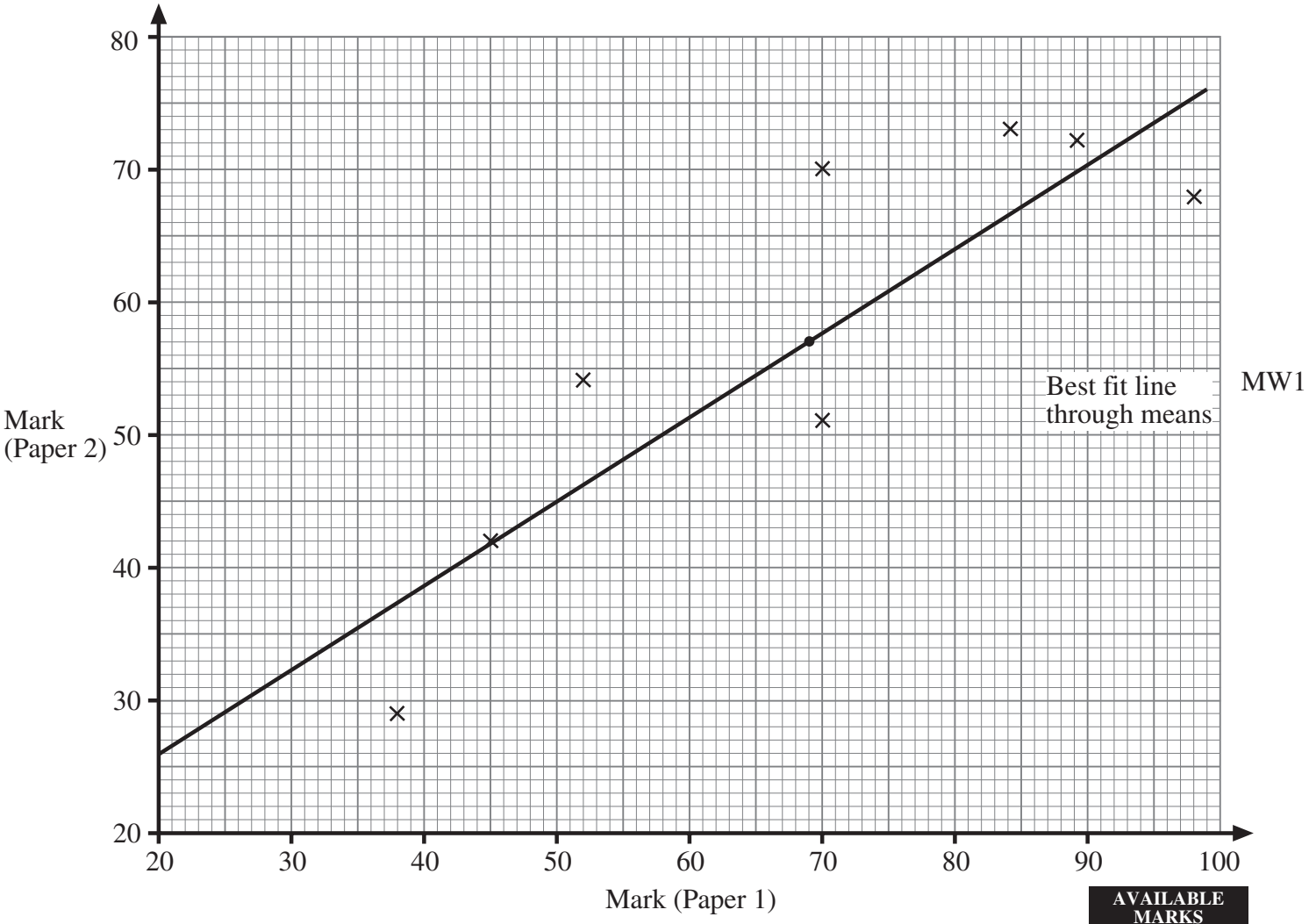
$x = 40$ M1W1

(iv) (gradual) decrease/decline/downward trend M1 12

AVAILABLE MARKS

11 (i) mean paper 1 = 68.25 MW1

mean paper 2 = 57.375 MW1



MW1

AVAILABLE MARKS

M1 (gradient)
M1 (intercept)

(ii) equation is $y = 0.653x + 12.82$ MW1 (equation – both methods correct)

(iii)

	rank 1	rank 2	d^2
A	1	4	9
B	2	2	0
C	8	8	0
D	6	5	1
E	4.5	6	2.25
F	4.5	3	2.25
G	7	7	0
H	3	1	4
			18.5

ranks MW1 × 2

Σd^2 M1W1

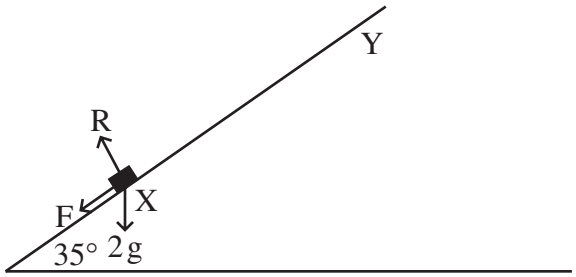
(iv) $r = 1 - \frac{6(18.5)}{8(63)}$

$= 0.78$ M1W1

(v) do well on paper 1, should do well on paper 2
(strong) positive correlation M1

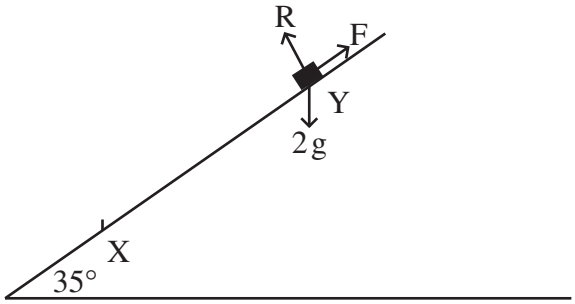
13

12



(i)	$R = 2\,g\cos 35°$	MW1
	$F = \mu R$	
	$\Rightarrow F = 0.4(2\,g\cos 35°)$	
	$\Rightarrow F = 6.55$ N	MW1
	Retarding force $= F + 2\,g\sin 35°$	M1
	$= 6.55 + 11.47$	
	$\Rightarrow$ *R.F.* $= 18.02$ N $=$ <u>18.0 N</u> (1 dec. pl.)	W1
(ii)	Retarding force = mass × retardation	
	$\Rightarrow 18.02 = 2 \times a$	M1
	$\Rightarrow a = 9.01 =$ <u>9.0 m/s^2</u> (1 dec. pl)	W1
(iii)	$v^2 = u^2 + 2as$	
	$0 = 6^2 + 2(-9.01)\,s$	M1
	$\Rightarrow 18.02\,s = 36$	
	$\Rightarrow s = 1.99 =$ <u>2.0 m</u> (1 dec. pl.)	W1

(iv)



	Accelerating Force $= 2\,g\sin 35 - F$	M2
	$= 11.47 - 6.55$	
	$\Rightarrow$ A.F. $= 4.92$ N	W1
	Accelerating Force = mass × acceleration	
	$\Rightarrow 4.92 = 2a$	M1
	$\Rightarrow a = 2.46 = 2.5$ m/s^2 (1 dec. pl.)	W1
(v)	$s = ut + \frac{1}{2}at^2$	
	$\Rightarrow 1.99 = 0 + \frac{1}{2}(2.46)\,t^2$	MW1
	$\Rightarrow t^2 = 1.62$	
	$\Rightarrow t = 1.27 = 1.3$ s (1 dec. pl.)	

Total **100**

AVAILABLE MARKS

14