Rewarding Learning

General Certificate of Secondary Education
2011

Additional Mathematics

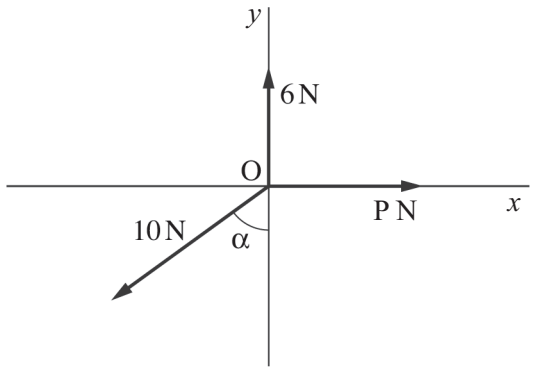
Paper 2
Mechanics and Statistics

[G0302]

THURSDAY 19 MAY, MORNING

MARK SCHEME

1



(i) Resolve vertically: $10\cos\alpha = 6$ MW1

$$\Rightarrow \cos\alpha = \frac{6}{10} = 0.6$$

$\Rightarrow \alpha = 53.1^\circ$ W1

(ii) Resolve horizontally

$P = 10\sin 53.1^\circ$ MW1

$\Rightarrow P = 10 \times 0.8$

$\Rightarrow P = 8$ W1 4

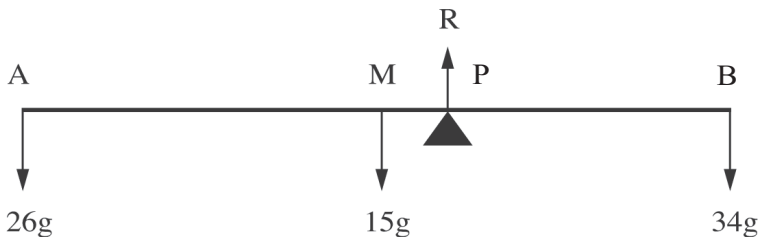
2 **(i)** suitable example for population M1

for subset of a population M1

(ii) situation involving cost/time… M1

(iii) situation involving destruction… M1 4

3 **(i)**



W1 (26g, 34g)

W1 (15g, R)

(ii) $R = 26g + 15g + 34g$

$\Rightarrow R = 75gN = 750N$ MW1

(iii) Let x = distance AP

Take moments about A M1

$750x = 150 \times 3 + 340 \times 6$ W1

$\Rightarrow \quad x = 3.32$

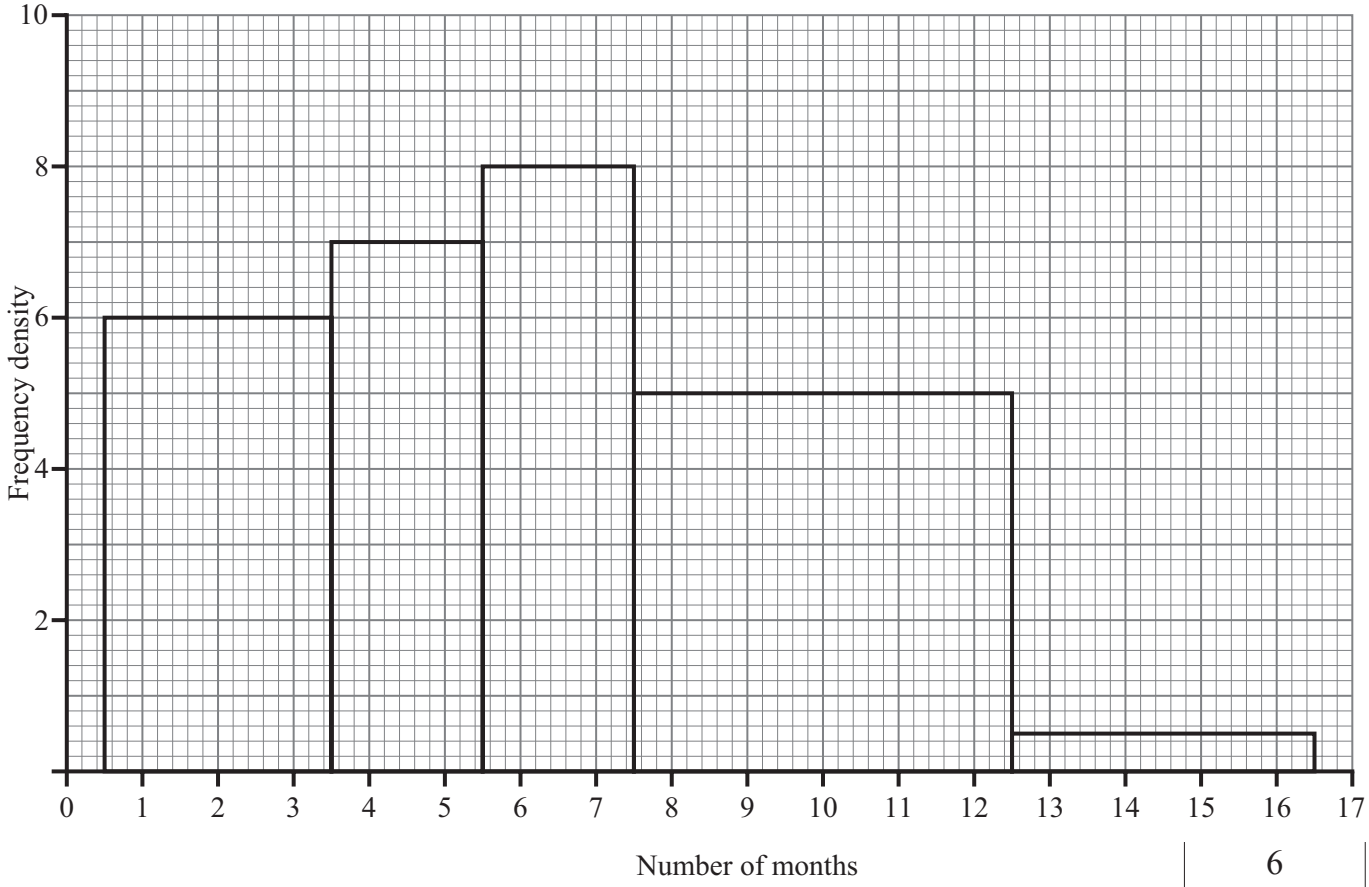
$\Rightarrow$ AP = 3.32m W1 6

AVAILABLE MARKS

4 **(i)** f.d. = 18/3 : $7 = f/2$ $8 = f/2$ $5 = f/5$ — MW1 for 6
= 6 $f = 14$ $f = 16$ $f = 25$ — MW1 for 14, 16
MW1 for 25

(ii) f.d. = 2/4 — M1W1 calc
= 1/2 — W1 plot

AVAILABLE MARKS



6

5 **(i)** Using $\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$

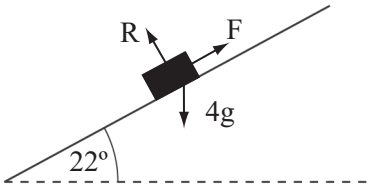
$\Rightarrow -16\mathbf{i} + 24\mathbf{j} = \frac{1}{2}\mathbf{a}t^2$ — MW1

$\Rightarrow -16\mathbf{i} + 24\mathbf{j} = 8\mathbf{a}$
$\Rightarrow \quad \mathbf{a} = (-16\mathbf{i} + 24\mathbf{j})/8$
$\Rightarrow \quad \mathbf{a} = (-2\mathbf{i} + 3\mathbf{j})\,\text{m/s}^2$ — W1

(ii) Using $\mathbf{v} = \mathbf{u} + \mathbf{a}t$
$\Rightarrow \quad \mathbf{v} = 0 + (-2\mathbf{i} + 3\mathbf{j}) \times 4$ — MW1
$\Rightarrow \quad \mathbf{v} = (-8\mathbf{i} + 12\mathbf{j})\,\text{m/s}$ — W1

(iii) Using $\mathbf{F} = m\mathbf{a}$
$\Rightarrow \quad \mathbf{F} = 3(-2\mathbf{i} + 3\mathbf{j})$ — MW1
$\Rightarrow \quad \mathbf{F} = (-6\mathbf{i} + 9\mathbf{j})\text{N}$
$\mathbf{F} = \mathbf{P} + \mathbf{Q}$
$\Rightarrow \quad -6\mathbf{i} + 9\mathbf{j} = (10\mathbf{i} - 5\mathbf{j}) + \mathbf{Q}$ — MW1
$\Rightarrow \quad \mathbf{Q} = (-6\mathbf{i} + 9\mathbf{j}) - (10\mathbf{i} - 5\mathbf{j})$
$\Rightarrow \quad \mathbf{Q} = (-16\mathbf{i} + 14\mathbf{j})\text{N}$ — W1

7

			AVAILABLE MARKS
6	**(a)** Total number of students = 389		
	$\text{median} = 20 + \frac{195-109}{122} \times 10 = 27$	MW1 (20) MW1 (195)	
	(or 194.5 instead of 195)	MW1 (other values) W1 (ans)	
	(b) $\text{mean} = \frac{737+5x}{232+x} = 3.5$	MW1 (numerator) MW1 (denominator)	
	$737 + 5x = 3.5(232 + x)$	M1 (equation)	
	$1.5x = 75$	W1	8
	$\therefore x = 50$		
7	**(i)** 	W1	
	(ii) $R = 4g\cos 22^\circ$	MW1	
	$\Rightarrow R = 37.09\text{N}$		
	(iii) $F = \mu R$		
	$\Rightarrow F = 0.3 \times 37.09$	MW1	
	$\Rightarrow F = 11.13\text{N}$	W1	
	(iv) Accelerating force $= 4g\sin 22^\circ - \mu R$		
	A.F. $= 14.98 - 11.13$	MW1	
	$\Rightarrow$ A.F. $= 3.85\text{N}$		
	A.F. $= ma$		
	$\Rightarrow 3.85 = 4a$	MW1	
	$\Rightarrow \quad a = 0.96\,\text{m/s}^2$	W1	
	(v) $v^2 = u^2 + 2as$		
	$\Rightarrow v^2 = 0 + 2(0.96)(1.4) = 2.69$	MW1	
	$\Rightarrow v = \sqrt{2.69} = 1.64\,\text{m/s}$	W1	9

8 **(i)** 1 – (rest) = 0.21 MW1

(ii) P(1 or 4) = 0.14 + 0.15
= 0.29 MW1

(iii) 4 : 1,3 or 3,1 or 2,2
P(4) = 2(0.14)(0.16) + $(0.17)^2$
= 0.0737
P (total square) = 0.0737 + 0.1182
= 0.1919

9 : 6,3 or 3,6 or 5,4 or 4,5
P(9) = 2(0.21)(0.16) + 2(0.15)(0.17)
= 0.1182

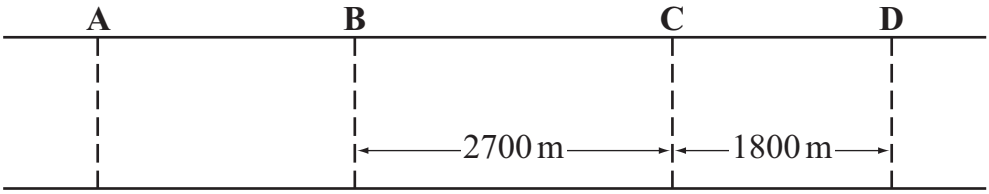
M1 (any 2 probabilities attempted)
M1 (any 4 probabilities attempted)
M1 (any 7 probabilities attempted)
W1 (answer)

(iv) P (even/square) = 0.0737/0.1919
= 0.384 M2W1

AVAILABLE MARKS

9

9



(i) A → B $v = u + at_1$
$\Rightarrow 15 = 45 + (-0.4t_1)$ MW1
$\Rightarrow -30 = -0.4t_1$
$\Rightarrow t_1 = 75$ secs W1

(ii) $v^2 = u^2 + 2as$
$\Rightarrow 15^2 = 45^2 + 2(-0.4)s_1$ MW1
$\Rightarrow 0.8s_1 = 2025 - 225 = 1800$
$\Rightarrow s_1 = 2250$ m W1

(iii) C → D $s = \left(\frac{u+v}{2}\right) t_3$ M1

$\Rightarrow 1800 = \left(\frac{15+45}{2}\right) t_3$ W1

$\Rightarrow t_3 = 60$ secs W1

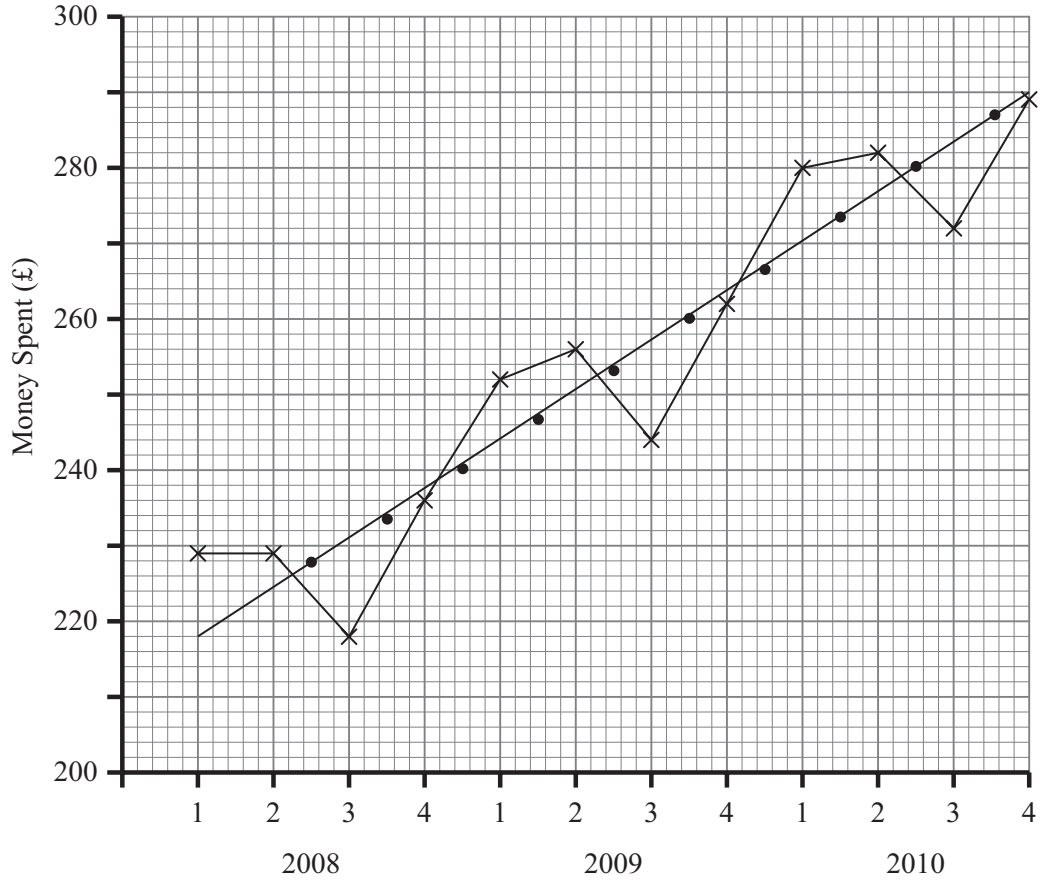
(iv) Total journey = 2250 + 2700 + 1800 = 6750 m
B → C 2700 @ 15m/s
$\Rightarrow t_2 = 2700/15 = 180$ secs W1
Total time taken = 75 + 180 + 60 = 315 secs W1
Time @ 45 m/s = 6750/45 = 150 secs W1
Total time lost = 315 – 150 = 165 secs W1

11

10 **(i)** 4pt moving average M1W1

228
233.75
240.5
247
253.5
260.5
267
274
280.75

(ii)



M2 set
MW1 line

(iii) $287 = \dfrac{282 + 272 + 289 + x}{4}$ M2 read

$x = 305$ M1W1

(iv) 25 M1 W1 11

AVAILABLE MARKS

11 **(i)**

Press-ups	9	10	5	7	2	8	1	4	3	6
Sit-ups	7	9	4	7	2	10	1	7	5	3

MW1 × 2

Alternatively

Press-ups	2	1	6	4	9	3	10	7	8	5
Sit-ups	4	2	7	4	9	1	10	4	6	8

(ii)

d^2	4	1	1	0	0	4	0	9	4	9

M1W1

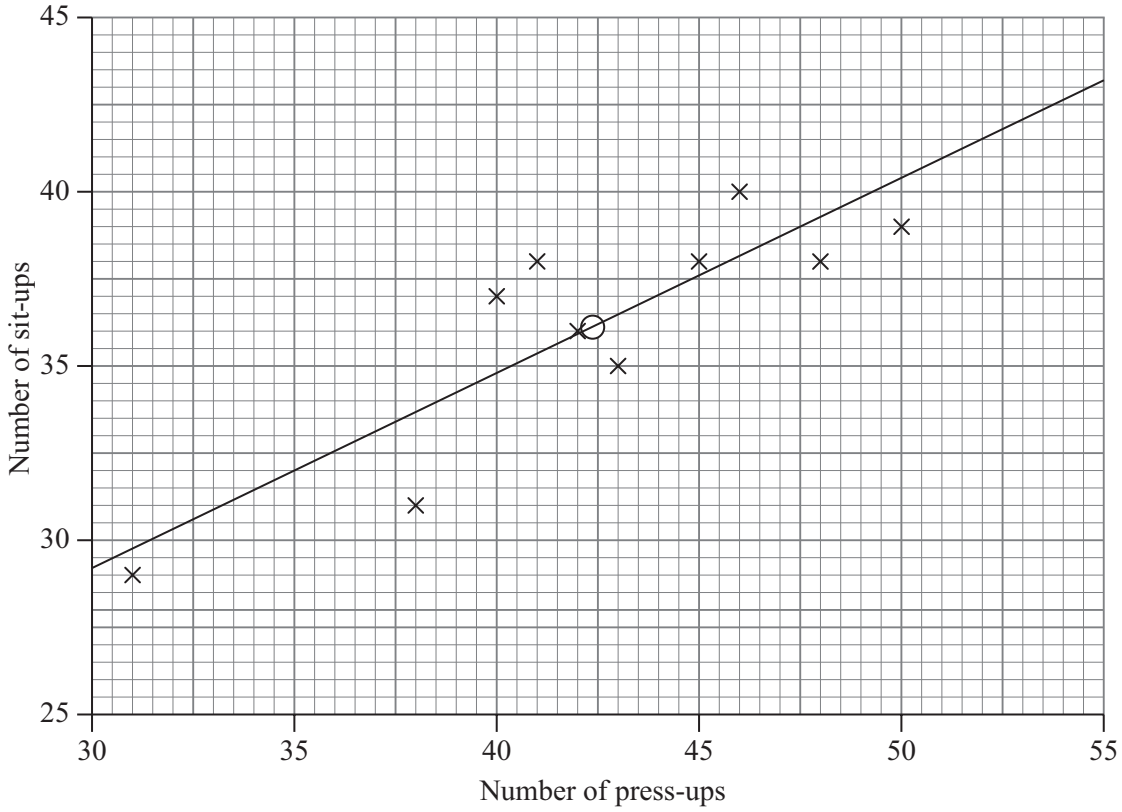
$$r = 1 - \frac{6(32)}{10(99)}$$

$r = 0.806$ MW1

(iii) (strong) positive correlation M1

(iv) Mean press-ups = 42.4 Mean Sit-ups = 36.1 MW1

(v)



M1 means
M1 slope

(vi) gradient $= \frac{43.2 - 29.2}{55 - 30} = 0.56$ MW1 gradient

$36.1 = 0.56(42.4) + c \quad \therefore c = 12.4$ MW1 c

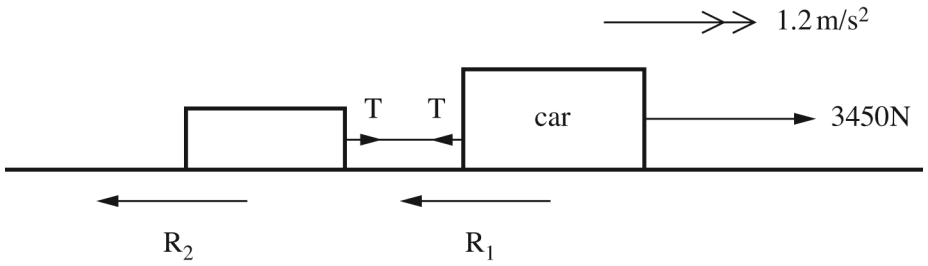
$y = 0.56x + 12.4$ MW1 equation

only if both methods correct

12

AVAILABLE MARKS

12



AVAILABLE MARKS

(i) Resistance to motion of car = $1050 \times 0.8 = 840$N — W1

(ii) Let R = total resistance where $R = R_1 + R_2$
Accelerating Force = Mass × Acceleration
A.F. = $(1050 + 750)1.2$ — MW1
$\Rightarrow$ A.F. = $1800 \times 1.2 = 2160$N
Accelerating Force = Tractive Force – Resistance
$\Rightarrow 2160 = 3450 - R$ — M1
$\Rightarrow R = 1290$N — W1

(iii) Resistance to motion of trailer = $R - R_1$
$1290 - 840 = 450$N — M1W1

(iv) Let T = tension in the towbar
$T - 450 = 750 \times 1.2$ — M1
$\Rightarrow T = 450 + 900$
$\Rightarrow T = 1350$N — W1

(v) When the towbar snaps T = 0
$\Rightarrow$ Retarding Force on the trailer = 450N — MW1
$\Rightarrow -450 = 750a$
$\Rightarrow a = -0.6\text{m/s}^2$ — W1
Using $v = u + at$
$0 = 12 + (-0.6)t$
$\Rightarrow t = 20$ secs — W1

(vi) Using $v^2 = u^2 + 2as$
$0 = 12^2 + 2(-0.6)s$ — M1
$\Rightarrow s = 120$ m — W1 — 13

Total — **100**