



## General Certificate of Education

# Mathematics 6300

## *Specification A*

*MAM1/W Mechanics 1*

# Mark Scheme

*2005 examination – June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.



## Key to Mark Scheme

<b>M</b>	mark is for	method
<b>m</b>	mark is dependent on one or more M marks and is for	method
<b>A</b>	mark is dependent on M or m marks and is for	accuracy
<b>B</b>	mark is independent of M or m marks and is for	accuracy
<b>E</b>	mark is for	explanation
<b>✓ or ft or F</b>		follow through from previous incorrect result
<b>CAO</b>		correct answer only
<b>AWFW</b>		anything which falls within
<b>AWRT</b>		anything which rounds to
<b>AG</b>		answer given
<b>SC</b>		special case
<b>OE</b>		or equivalent
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>-x EE</b>		deduct $x$ marks for each error
<b>NMS</b>		no method shown
<b>PI</b>		possibly implied
<b>SCA</b>		substantially correct approach
<b>c</b>		candidate
<b>sf</b>		significant figure(s)
<b>dp</b>		decimal place(s)

## Abbreviations used in Marking

<b>MC – <math>x</math></b>	deducted $x$ marks for mis-copy
<b>MR – <math>x</math></b>	deducted $x$ marks for mis-read
<b>ISW</b>	ignored subsequent working
<b>BOD</b>	given benefit of doubt
<b>WR</b>	work replaced by candidate
<b>FB</b>	formulae book

## Application of Mark Scheme

<b>No method shown:</b>	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
<b>More than one method / choice of solution:</b>	
2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only
<b>Crossed out work</b>	do not mark unless it has not been replaced
<b>Alternative solution</b> using a correct or partially correct method	award method and accuracy marks as appropriate

## MAM1/W

Q	Solution	Marks	Total	Comments
1	$12m = 3mv + 3mv$	M1A1	3	M1 Momentum terms, all present, accept one slip ft slip
	$v = 2$	A1F		
<b>Total</b>			<b>3</b>	
2(a)	$5 = 10 \cos \theta^\circ$ $\theta = 60^\circ$	M1 A1	2	Component attempted AG
(b)	$Q = 10 \sin \theta$	M1	2	Component attempted Accept either form
	$Q = 5\sqrt{3}N = 8.66N$	A1		
<b>Total</b>			<b>4</b>	
3(a)(i)	$V = 0 + 3 \times 0.8$	M1	2	AG
	$V = 2.4$	A1		
(ii)	$S = \frac{1}{2}(5 + 8) \times 2.4$	M1	3	Method for total area ft slip
	$S = 15.6m$	A1F		
(b)	$\frac{1}{2} \times T \times 2.4 = 4.8$	M1	4	Full method for time Total distance / total time ft one error in $S$ or in $T$
	$T = 4$	A1		
	Average speed $= \frac{15.6 + 4.8}{8 + 4}$	M1		
	$= 1.7ms^{-1}$	A1F		
<b>Total</b>			<b>9</b>	
4(a)		M1	2	Triangle with resultant as hypotenuse All arrows correct, at least 2 speeds shown correctly
		A1		
(b)	$x^2 = 6^2 + 2^2$	M1	2	Allow use of candidate's triangle with 6 as hypotenuse (Allow 5.66 if M1 awarded for 6 as hypotenuse); condone $2\sqrt{10}$
	$x = 2\sqrt{10} = 6.32$	A1		
(c)	$\tan \theta = \frac{2}{6}$	M1	2	Full method for an acute angle inside triangle with $x$ as hypotenuse Accept: N $18.4^\circ$ (or $18^\circ$ ) E; $18.4^\circ$ (or $18^\circ$ ) E of N; $018.4^\circ$
	$\theta = 18.4^\circ \rightarrow$ bearing $018^\circ$	A1		
<b>Total</b>			<b>6</b>	

## MAM1/W (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)		B1		For any 3 forces correct
		B1	2	For the rest correct, and no extras (accept $F$ in either direction, but not $\mu R$ )
(ii)	$R = 0.2 \times g$ $F = 0.5 \times R$ $F = 0.98\text{N}$	M1 A1	2	For equations for both $R$ and $F$ AG
(iii)	$T = 0.3 \times 9.8 = 2.94\text{N}$	M1A1	2	
(iv)	$P + F = T$ least $P = 1.96\text{N}$	M1 A1F	2	ft $T$ provided $P > 0$
(b)(i)	$2.94 - T = 0.3a$ $T - 0.98 = 0.2a$ $1.96 = 0.5a$ $a = 3.92\text{ms}^{-2}$	M1A1 A1 m1 A1F	5	M1 either equation (whole string method: 'correct' equation, M1 A1, answer A1; max 3 / 5) ft one error
(ii)	$0.1 = \frac{1}{2} \times 3.92 \times t^2$ $t = 0.226$ (0.22588)	M1 A1F	2	Use of candidate's acceleration, if $< 9.8$ ft candidate's acceleration (not 9.8) if $a = 1.96$ used, $t = 0.319$
<b>Total</b>			<b>15</b>	
6(a)	$\mathbf{a} = 4t\mathbf{i} + 3\mathbf{j}$	B1	1	<b>Answers in</b> <b>(a), (b) and (c)(i) must be vectors</b> Must be vector, both $\mathbf{i}$ and $\mathbf{j}$ present
(b)	$\mathbf{v} = 2t^2\mathbf{i} + 3t\mathbf{j}$	M1 A1F	2	Integration of acceleration attempted ft $\mathbf{a}$ , both $\mathbf{i}$ and $\mathbf{j}$ present
(c)(i)	$\mathbf{r} = \int_0^t (2t^2\mathbf{i} + 3t\mathbf{j}) dt$ $= \frac{2t^3}{3}\mathbf{i} + \frac{3t^2}{2}\mathbf{j}$	M1 A1A1	3	Integration attempted A1 each term. Condone $\mathbf{i}$ and $\mathbf{j}$ missing. -1 for constants present, -1 for both terms unsimplified
(ii)	$\left. \begin{array}{l} \mathbf{v} \text{ parallel to } \mathbf{i} + \mathbf{j} \\ 2t^2 = 3t \end{array} \right\}$ $t = \frac{3}{2}$	M1 A1F		Solve, ft $\mathbf{v}$ with vector components
	$\mathbf{r} = \frac{9}{4}\mathbf{i} + \frac{27}{8}\mathbf{j}$	A1F		
	Distance = $\sqrt{\left(\left(\frac{9}{4}\right)^2 + \left(\frac{27}{8}\right)^2\right)}$ $= 4.06$ (4.056)	M1 A1F	5	Magnitude of $\mathbf{r}$ in any form Numerical answer, ft candidate's $\mathbf{r}$ and $t$
<b>Total</b>			<b>11</b>	

**MAM1/W (cont)**

Q	Solution	Marks	Total	Comments
7(a)(i)	$x = 14t$	B1	3	Accept as components of position vector Accept $x = 15.7 \cos 26.6t$
	$y = 7t - 4.9t^2$	M1 A1		Use of equation Substitution  Accept $g$ ; accept $y = 15.7 \sin 26.6t - \frac{1}{2}gt^2$
(ii)	$t = \frac{x}{14}$ $y = 7 \times \frac{x}{14} - 4.9 \times \left(\frac{x}{14}\right)^2$	M1 A1	3	Use of candidate's coordinates Substituted; accept unsimplified
	$= \frac{x}{2} - 4.9 \frac{x^2}{196}$ $y = \frac{20x - x^2}{40}$	A1		AG; convincingly found
(iii)	$y = 0$ $20x - x^2 = 0$	M1	2	Full method for range ( $t = 1.4286$ for range, or $t = 0.7143$ for greatest height and horizontal distance then doubled, or $R = \frac{v^2 \sin 2\alpha}{g}$ )
	$x = 20$	A1		AWRT
(b)	$x = 12, \quad y = 2.4$	M1	3	Substitution into appropriate equation(s), ( $t = 0.857$ ) For $y = 2.4$ ft provided $y > 0$
	$\therefore$ under bar	A1 A1F		<b>Alt:</b> M1 for $x = 10$ subs and followed by comparison, $H = 2.5$ A1, conclusion A1
(c)	Air resistance ignored, ball treated as particle...	B1	1	
<b>Total</b>			<b>12</b>	
<b>TOTAL</b>			<b>60</b>	