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ASSESSMENT and QUALIFICATIONS ALLIANCE

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

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

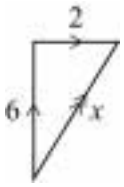
Abbreviations used in Marking

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

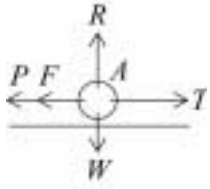
Application of Mark Scheme

No method shown:	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
More than one method / choice of solution:	
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
Crossed out work	do not mark unless it has not been replaced
Alternative solution 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		M1 Momentum terms, all present, accept one slip
	$v = 2$	A1F	3	ft slip
	Total		**3**	
2(a)	$5 = 10\cos\theta^\circ$	M1		Component attempted
	$\theta = 60^\circ$	A1	2	AG
(b)	$Q = 10\sin\theta$	M1		Component attempted
	$Q = 5\sqrt{3}\text{N} = 8.66\text{N}$	A1	2	Accept either form
	Total		**4**	
3(a)(i)	$V = 0 + 3\times 0.8$	M1		
	$V = 2.4$	A1	2	AG
(ii)	$S = \frac{1}{2}(5+8)\times 2.4$	M1		Method for total area
		A1		
	$S = 15.6\text{m}$	A1F	3	ft slip
(b)	$\frac{1}{2}\times T \times 2.4 = 4.8$	M1		Full method for time
	$T = 4$	A1		
	Average speed $= \frac{15.6+4.8}{8+4}$	M1		Total distance / total time
	$= 1.7\text{ms}^{-1}$	A1F	4	ft one error in S or in T
	Total		**9**	
4(a)		M1		Triangle with resultant as hypotenuse
		A1	2	All arrows correct, at least 2 speeds shown correctly
(b)	$x^2 = 6^2 + 2^2$	M1		Allow use of candidate's triangle with 6 as hypotenuse
	$x = 2\sqrt{10} = 6.32$	A1	2	(Allow 5.66 if M1 awarded for 6 as hypotenuse); condone $2\sqrt{10}$
(c)	$\tan\theta = \frac{2}{6}$	M1		Full method for an acute angle inside triangle with x as hypotenuse
	$\theta = 18.4^\circ \rightarrow$ bearing 018°	A1	2	Accept: N 18.4° (or 18°) E; 18.4° (or 18°) E of N; 018.4°
	Total		**6**	

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 μR)
(ii)	$R = 0.2 \times g$			
	$F = 0.5 \times R$	M1		For equations for both R and F
	$F = 0.98\text{N}$	A1	2	AG
(iii)	$T = 0.3 \times 9.8 = 2.94\text{N}$	M1A1	2	
(iv)	$P + F = T$	M1		
	least $P = 1.96\text{N}$	A1F	2	ft T provided $P > 0$
(b)(i)	$2.94 - T = 0.3a$	M1A1		M1 either equation
	$T - 0.98 = 0.2a$	A1		(whole string method: 'correct' equation, M1 A1, answer A1; max 3 / 5)
	$1.96 = 0.5a$	m1		
	$a = 3.92\text{ms}^{-2}$	A1F	5	ft one error
(ii)	$0.1 = \frac{1}{2} \times 3.92 \times t^2$	M1		Use of candidate's acceleration, if < 9.8
	$t = 0.226 \ (0.22588)$	A1F	2	ft candidate's acceleration (not 9.8) if $a = 1.96$ used, $t = 0.319$
	Total		**15**	
				Answers in (a), (b) and (c)(i) must be vectors
6(a)	$\mathbf{a} = 4t\mathbf{i} + 3\mathbf{j}$	B1	1	Must be vector, both **i** and **j** present
(b)	$\mathbf{v} = 2t^2\mathbf{i} + 3t\mathbf{j}$	M1		Integration of acceleration attempted
		A1F	2	ft **a**, both **i** and **j** present
(c)(i)	$\mathbf{r} = \int_0^t \left(2t^2\mathbf{i} + 3t\mathbf{j}\right) \mathrm{d}t$	M1		Integration attempted
	$= \frac{2t^3}{3}\mathbf{i} + \frac{3t^2}{2}\mathbf{j}$	A1A1	3	A1 each term. Condone **i** and **j** missing. –1 for constants present, –1 for both terms unsimplified
(ii)	$\left.\begin{array}{l}\mathbf{v} \text{ parallel to } \mathbf{i} + \mathbf{j} \\ 2t^2 = 3t\end{array}\right\}$	M1		
	$t = \frac{3}{2}$	A1F		Solve, ft **v** with vector components
	$\mathbf{r} = \frac{9}{4}\mathbf{i} + \frac{27}{8}\mathbf{j}$	A1F		
	Distance $= \sqrt{\left(\left(\frac{9}{4}\right)^2 + \left(\frac{27}{8}\right)^2\right)}$	M1		Magnitude of **r** in any form
	$= 4.06 \ \ (4.056)$	A1F	5	Numerical answer, ft candidate's **r** and t
	Total		**11**	

MAM1/W (cont)

Q	Solution	Marks	Total	Comments
7(a)(i)	$x = 14t$	B1		Accept as components of position vector Accept $x = 15.7\cos 26.6t$
	$y = 7t - 4.9t^2$	M1 A1	3	Use of equation Substitution Accept g; accept $y = 15.7\sin 26.6t - \frac{1}{2}gt^2$
(ii)	$t = \frac{x}{14}$ $\quad y = 7\times\frac{x}{14} - 4.9\times\left(\frac{x}{14}\right)^2$	M1 A1		Use of candidate's coordinates Substituted; accept unsimplified
	$= \frac{x}{2} - 4.9\frac{x^2}{196}$			
	$y = \frac{20x - x^2}{40}$	A1	3	AG; convincingly found
(iii)	$y = 0$ $\quad 20x - x^2 = 0$	M1		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	2	AWRT
(b)	$x = 12$, $\quad y = 2.4$	M1		Substitution into appropriate equation(s), (t = 0.857)
		A1		For $y = 2.4$
	$\therefore$ under bar	A1F	3	ft provided $y > 0$ **Alt:** 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	
	Total		**12**	
	TOTAL		**60**	