AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Mathematics 6360

MM2A Mechanics 2A

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 and abbreviations used in marking

M	mark is for method		
m or dM	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 method and accuracy		
E	mark is for explanation		
√ or ft or F	follow through from previous		
	incorrect result	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	OE	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
−x EE	deduct x marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

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

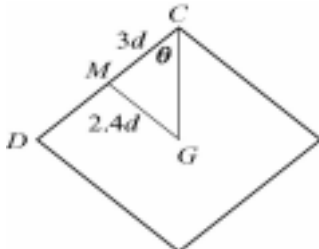**Crossed out work** do not mark unless it has not been replaced

Alternative solution using a correct or partially correct method award method and accuracy marks as appropriate
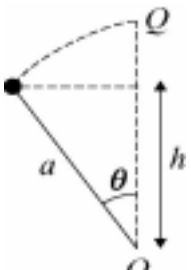
MM2A/W

Q	Solution	Marks	Total	Comments
1(a)	$12.5 = \lambda \times \dfrac{0.1}{0.4}$	M1A1		M1: subs. A1: All correct
	$\lambda = 50$	A1	3	
(b)	$\text{EPE} = \dfrac{50 \times (0.1)^2}{2 \times 0.4}$	M1		Subs.
	$= 0.625 \, \text{J}$	A1		PI A1: all correct
	$0.625 = \dfrac{1}{2} \times 0.2 \times v^2$	M1		M1 use of principle
		A1F		ft EPE
	$v = 2.5 \, \text{ms}^{-1}$	A1F	5	ft EPE
	Total		**8**	
2(a)		B1	1	All forces shown and in correct direction (no extras)
(b)	$R = 125g \qquad (=1225)$	B1		
	$F = 0.3 \times R$	M1		Condone inequality
	$F = 367.5 \, \text{N}$	A1F	3	ft slip, both vertical forces present (g missing B0 M1 A1F)
(c)	M (ground)			
	$35g \times 1.5\cos 60° + 90g \times x \times \cos 60°$ $= N \times 3\cos 30°$	M1A2		M1 attempt at moments eqn., accept one force missing. -1 each term missing or incorrect. Condone repeated error, g missing or sin/cos mix.
	$F = N$	B1		
	Substitute to find x	m1		Subs. of candidate's N
	$x = 1.582$ metres	A1	6	Accept 1.6
	Total		**10**	

MM2A/W (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$T \cos 60° = 0.4g$	M1A1		
	$T = 7.84$ newtons	A1	3	AG
(b)	$T \cos 30° = 0.4 \, \omega^2 r$	M1A1		
	$r = \tan 60°$	B1		
	$7.84 \times \cos 30° = 0.4 \, \omega^2 \times \tan 60°$	m1		Subs
	$\omega = 3.13$	A1	5	AG
(c)	$T = \dfrac{2\pi}{\omega} = 2.007$			
	≈ 2 sec	B1	1	
	Total		9	
4(a)	$M(A) \; 4Mg \times \dfrac{3d}{2} + Mg \times 2d = 5Mg \times \overline{y}$	M1A2		M1 3 terms (M1 A0 if areas used) Condone ratio methods for weights. -1 each term wrong $M(AB) \; 4Mg \times \dfrac{3d}{2} + Mg \times 2d = 5Mg \times \overline{y}$
	$\overline{y} = 1.6d$	A1	4	
(b)				
	$\tan\theta = \dfrac{GM}{CM}$	M1		Full method for an acute angle involving wallet
	$= \dfrac{2.4d}{3d}$	A1A1		A1A0 for inverse
	$\theta = 38.7°$	A1F	4	ft slip in subtraction
	Total		8	
5	$\dfrac{dv}{dt} = \dfrac{k}{v}$	B1		
	$\int v dv = \int k dt$	M1		Separation of variables involving t
	$\dfrac{v^2}{2} = kt + c$	m1 A1		Integrate
	$t = 0, \; v = u, \; \therefore c = \dfrac{u^2}{2}$	m1		
	$v^2 = u^2 + 2kt$	A1	6	
	Total		6	

MM2A/W (cont)

Q	Solution	Marks	Total	Comments
6(a)	$\mathbf{a} = 8\cos t\,\mathbf{i} - 4\sin t\,\mathbf{j}$ $\mathbf{F} = 2\cos t\,\mathbf{i} - \sin t\,\mathbf{j}$	M1A1 A1	3	M1 differentiation
(b)(i)	$\|\mathbf{F}\| = \sqrt{(4\cos^2 t + \sin^2 t)}$ $= \sqrt{(3\cos^2 t + 1)}$	M1 m1 A1	3	Magnitude CAO
(ii)	$1 \leq \|\mathbf{F}\| \leq 4$	B1B1	2	B1 each value (at end of range)
	Total		**8**	
7(a)	$\frac{1}{2}mU^2 = mga$ $U = \sqrt{(2ga)}$	M1A1 A1F	3	Conservation of energy for M1 $v = 0$ for A1 ft slip (eg $h = 2a$)
(b)	 $R = 0: mg\cos\theta = \dfrac{mv^2}{a}$ $v^2 = ag \times \dfrac{h}{a} \qquad v^2 = ag \times \dfrac{h}{a}$ $v^2 = hg \quad v^2 = hg$ $\frac{1}{2}m\left(\dfrac{5ag}{2}\right) = \frac{1}{2}mv^2 + mgh$ $\dfrac{5ag}{2} = 3gh$ $h = \dfrac{5a}{6}$	M1A1 m1 A1F M1A1 m1 A1	8	M1 for $F = ma$ in general position Subs for $\cos\theta$ ft errors in height M1 conservation of energy using u, v and h. Subs for v^2
	Total		**11**	
	Total		**60**	