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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MM2B Mechanics 2B

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

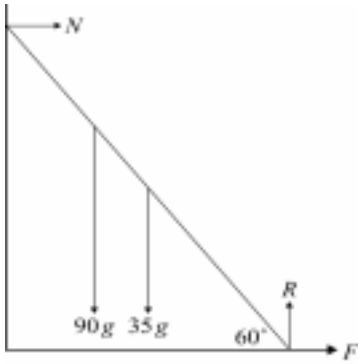
No method shown:

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

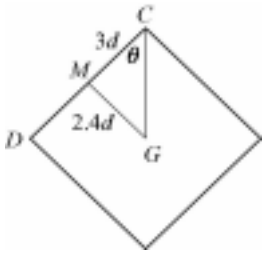
More than one method / choice of solution:

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

MM2B

Q	Solution	Marks	Total	Comments
1(a)	$12.5 = \lambda \times \frac{0.1}{0.4}$	M1A1		M1: Substitution A1: All correct
	$\lambda = 50$	A1	3	
(b)	$\text{EPE} = \frac{50 \times (0.1)^2}{2 \times 0.4}$	M1		M1 subs.
	= 0.625 J	A1		PI A1 all correct
	$0.625 = \frac{1}{2} \times 0.2 \times v^2$	M1		M1 use of principle ft EPE
	v = 2.5 ms^{-1}	A1F A1F	5	ft EPE
	Total		**8**	
2(a)		B1	1	All forces shown and in correct direction (no extras)
(b)	$R = 125g \quad (= 1225)$	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**	

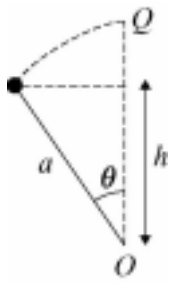
MM2B (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$\frac{1}{2}\times 28\times 1^2 + 28\times 9.8\times 2.5 = \frac{1}{2}\times 28\times v^2$	M1A2		M1 all 3 terms – 1 each term incorrect
	$v = 7.07\text{ms}^{-1}$ (3 sf) (3 sf)	A1	4	Convincingly obtained
		B1 B1 B1	3	v increasing accept straight line, not horizontal labels all correct (1, 7.07, T) correct shape
(b)	Initial energy = PE + KE $\frac{1}{2}\times 28\times 1 + 28\times 9.8\times 2.5$	M1		
	$700 - \frac{1}{2}\times 28\times v^2 = 350$	M1A1		M1 work/energy principle A1 correct
	$v = 5\text{ms}^{-1}$	A1F	4	ft slip eg sign
	Total		**11**	
4(a)	$M(AB)\ 4Mg\times\frac{3d}{2} + Mg\times 2d = 5Mg\times\bar{y}$	M1A2		M1A0 if areas used M1 3 terms, condone ratio methods for weights – 1 each term wrong
	$\bar{y} = 1.6d$	A1	4	
(b)				
	$\tan\theta = \frac{GM}{CM}$	M1		Full method for an acute angle involving wallet
	$= \frac{2.4d}{3d}$	A1A1		A1A0 for inversion
	$\theta = 38.7^\circ$	A1F	4	ft slip in subtraction
	Total		**8**	

MM2B (cont)

Q	Solution	Marks	Total	Comments
5	$\frac{dv}{dt}=\frac{k}{v}$	B1		
	$\int v\,dv=\int k\,dt$	M1		Separation of variables involving t
	$\frac{v^2}{2}=kt(+c)$	m1		Integrate
		A1		
	$t=0,\ v=u,\ \therefore c=\frac{u^2}{2}$	m1		
	$v^2=u^2+2kt$	A1	6	
	Total		**6**	
6(a)(i)	Acceleration $=\frac{v^2}{r}=\frac{(7.5)^2}{15}$	M1		Attempt at $\frac{v^2}{r}$
	$=3.75\,\text{ms}^{-2}$	A1	2	
(ii)	$2940=400\times\frac{V^2}{15}$	M1A1		M1 use, A1 subs correct
	$V=10.5\,\text{ms}^{-1}$	A1	3	
(b)	Motorcycle and rider modelled as a particle	B1		
	Size of rider/cycle compared with radius / 15m	B1	2	
(c)	Acceleration or force $\left(\frac{v^2}{r}\right)$ must decrease	M1		Force decrease → radius increase B1 sc
	so r must increase	A1	2	For 2 marks, algebraic reference or convincing explanation
	Total		**9**	
7(a)(i)	$\mathbf{v}=2\cos 2t\mathbf{i}+6\mathbf{j}$	M1A1	2	M1 differentiation ($6t$)
(ii)	$\lvert\mathbf{v}\rvert=\sqrt{4\cos^2 2t+36}$	M1		Sum of squares, for v or v^2
		A1F	3	ft trig term for **v**
		A1		CAO
(iii)	$\cos^2 2t=0$ or cos 2t = 0	M1		
	$t=\frac{\pi}{4}$	A1	2	radians
(b)(i)	$\mathbf{a}=-4\sin 2t\,\mathbf{i}$	M1		Differentiation attempt
	$\mathbf{F}=0.25\mathbf{a}$	M1		Used
	$\mathbf{F}=-\sin 2t\,\mathbf{i}$	A1F	3	ft **v**, see vector
(ii)	Direction is $\pm\mathbf{i}$	B1		
	$\lvert\sin 2t\rvert\le 1$	B1	2	
	Total		**12**	

MM2B (cont)

Q	Solution	Marks	Total	Comments
8(a)	$\frac{1}{2}mU^2 = mga$	M1A1		Conservation of energy M1
	$U = \sqrt{2ga}$	A1F	3	ft slip (eg $h = 2a$)
(b)				
	$R = 0 : mg\cos\theta = \frac{mv^2}{a}$	M1A1		M1 for $F = ma$ in general position
	$v^2 = ag \times \frac{h}{a}$	m1		Subs for cos θ
	$v^2 = hg$	A1F		ft errors in height
	$\frac{1}{2}m\left(\frac{5ag}{2}\right) = \frac{1}{2}mv^2 + mgh$	M1A1		M1 conservation of energy using u, v and h
	$\frac{5ag}{2} = 3gh$	m1		subs. for v^2
	$h = \frac{5a}{6}$	A1	8	
	Total		**11**	
	Total		**75**	