



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
Incorrect answer without working

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

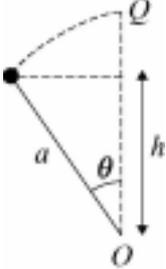
MM2B (cont)

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

MM2B (cont)

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

MM2B (cont)

Q	Solution	Marks	Total	Comments
8(a)	$\frac{1}{2}mU^2 = mga$ $U = \sqrt{2ga}$	M1A1 A1F	3	Conservation of energy M1 ft slip (eg $h = 2a$)
(b)	 <p>The diagram shows a particle of mass m attached to a string of length a, pivoted at point O. The particle is at a height h above O, making an angle θ with the vertical. A dashed arc indicates the path of the particle from its initial position to point Q at the top of the string.</p> $R = 0: mg \cos \theta = \frac{mv^2}{a}$ $v^2 = ag \times \frac{h}{a}$ $v^2 = hg$ $\frac{1}{2}m\left(\frac{5ag}{2}\right) = \frac{1}{2}mv^2 + mgh$ $\frac{5ag}{2} = 3gh$ $h = \frac{5a}{6}$	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		75	