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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MM1B Mechanics 1B

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

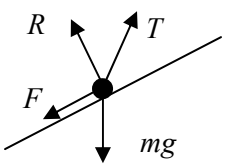
MM1B

Q	Solution	Marks	Total	Comments
1(a)	$m\begin{bmatrix}4\\2\end{bmatrix}+3\begin{bmatrix}-1\\-1\end{bmatrix}=(m+3)\begin{bmatrix}1\\V\end{bmatrix}$	M1		M1: Conservation of momentum equation with 3 terms
	$4m-3=m+3$ **AG**	A1		A1: Correct momentum equation
	$3m=6$	M1		M1: Solving equation
	$m=2$	A1	4	A1: Correct m from correct working Note: Deduct one mark for using mg instead of m
(b)	$4-3=5V$	M1		M1: Conservation of momentum equation for component containing V
		A1		A1: Correct equation
	$V=0.2$	A1	3	A1: Correct V
	Total		**7**	
2(a)	$s_1=\frac{1}{2}\times15\times20=150$	M1		M1: Finding length of first stage
		M1		M1: Finding length of second stage
	$s_2=\frac{1}{2}\times15\times80=600$	A1		A1: Both distances correct
	$s=600+150=750$ m	A1	4	A1: Correct total distance
(b)(i)	$t=\frac{750}{15}=50$ s	B1ft	1	B1: Correct time or their distance correctly divided by 15
(ii)	Delay $=120-50=70$ s	B1ft	1	B1: Correct time or their previous time correctly subtracted from 120 to give a positive answer
(c)	$a=\frac{15}{80}=\frac{3}{16}=0.1875$ ms^{-2}	M1		M1: Finding acceleration
		A1		A1: Correct acceleration
	$F=500000\times0.1875=93800$ N (to 3sf)	M1		M1: Use of $F = ma$
		A1	4	A1: Correct force
	Total		**10**	
3(a)	$2\cos\alpha=0.8$	M1		M1: Use of cos or sin to find α with 2 and 0.8
	$\cos\alpha=\frac{0.8}{2}$ **AG**	A1		A1: Correct equation
	$\alpha=\cos^{-1}\left(\frac{0.8}{2}\right)=66.4°$	A1	3	A1: Correct α from correct working
(b)(i)	$v=\sqrt{2^2-0.8^2}=1.83$ ms^{-1}	M1		M1: Use of Pythagoras with 2 and 0.8 or trigonometry with angle from above
	or			
	$v=2\sin 66.4°=1.83$ ms^{-1}	A1	2	A1: Correct velocity
(ii)	$t=\frac{14}{1.83}=7.64$ s	M1		M1: Use of distance over speed from previous
	Allow 7.65 s	A1	2	A1: Correct time
	Total		**7**	

MM1B (cont)

Q	Solution	Mark	Total	Comments
4(a)	$9g - T = 9a$ $T - 5g = 5a$ $4g = 14a$ $a = \frac{4g}{14} = 2.8 \text{ ms}^{-2}$ **AG**	M1 A1 M1 A1 A1	5	M1: Equation for one particle A1: Correct equation M1: Equation for other particle A1: Correct equation A1: Correct a from correct working
(b)	$T - 5g = 5 \times 2.8$ $T = 63 \text{ N}$	M1 A1	2	M1: Substituting acceleration to find T A1:Correct tension
(c)	$s = \frac{1}{2} \times 2.8 \times 0.5^2$ $= 0.35 \text{ m}$ $\text{Total} = 2 \times 0.35 = 0.7 \text{ m}$	M1A1 A1 A1ft	4	M1: Constant acceleration equation with $u = 0$ and a $\neq g$ to find s. Allow $\pm$answers A1: Correct equation A1: Correct distance A1: Doubling their distance to get total distance apart
	Total		**11**	
5(a)	No air resistance/Only gravity or weight	B1	1	B1: Acceptable assumption
(b)(i)	$0.2 \times 8 = 0.2 \times 9.8 - R$ $R = 0.36 \text{ N}$	M1 A1 A1	3	M1: Three term equation of motion A1: Correct equation A1: Correct magnitude of the resistance force
(b)(ii)	**Increases** as the speed increases	B1	1	B1: Correct explanation
(c) (i)	$\pm$ 9.8 ms^{-2}	B1	1	B1: CAO
(ii)	**Decreases** towards zero	B1	1	B1: Correct explanation
	Total		**7**	
6(a)	Ball is a particle/no spin No air resistance/Only gravity or weight	B1 B1	2	B1: One assumption B1: Second assumption
(b)(i)	$24.5t - 4.9t^2 = 0$ $\left(t = 0 \text{ or } t = \frac{24.5}{4.9} = 5 \text{ s}\right)$ **AG**	M1 A1 dM1 A1	4	M1: Equation for vertical motion with height zero A1:Correct equation dM1: Solving for t A1: Correct time from correct working
(b)(ii)	$R = 10 \times 5 = 50 \text{ m}$	M1 A1	2	M1: Use of horizontal component of velocity to find the range A1: Correct range
(c)	$20 = 10t$ $t = 2$ $h = 24.5 \times 2 - 4.9 \times 2^2 = 29.4 \text{ m}$	M1 A1 dM1 A1	4	M1: Horizontal equation A1: Time to reach wall dM1: Vertical equation for height with $u = 24.5$ and a negative acceleration A1: Correct height
(d)	No change as acceleration and initial velocity do not change with the mass	B1 B1	2	B1: No change B1: Explanation
	Total		**14**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	$\mathbf{v} = 4\mathbf{j} + (3\mathbf{i} - 5\mathbf{j})t$	M1A1	2	M1: Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$ and $\mathbf{u} \neq 0$ or integration A1: Correct expression
(b)	$\mathbf{v} = 3t\mathbf{i} + (4 - 5t)\mathbf{j}$ $4 - 5t = 0$	M1		M1: j component of velocity equal to zero
	$t = 0.8$ s	A1	2	A1: Correct t
(c)	$\mathbf{v} = 12\,\mathbf{i} - 16\mathbf{j}$	M1		M1: Finding velocity when $t = 4$
	$\mathbf{v} = \sqrt{12^2 + 16^2} = 20$ **AG**	A1 dM1 A1	 4	A1: Correct velocity dM1:Finding the magnitude A1:Correct speed from correct working
	Total		**8**	
8(a)		B1	1	B1: Correct force diagram
(b)	$R + 20\sin 30° = 6g\cos 10°$ $R = 6g\cos 10° - 20\sin 30°$	M1		M1: Resolving perpendicular to the slope with 3 terms
	$R = 47.9$ N (to 3 sf) **AG**	A1 dM1 A1	 4	A1: Correct equation dM1 Solving for R A1: Correct R from correct working
(c)	$F = \mu R$	M1		M1: Use of F = μ R
	$6 \times 0.4 = 20\cos 30° - 6g\sin 10° - \mu R$	M1 A1		M1: Resolving parallel to slope to get 4 term equation of motion A1: Correct equation
	$\mu R = 4.710$	A1		A1: Correct F / μ R
	$\mu = \frac{4.710}{47.91} = 0.0983$	dM1 A1	 6	dM1: Solving for μ A1: AWRT 0.098
	Total		**11**	
	Total		**75**	