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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics and Statistics 6320
Specification B

MBM1 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
cso		correct solution only
awfw		anything which falls within
awrt		anything which rounds to
acf		any correct form
ag		answer given
sc		special case
oe		or equivalent
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
–*x* ee		deduct *x* marks for each error
pi		possibly implied
sca		substantially correct approach

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

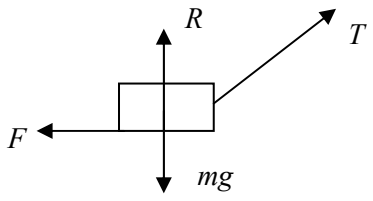
Application of Mark Scheme

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

Mathematics and Statistics B Mechanics 1 MBM1 June 2005

Q	Solution	Marks	Total	Comments
1(a)	$3\times5+2\times(-5)=5v$	M1		Three term conservation of momentum equation
		A1		Correct equation
	$v=\frac{5}{5}=1$ ms^{-1}	A1	3	Correct velocity
(b)	$3\times5+2\times(-5)=2v+3\times0.5$	M1		Four term conservation of momentum equation
		A1		Correct equation
	$v=\frac{3.5}{2}=1.75$ ms^{-1}	m1		Solving for velocity
		A1	4	Correct velocity
	Total		**7**	
2(a)	$0^2=7^2+2(-9.8)s$	M1		Use of constant acceleration equation with $v=0$
	$s=\frac{49}{19.6}=2.5$	A1		Correct s
	Max Height $=5+2.5=7.5$ m	B1	3	**ag** Adding 5 to get total height
(b)	$0=7-9.8t$	M1		Use of constant acceleration equation with $v=0$
	$t=\frac{7}{9.8}=0.714$ s	A1	2	**ag** Correct time from correct working
(c)(i)	$5.5=4.9t^2$	M1		Finding time to fall 5.5 metres
	$t=\sqrt{\frac{5.5}{4.9}}=1.059$	A1		Correct time
		m1		Finding total time
	Total Time $=0.7143+1.059=1.77$ s	A1	4	Correct time
(c)(ii)	$v^2=0^2+2\times9.8\times5.5$	M1		Use of constant acceleration based on catch at the correct height
		A1		Correct equation
	$v=\sqrt{107.8}=10.4$ ms^{-1}	A1	3	Correct speed
	Total		**12**	
3(a)	$T-800\times9.8=800\times0.2$	M1		Three term equation of motion
		A1		Correct equation
	$T=7840+160=8000$ N	A1	3	**ag** Correct tension
(b)	$T-800\times9.8=800\times(-0.2)$	M1		Three term equation of motion
	$T=7840-160=7680$ N	A1	2	Correct tension
(c)	$T=800\times9.8=7840$ N	B1	1	Correct tension
	Total		**6**	

MBM1 (cont)

Q	Solution	Marks	Total	Comments
4(a)	$R = 20\times 9.8 = 196$ N	M1		Finding R and using $F = \mu R$
	$F = 0.15\times 196 = 29.4$ N	A1	2	Correct friction
(b)	$T - 29.4 = 20a$	M1		Equation of motion for A
		A1		Correct equation
	$5\times 9.8 - T = 5a$	M1		Equation of motion for B
		A1		Correct equation
	$49 - (20a + 29.4) = 5a$			
	$a = \frac{19.6}{25} = 0.784$ ms^{-2}	A1	5	**ag** Correct acceleration from correct working
(c)	$T = 20\times 0.784 + 29.4 = 45.1$ N	M1		Substituting a into one equation of motion
		A1	2	Correct tension
(d)	$s = \frac{1}{2}\times 0.784\times 3^2$	M1		Use of constant acceleration equation with $u = 0$
		A1		Correct equation
	$= 3.53$ m	A1	3	Correct distance
	Total		**12**	
5(a)	Area $= 16 + 4 = 20$ cm^2	B1		Correct area of lamina
	$\bar{x} = \frac{16\times 2 + 4\times 6}{20}$	M1		Three term moment equation
		A1		Correct equation
	$= 2.8$ cm	A1	4	**ag** Correct distance from correct working
(b)	$\bar{y} = \frac{16\times 2 + 4\times 3.5}{20}$	M1		Three term moment equation
		A1		Correct equation
	$= 2.3$ cm	A1	3	Correct distance
(c)	$\tan\alpha = \frac{2.3}{2.8}$	M1		Use of tan
		A1		Correct equation
	$\alpha = 39.4°$	A1	3	Correct angle
	Total		**10**	
6(a)		B1	1	Correct force diagram
(b)	$R + T\sin 30° = 200\times 9.8$	M1		Three term equation from resolving vertically
	$R + 0.5T = 1960$	A1		Correct equation
	$R = 1960 - 0.5T$	A1	3	**ag** Correct result from correct working
(c)	$F = T\cos 30°$	M1		Resolving horizontally
	$T\cos 30° = 0.6(1960 - 0.5T)$	M1		Use of $F = \mu R$
	$T(\cos 30° + 0.3) = 1176$	A1		Correct equation
		m1		Solving for T
	$T = \frac{1176}{(\cos 30° + 0.3)} = 1010$ N	A1	5	Correct T
	Total		**9**	

MBM1 (cont)

Q	Solution	Marks	Total	Comments
7(a)	$8 = 10\cos 60° t$	M1		Horizontal equation based on travelling 8 metres
	$t = \dfrac{8}{10\cos 60°} = 1.6$ s	A1 A1	3	Correct equation **ag** Correct time from correct working
(b)	$h = 10\sin 60° \times 1.6 - 4.9 \times 1.6^2$	M1 A1		Expression for height using $t = 1.6$ Correct expression
	$= 1.31$ m	A1	3	Correct height
(c)	$v_x = 10\cos 60° = 5$	B1		Horizontal component of the velocity
	$v_y = 10\sin 60° - 9.8 \times 1.6 = -7.020$	M1 A1		Expression for vertical component of velocity Correct vertical component
	$v = \sqrt{5^2 + 7.020^2} = 8.62$ ms^{-1}	M1 A1	5	Finding the magnitude Correct magnitude
	Total		**11**	
8(a)	$5\mathbf{i} - 2\mathbf{j} = 4\mathbf{i} + 3\mathbf{j} + 10\mathbf{a}$	M1		Use of constant acceleration equation for velocity
	$\mathbf{a} = \dfrac{1}{10}(\mathbf{i} - 5\mathbf{j}) = (0.1\mathbf{i} - 0.5\mathbf{j})$ ms^{-2}	A1 A1	3	Correct equation **ag** Correct acceleration from correct working
(b)	$\mathbf{r} = (4\mathbf{i} + 3\mathbf{j})t + 0.5(0.1\mathbf{i} - 0.5\mathbf{j})t^2$	M1		Use of constant acceleration equation for position
		A1	2	Correct expression
(c)	$\mathbf{r} = (4t + 0.05t^2)\mathbf{i} + (3t - 0.25t^2)\mathbf{j}$	M1		**j** component is zero
	$3t - 0.25t^2 = 0$	A1		Correct equation
	$t(3 - 0.25t) = 0$	m1		Solving for t
	$t = 0$ or $t = \dfrac{3}{0.25} = 12$ s			
	$t = 12$ s	A1	4	Correct time
(d)	$\mathbf{v} = (4 + 0.1t)\mathbf{i} + (3 - 0.5t)\mathbf{j}$	M1		Expression for velocity
	$3 - 0.5t = 0$	A1		Correct velocity
	$t = 6$	m1		**j** component is zero
		A1	4	Correct time
	Total		**13**	
	TOTAL		**80**	