AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics A

Unit MAM2

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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 mark 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
CAO		correct answer only
AWFW		anything which falls within
AWRT		anything which rounds to
AG		answer given
SC		special case
OE		or equivalent
A2,1		2 or 1 (or 0) accuracy marks
– *x* EE		Deduct *x* marks for each error
NMS		No method shown
PI		Perhaps implied
c		Candidate

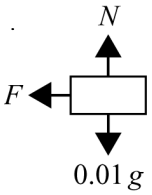
Abbreviations used in marking

MC – *x*	deducted *x* marks for miscopy
MR – *x*	deducted *x* marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	work replaced by candidate

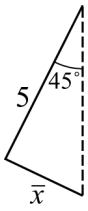
Application of mark scheme

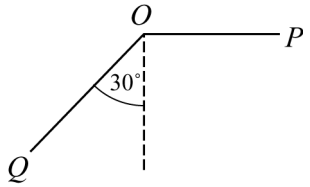
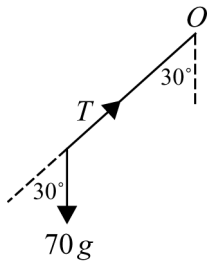
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

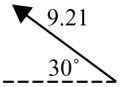
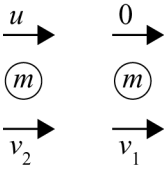
Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Q	Solution	Marks	Total	Comments
1 (a)	Impulse = area	M1		
	$= 2000 \times 5 + \frac{1}{2}(2000) \times 5$	M1		Rectangle or triangle or trapezium area
	$= 15\ 000$ N s	A1	3	AG
(b)	$\lvert$Change in momentum$\rvert$ = impulse	M1		Attempt at $\lvert mv - mu \rvert$ = impulse from (a)
	$1000\ v - 0 = 15000$			
	$v = 15\ \text{m s}^{-1}$	A1	2	Must state units
	Total		**5**	
2 (a)		B1	1	
(b)	$F = mr\omega^2$	M1		Formula quoted and attempt at use
	$= 0.01(0.4)\omega^2$			
	$= 0.004\omega^2$	A1	2	
(c)	$F = \mu N$	M1		Use of limiting fraction
	$= 0.8\ (0.01g)$			
	$= 0.008g$	A1		or 0.0784 seen
	Limiting, so			
	$0.004\omega^2 = 0.008g$	M1		Equates their expressions
	$\omega^2 = 2g$			
	$\omega = 4.43$	A1	4	AG
	Total		**7**	

Q	Solution	Marks	Total	Comments
3 (a)	$\text{EPE} = \frac{1}{2}(50)(0.03)^2$	M1		Use of correct formula
	$= 0.0225$ J	A1	2	
(b)	KE + PE = EPE			
	$\frac{1}{2}mv^2 + mgh = \text{EPE}$	B1		KE or PE term correct
	$\frac{1}{2}(0.02)v^2 + (0.02)(9.8)(0.03) = 0.0225$	M1 A1√		Equation formed Equation correct; ft EPE
	$v \approx 1.29\,\text{m s}^{-1}$	A1	4	AG
(c)	Energy remains constant –			
	No KE at end, no EPE at end			
	$\therefore (0.02)(9.8)\,h = 0.0225$	M1A1		
	$\therefore h = 0.11$ m	A1√	3	ft EPE 2 sig fig accuracy
	i.e.11cm			
	Alternatives to part (c)			
	Energy remains constant			
	KE at point of release = PE on reaching max height			
	$\frac{1}{2}(0.02)(1.29)^2 = (0.02)gh$	(*M1*)		
	$\therefore h = 0.849...$	(*A1*)		
	$\therefore$ height above initial position $= 0.849... + 3$ $= 0.11$m	(*A1*√)		ft their h value + 3
	or Use of $v^2 - u^2 = 2as$	(*M1*) (*A1*)		
	$s = 0.849$ distance = 0.849 + 3 = 0.11	(*A1*√)		ft their (s + 3) total
	Total		**9**	

Q	Solution	Marks	Total	Comments
4 (a)	5cm	B1	1	
(b)	$\Sigma mx = (\Sigma m)\bar{x}$			M1 one side correct
	About PS: $6(m)+6(m)+3(1)=(2m+1)\bar{x}$	M1A1		
	$\bar{x} = \dfrac{12m+3}{2m+1}$	A1	3	AG
(c)				
	$\tan 45^\circ = \dfrac{\bar{x}}{5}$	M1 A1		Principle applied Equation correct – use of part (a)
	$\Rightarrow \dfrac{12m+3}{2m+1} = 5$	A1		Substitute and tan 45º= 1
	$12m + 3 = 10m + 5$	m1		Solving - dependent
	$2m = 2$			
	$m = 1$	A1	5	CAO
	Total		**9**	

Q	Solution	Marks	Total	Comments
5 (a)				
(i)	$At\ P, \text{PE} = 70g\,5\cos 30^\circ \text{KE} = 0$ $At\ Q, KE = \frac{1}{2}(70)v^2\ PE = 0$ Conservation of energy	B1		PE or KE term seen correct (Non zero)
	$\frac{1}{2}(70)v^2 = 70g5\cos 30^\circ$	M1A1		Forming equation
	$v^2 = 10g\cos 30^\circ$			
	$\Rightarrow v \approx 9.21\text{m s}^{-1}$	A1	4	AG
(ii)				
	Force towards $O = T - 70g\ \cos 30^\circ$ For circular motion, $F = ma$	B1		$\pm\left(T - 70g\cos 30^\circ\right) or\ \frac{mv^2}{r}$ evaluated
	$\Rightarrow T - 70g\cos 30^\circ = \frac{mv^2}{r}$	M1A1		Form equation – Res.force = $\frac{mv^2}{r}$
	$\Rightarrow T - 70g\cos 30^\circ = \frac{70(9.21)^2}{5}$			
	$\Rightarrow T \approx 1782.28....$	ml		Dependent – substitute and rearrange
	$\Rightarrow T = 1780\text{N}$	A1	5	AWRT 1780

Q	Solution	Marks	Total	Comments
5 (b)				
		M1		$v^2 - u^2 = 2as$ seen
	Vertically, $u = 9.21\sin 30^o$	A1		Initial vertical velocity component seen $= 9.21\sin 30^o$
	$v = 0$ $a = -9.8$ $s = ?$			
	Using $v^2 - u^2 = 2as$:			
	$\left(\frac{9.21\sin 30^\circ}{2(9.8)}\right) = 5$	M1		Substitute values into $v^2 - u^2 = 2as$
	$s \approx 1.08$ Approx 1 metre	A1	4	Must see 1. ...
(c)	Height of a man significant to length if rope/distances involved.			
	Air resistance would reduce speed/height.	B1	1	Comment that indicates effect of assumption
	Total		**14**	
6				
(a)	Restitution: $v_1 - v_2 = eu$	M1		Attempt at restitution
	Momentum: $mv_1 + mv_2 = mu$	M1		Attempt at momentum
	$v_1 - v_2 = eu$ (1)	A1		Both correct
	$v_1 + v_2 = u$ (2)			
	(1)+(2) $2v_1 = u(1+e)$	M1		
	$v_1 = \frac{u}{2}(1-e)$	A1		AG
	(2)-(1) $2v_2 = u(1-e)$			
	$v_2 = \frac{u}{2}(1-e)$	B1√	6	

Q	Solution	Marks	Total	Comments
6 (b)	Speed $= \frac{2}{3} \times \frac{u}{2}(1+e) = \frac{u}{3}(1+e)$	B1	1	
(c)(i)	$\frac{u}{3}(1+e) = \frac{u}{2}(1-e)$	M1		Equating
	$2 + 2e = 3 - 3e$			
	$5e=1$			
	$e = \frac{1}{5}$	A1	2	Solving or showing
(ii)	Speed$= \frac{2u}{5}$	B1	1	
(d)	B reached wall after $\frac{5d}{3u}$	M1A1√		Attempt to find twice
	In this time A travels $\frac{5d}{3u} \times \frac{2u}{5} = \frac{2d}{3}$	M1A1√		Attempt to find distance
	A and B now have same speed so meet at half remaining distance $= \frac{1}{2}\left(\frac{d}{3}\right)$	M1		Attempt to find remaining distances
	$= \frac{d}{6}$	A1	6	Special case $\frac{5d}{6} \Rightarrow 5$ marks
	Alternative :			
	Ratio of speeds after collision = 1.5 : 1	*(M1A1√)*		
	Ratio of distance after collision = $1:\frac{2}{3}$	*(M1A1√)*		
	Then $d - \frac{2}{3}d$ left $= \frac{d}{3}$	*(M1)*		
	Same speed to meet half way = $\frac{1}{2}\left(\frac{d}{3}\right) = \frac{d}{6}$	*(A1)*		
	Total		**16**	
	Total		**60**	