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	GCE A LEVEL – October/November 2012	9709	52
1 $OG = 0.25 \sin(\pi/2)/(\pi/2)$ $v = 0.159 \times 2.4$ $v = 0.382 \text{ ms}^{-1}$	B1 M1 A1 $\sqrt{\quad}$ [3]	$0.159 (15..)$ $\sqrt{\quad} 2.4 \times cv (OG)$	
2 (i) $6 \times 0.4 \cos 60 = 0.8 P \cos 45$ $P = 2.12 \text{ N}$	M1 A1 A1 [3]	Takes moments about B P is the force at A	
(ii) $F = P \sin 75$ (F is friction force at B) $R = 6 + P \cos 75$ (R is normal reaction at B) $\mu = (2.12 \sin 75)/(6 + 2.12 \cos 75)$ $\mu = 0.313$	B1 B1 M1 A1 [4]	Must use correct angle ($\cos 15$) Must use correct angle ($\sin 15$)	
3 (i) $0.2 \text{ dv/dt} = 0.2g - 0.8v$ $a = (dv/dt) = 10 - 4v$	M1 AG A1 [2]	Use Newton's Second Law, – sign essential	
(ii) $\int 1/(10 - 4v) \text{ dv} = \int dt$ $\frac{-1}{4} \ln(10 - 4v) = t (+c)$ $[c = \frac{-1}{4} \ln 10]$ $\frac{-1}{4} \ln(10 - 4v) = 0.6 - \frac{1}{4} \ln 4$ $v = 2.27$	M1 A1 M1 A1 A1 [5]	Separates variables and attempts to integrate Attempts to find the constant or uses the correct limits	
4 $R \cos 45 - T \cos 45 = mg$ $R \cos 45 = mg + mg \cos 45$ $R \sin 45 + T \sin 45 = m\omega^2 \times 0.67$ $mg + mg \cos 45 + mg \sin 45 = m\omega^2 \times 0.67$ $\omega = 6(.00) \text{ rads}^{-1}$	M1 A1 M1 M1 A1 A1 [6]	Resolves vertically for P May be implied for later work Uses Newton's Second Law horizontally for P Obtaining an equation in m (and g)	

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OR 4 Acceleration = $\omega^2 \times 0.67 \cos 45$ $m\omega^2 \times 0.67 \cos 45 = T + mg \cos 45$ $m\omega^2 \times 0.67 \cos 45 = mg + mg \cos 45$ $\omega = 6(.00) \text{ rads}^{-1}$	M1		Resolves radial acceleration parallel to the slope for P
	A1		May be implied by later work
	M1		Uses Newton's Second Law parallel to the slope for P
	M1		Obtaining an equation in m (and g)
	A1		
5 (i) $v^2 = 17^2 - (30 \cos 60)^2$ $v = -8$	M1		Finds vertical speed
	A1	[2]	– may be implied by later work
(ii) $-8 = 30 \sin 60 - gt$ $t = 3.4$ $y = [(30 \sin 60)^2 - 8^2] / (2g) (= 30.55)$ $OP^2 = (30 \cos 60 \times 3.4)^2 + 30.55^2$ $OP = 59.4 \text{ m}$	M1		Finds relevant time
	A1		3.398
	B1		Or $y = (30 \sin 60) \times 3.4 - g \cdot 3.4^2 / 2 (= 30.53)$
	M1		Use of Pythagoras
	A1	[5]	Accept 59.5
6 (i) Height of triangle = $0.36 / 0.3 (= 1.2 \text{ m})$ Semi-circle C of $M = 2 \times 0.6 / (3\pi/2)$ $0.36 \times (1.2/3) = \pi \times 0.6^2 / 2 \times 2 \times 0.6 / (3\pi/2)$ $0.144 = 0.144$	B1		
	B1		Centre of mass lamina from BOD
	M1		Equating moments idea
	A1	[4]	Evidence of checking equality
OR $0.36 \times (1.2/3) - \pi \times 0.6^2 / 2 \times 2 \times 0.6 / (3\pi/2)$ = distance \times total area Distance = 0	M1		Table of moments idea
	A1		
(ii) 0.36×0.3 = $(0.36 + \pi \cdot 0.6^2 / 2) \times OG$ $OG = 0.117 \text{ m}$	A1		Correct sum of parts
	A1		Correct moment of whole
	A1	[4]	

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<p>7 (i)</p> $45 \times 1^2 / (2 \times 1.5) + 0.6 gh = 45 h^2 / (2 \times 1.5)$ $5h^2 - 2h - 5 = 0$ $h = 1.22 \text{ m}$	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1 [4]</p>	<p>Energy conservation, no KE, 2 EE terms</p> <p>Simplifies, tries to solve a 3 term quadratic equation</p>
<p>(ii)</p> $45e / 1.5 = 45(1 - e) / 1.5 + 6$ $AP = (1.5 + 0.6) = 2.1 \quad \text{AG}$ $0.6 v^2 / 2 = 0.6 g \times 0.6 + 45 (1)^2 / (2 \times 1.5) - 4.5(0.6)^2 / (2 \times 1.5) - 45(0.4)^2 / (2 \times 1.5)$ $v = 6 \text{ ms}^{-1}$	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1 [5]</p>	<p>Finds equilibrium position ($e = 0.6$)</p> <p>Energy conservation with KE/PE/EE terms</p>
<p>(iii)</p> $0.6 a = \pm (0.6g + 45 \times 1 / 1.5)$ $0.6 a = \pm (0.6g - 45 \times 1.22 / 1.5)$ $ a = 60 \text{ ms}^{-2}$	<p>M1*</p> <p>M1*</p> <p>A**1 [3]</p>	<p>Top $a = \pm 60 \text{ ms}^{-2}$</p> <p>Bottom $a = \pm 51 \text{ ms}^{-2}$</p> <p>Needs acceleration at both extreme positions considered.</p>