9709_s14_ms_53

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1	$EE = 5 \times (2.4 - 1.5)^2 / (2 \times 15)$ $5 \times (2.4 - 1.5)^2 /$ $(2 \times 1.5) - 0.1g \times (2.4 - 1.5)$ $= 0.1v^2 / 2$ $v = 3 \text{ ms}^{-1}$	B1 M1 A1	 [3]	EE/KE/PE conservation

2	$12F = 24 \times (2 \times 12/3)\cos(10 + 100/2)$ $F = 8$ AG	M1 A1 A1	 [3]	Moments about vertex attempt

3	(i)	$0.2a = 0.42$ $v = (2.1 \times 1) = 2.1$	M1 A1	 [2]	Newton's Second Law and $v = u + at$
	(ii)	$0.2dv / dt = 0.42 - 0.32t$ $[v]_{2.1}^{v} = [2.1t - 0.8t^2]_1^2$ $v = 1.8$	M1 M1 A1	 [3]	Newton's Second Law with $a = dv / dt$
	(iii)	$v = \int(0.42 - 0.32t + 0.06t^2)dt / 0.2$ $v = [0.42t - 0.16t^2 + 0.02t^3]_0^3 / 0.2$ or $[v]_{1.8}^{v} = [0.42t - 1.16t^2 + 0.02t^3]_2^3 / 0.2$ $v = 1.8$, so no change	M1 M1 A1	 [3]	For attempt to integrate and correct limits seen

4	(i)	$T\cos 60 = 0.2g$ $T = 4N$ $T\sin 60 = 0.2v^2 / (2.4\sin 60)$ $v = 6\text{ms}^{-1}$	M1 A1 M1 A1	 [4]	Resolve vertically for P Newton's Second Law with $a = v^2/r$
	(ii)	$T\sin\theta = 0.2 \times 4^2 \times 1.2\sin\theta$ $T = 3.84$ $3.84\cos\theta = 0.2g$ $\theta = 58.6°$	M1 A1 M1 A1	 [4]	Newton's Second Law with $a = \omega^2 r$ Resolve vertically with new tension

5	(i)	$y = gt^2/2$	B1		Must be positive
		$x = 5t$	M1		
		$y\left[=10(x/5)^2)/2\right]=0.2x^2$	A1	[3]	
	(ii)	$x^2 + y^2 = 18^2$	M1*		
		$x^2 + (0.2x^2)^2 = 18^2$	D*M1		Sets up and tries to solve a 3 term quadratic equation
		$0.04(x^2)^2 + x^2 - 324 = 0$			
		$x = 8.85$	A1		$8.8523...$ from $x^2 = 78.3639...$
		$y = 0.2 \times 8.8523...^2$	B1		y = 15.67…
		$v^2 = 5^2 + 2g \times 15.67...$	M1		
		$v = 18.4\,\mathrm{ms}^{-1}$	A1	[6]	
		OR			
		$V^2 = 2g \times 0.2 \times 8.8523...^2$	B1		$V = 17.7046$
		$v^2 = 5^2 + 17.7...^2$	M1		
		$v = 18.4\ \mathrm{ms}^{-1}$	A1		
		OR			
		$t = 8.85/5 = 1.77, V = 10 \times 1.77 = 17.7$	B1		
		$v^2 = 17.7^2 + 5^2$	M1		
		$V = 18.4\,\mathrm{ms}^{-1}$	A1		

6	(i)	$T = 9 \times (0.4/\sin\theta)/1.5$	B1		Must use the general angle θ
		$R = 0.6g - T\sin\theta$	M1		
		$R = 3.6N$ AG	A1	[3]	
	(ii)	$\mathrm{Ext}(A) = 0.4/\sin 30, \mathrm{ext}(B) = 0.4$	B1		
		$\mathrm{EE\ change} = 9 \times (0.8^2 - 0.4^2)/(2\times1.5)$	B1		Uses EE in two positions. EE=1.44
		$\mathrm{WD} = 1.44 - 0.6 \times (3^2 - 2.5^2)/2$	M1		
		$\mathrm{WD} = 0.615J$	A1	[4]	
	(iii)	$\mu = 0.615/(0.4/\tan 30)/3.6$	M1		
		$\mu = 0.247$	A1	[2]	Accept 0.246 without wrong working

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7	(i)	OG (handle) $= 0.3\sin(\pi/2)/(\pi/2)$ $(8+14)d = 14 \times 0.15 - 8 \times 0.6/\pi$ $d = 0.026(0)\text{m}$	B1 M1 A1	 [3]	$0.6/\pi,\ 0.19098...$
	(ii)	$(8=14)x = 8 \times 0.191$ $x = 0.0694545...$ $(8+14)y = 14 \times 0.15$ $y = 0.0954545...$ Distance $= 0.118$ AG	M1 A1 M1 A1 A1	 [5]	Horizontal distance from bowl axis Vertical distance from bowl rim Distance$^2 = 0.06945^2 + 0.095454^2$
	(iii)	$\tan\theta = 0.0694545/0.0954545$ or $\sin\theta = 0.0694545/0.118$ or $\cos\theta = 0.094545/0.118$ $\theta = 36(.0)°$	M1 A1	 [2]	Any trig ratio correctly using the two answers in (ii) Accept 36.1, 35.9

Alternative for 7(ii), 7(iii) (diagram below)

7	(ii)	$\tan H = 0.15/0.19098$ $HG = \dfrac{14}{22} \times \sqrt{(0.15^2 + 0.19098^2)}$ $OG^2 = 0.19098^2 + 0.15454^2 -$ $2 \times 0.19098 \times 0.15454 \cos 38.147$ Distance $= 0.118$ AG	M1 A1 M1 A1 A1	 [5]	H = 38.147° 0.15454 m Cosine rule on triangle OHG
	(iii)	$\sin HOG = 0.15454 \sin 38.147/0.118$ Angle $(= 90 - HOG) = 35.9$	M1 A1	 [2]	54.06° Accept 36(.0), 36.1

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