1	**(i)**	$9 \times 0.4 = 0.6 \times T\sin 30$	M1		Moments about A
		$T = 12N$	A1	[2]	
	(ii)		M1		For resolving horizontally and vertically
		$\mu = (9 - 12\sin 30)/(12\cos 30)$	M1		For using $F = \mu R$
		$\mu = 0.289$	A1	[3]	
2	**(i)**	$x = (v\cos 60)0.6$ and $y = (v\sin 60)0.6 - g0.6^2/2$	M1		Finds both coordinates in terms of t = 0.6
			DM1		Relates coordinates and 45º angle
		$\tan 45 = [(v\sin 60)0.6 - g0.6^2/2]/[(v\cos 60)0.6]$	A1		$(v\sin 60)0.6 - g0.6^2/2 = (v\cos 60)0.6$
		$v = 8.2(0)\ ms^{-1}$ AG	A1	[4]	
	(ii)		M1		Relates velocity components and 45º
		$8.2\sin 60 - gt = 8.2\cos 60$	A1		$\tan 45 = (8.2\sin 60 - gt)/(8.2\cos 60)$
		$T = 0.3(00)$ s	A1	[3]	
3	**(i)**	$0.25g = 20e/0.4$	M1		Uses $T = \lambda x/L$
		$OP\ (= 0.05 + 0.4) = 0.45$ m	A1	[2]	
	(ii)	$20 \times 0.05^2/(2 \times 0.4) + 0.25v^2/2 = 0.25g \times 0.45$	M1 A1		
		$v = 2.92\ ms^{-1}$	A1	[3]	
	(iii)	$20(d - 0.4)^2/(2 \times 0.4) = 0.25gd$	M1		Hence $d^2 - (0.8 + 0.1)d + 0.16 = 0$
		$d = [0.9 \pm \sqrt{(0.9^2 - 4 \times 0.16)}]/2$	M1		Solves a 3 term quadratic equation
		$d = 0.656$	A1	[3]	Ignore d = 0.244 if seen
4	**(i)**	$\tan\theta = 0.7/(2.4/4)$	M1		
		$\theta = 49.4º$	A1	[2]	
	(ii)	$h/2 = 2.4/4$	M1		
		$h = 1.2$	A1	[2]	

	(iii)		M1	Table of values idea, accept w = 1
		$4wVG = w \times 2.4 \times 3/4 + 3w(2.4 + h/2)$	A1	
			M1	Centre of mass above common circumference
		$VG = [\sqrt{(0.7^2 + 2.4^2)}]/\cos\alpha$	A1	$\cos\alpha = 2.4/2.5 = 0.96$
		$h = 0.944$	A1 [5]	
5	**(i)**	$0.05dv/dt = 0.05g – 0.01v$	M1	Uses Newton's Second Law
		$dv/dt = 10 – 0.2v$ AG	A1	
		$\int dv/(10 – 0.2v) = \int dt$	M1	
		$–\ln(10 – 0.2v)/0.2 = t (+ c)$	A1	
		$t = 0, v = 0$, hence $c = –5\ln10$	M1	–4.60517…
		$\ln(10 – 0.2v)/10 = 0.2t$, $1 – 0.02v = e^{–0.2t}$ $v = 50 – 50e^{–0.2t}$	A1 [6]	
	(ii)	$dx/dt = 50 – 50e^{–0.2t}$		
		$x = \int (50 – 50e^{–0.2t})dt$	M1	
		$x = 50t + 50e^{–0.2t}/0.2 (+c)$	A1	
		$h = [50t + 50e^{–0.2t}/0.2]_2^0$	M1	Or uses h = 0, t = 0 to evaluate c = (–250) and then finds h(2)
		$h = 17.6$	A1 [4]	
6	**(i)**	$\theta = \sin^{-1}(0.2/0.7) = 16.6^\circ$ with the vertical	B1	73.4º with the horizontal
		$T\cos\theta = 0.3g$	M1	T = 3.13 Resolves vertically
		$T + T\sin\theta = 0.3\omega^2 \times 0.2$	M1	Uses Newton's Second Law radially
		$\omega = 8.19$	A1	
		KE ($= 0.3 \times (8.19 \times 0.2)^2/2$) = 0.402 J	A1 [5]	Accept 0.403 J

(ii)	$(0.9 - AB)/AB = ½$	M1	$\alpha = \tan^{-1}0.5 = 26.565°$ or $BC/(0.9–BC) = ½$
	$AB = 0.6$ m	A1	$BC = 0.3$ m
	$T\cos\alpha - T\sin\alpha = 0.3g$	M1	Resolves vertically
	$T = 6.71$	A1	
	$T\cos\alpha + T\sin\alpha = 0.3\omega^2 \times 0.6\sin\alpha$	M1	$0.3\omega^2 \times 0.3\cos\alpha$ Uses Newton's Second Law radially
	$\omega = 10.6$	A1 [6]	