1		$0.6 = 1.2\,\omega$	M1		Uses $v = r\,\omega$
		$\omega = 0.5\,\text{rads}^{-1}$	A1	[2]	**[2]**
2	**(i)**	$(9 + 11)OG =$ $+/-[9 \times 0.7/(\pi/2) - 11 \times (2 \times 0.7)/3\pi/2)]$	M1 A1		Table of value idea with signs either way round.
		$OG = 0.0371\,\text{m}$ AG	A1	[3]	Accept –ve answer
	(ii)	$\tan\theta = 0.0371(36..)/0.7$	M1		
		$\theta = 3.0°$	A1		
		Lamina	B1	[3]	**[6]**
3	**(i)**	$F + F\cos 60 = mg$	M1		Resolves vertically for S
		$F = 10m/1.5$	A1		May be implied by later work
		$F\sin 60 = mv^2/0.6$	M1		$10m/1.5 = mv^2/0.6$
		$v = 1.86\,\text{ms}^{-1}$	A1	[4]	
	(ii)	$F\cos 60 = 10m$	B1		May be implied by later work
		$F\sin 60 = m\omega^2/0.6$	M1		
		$\omega = 5.37\,\text{rads}^{-1}$	A1	[3]	**[7]**
4	**(i)**	$\text{EE} = 21(\sqrt{1.2^2 + 1.6^2} - 1.2)^2/(2 \times 1.2)$	B1		Use of EE formula (= 5.6 J)
		$m12^2/2 = mg \times 1.6 +$ $2 \times 21(\sqrt{1.2^2 + 1.6^2} - 1.2)^2/(2 \times 1.2)$	M1 A1		KE/EE/PE conservation
		$m = 0.2$	A1	[4]	
	(ii)	$T = 21(\sqrt{1.2^2 + 0.5^2} - 1.2)/1.2$	B1		
		$ma = 2 \times 21(\sqrt{1.2^2 + 0.5^2} - 1.2)/1.2 \times \frac{0.5}{1.3}$ $- mg$	M1 A1		Newton's Second Law with component of T or reversed signs
		$a = (-)3.27\,\text{ms}^{-2}$	A1	[4]	**[8]**

5	**(i)**	$0.4v\mathrm{d}v/\mathrm{d}x = 0.4g\sin 30 - 0.6x$	B1	Newton's Second Law, – sign essential
		$\int v\mathrm{d}v = \int(5 - 1.5x)\mathrm{d}x$	M1	Accept uncancelled integration
		$v^2/2 = 5x - 1.5x^2/2$ (+ c)	A1	Accept omission of c
		$0.4g\sin 30 - 0.6x = 0$	M1	Maximum speed when acceleration = 0
		$x = 3\frac{1}{3}$	A1	Accept 10/3
		$v^2/2 = 5 \times 10/3 - 1.5 \times (10/3)^2/2$	M1	
		$v = 4.08\,\mathrm{ms}^{-1}$	A1 [7]	
	(ii)	$0 = 5x - 1.5x^2/2$	M1	Uses $v = 0$ appropriately
		$x = 6\frac{2}{3} = 6.67$	A1 [2]	Not 20/3 **[9]**
6	**(i)**		M1	Table of moments idea
		$1.5 \times 0.4 \times 0.2 + 1 \times 1 \times 0.9$ $= (1 \times 1 + 1.5 \times 0.4)d$ or $0.5 \times 0.4 \times 0.2 + 1 \times 1.4 \times 0.7$ $= (0.5 \times 0.4 + 1 \times 1.4)d$ or $1.5 \times 1.4 \times 0.7 - 1 \times 0.5 \times 0.9$ $= (1.5 \times 1.4 - 1 \times 0.5)d$	A1	Uses area or any weight/m^2 value
		$d = 0.6375$	A1 [3]	Accept 0.637 or 0.638
	(ii)	$F \times 1.5 = 120 \times 0.6375$	M1	Moments about O
		$F = 51$	A1	
		$F \times 1.5 = 120 \times (0.6375 - 0.4)$	M1	
		$F = 19$	A1	
		$51 > F > 19$	M1 A1√ [6]	Candidates consider both cases √ [cv(two values of F)] accept > **[9]**

7	**(i)**	$x = (15\cos 41)t$	B1		
		$y = (15\sin 41)t - gt^2/2$	B1		
		$y = (15\sin 41)x/(15\cos 41) - 5\,[x/(15\cos 41)]^2$	M1		
		$y = 0.869x - 0.0390x^2$	A1	[4]	$y = 0.86928..x - 0.03901..x^2$
	(ii)	$H = 0.869 \times 1.5 - 0.039 \times 1.5^2 + 1.6$	M1		Must add height of O
		$H = 2.82\,\text{m}$	A1		
		$0.039x^2 - 0.869x - 1.6 = 0$	M1		Uses $y = -1.6$ and tries to solve
		$D = 23.99 - 1.5$	DM1		Solve a 3 term quadratic equation and minus 1.5
		$D = 22.5\,\text{m}$	A1	[5]	Accept 22.4 **[9]**