1	$17\sin 50 - 2g$	B1		Vertical component of velocity
	$v^2 = (17\sin 50 - 2g)^2 + (17\cos 50)^2$	M1		Pythagoras with 2 perpendicular components
	$v = 13(.0)\ \text{ms}^{-1}$	A1	[3]	
2	**(i)** 0.212	B1	[1]	From (0.6/2)cos45
	(ii) **(a)** $0.3\cos 45 \times (2 \times 7) = (2 \times 06\sin 45) \times F$	M1		Moments about A
	$F = 3.5$	A1	[2]	
	(ii) **(b)** $0.3\cos 45 \times (2 \times 7) = 0.6F$	M1		Or Ans **(i)**/cos45
	$F = 4.95$	A1	[2]	
3	**(i)** $x = (25\cos 45)t$	B1		
	$y = (25\sin 45)t - gt^2/2$	B1		
	$y = x(25\sin 45)/(25\cos 45) - g[x/(25\cos 45)^2]/2$	M1		Eliminates t between 2 simultaneous equations
	$y = x - 0.016x^2$	A1	[4]	
	(ii) $2.4 = x - 0.016x^2$	M1		Creates and attempts to solve a quadratic equation ($x = 2.5, 60$)
	Distance = 57.5 m	A1	[2]	
4	**(i)** $0.4\delta v/\delta t = 0.2v^2$	M1		Newton's Second Law with $a = \delta v/\delta t$
	$\int v^{-2}\delta v = -0.5\int \delta t$	A1		
	$-v^{-1} = -0.5t\ (+c)$			
	$t = 0$, $v = 8$, hence $c = -0.125$	M1		
	$v = 1/(0.125 + 0.5t) = 8/(1 + 4t)$ *AG*	A1	[4]	
	(ii) $\delta x/\delta t = 8/(1 + 4t)$	M1*		
	$x = 8\int \delta t / (1 + 4t)$			
	$x = \frac{8}{4}\ln(1 + 4t)\ (+c)$	A1		Accept $c = 0$ assumed
	$t = 1.5$, $x = \frac{8}{4}*\ln(1 + 4 \times 1.5)$	D* M1		Or limits used $\frac{8}{4}[\ln(1 + 4t)]_0^{1.5}$
	$OP = 3.89$ m	A1		4

5	**(i)**	$0.2\omega^2 \times 1.2 = 6$	M1		Uses radial acceleration on R, 1 force
		$\omega = 5$	A1	[2]	
	(ii)	$m\omega^2 \times 2 \times 0.4 = 10 - 6$	M1 A1		Uses radial acceleration on Q, 2 forces
		$m = 0.2$ kg	A1	[3]	
	(iii)	$0.2 \times (5 \times 1.2)^2/2 = M(5 \times 0.4)^2/2$	M1		
		$M = 1.8$ kg	A1		
		$1.8 \times 5^2 \times 0.4 = T - 10$	DM1		
		$T = 28$ N	A1	[4]	
6	**(i)**		M1		Table of moments idea
		$\pi 0.6^2 \times 0.6 \times 0.3 - 2\pi 0.6^3/3 \times 3 \times 0.6/8$	A1		Correct elements
		$= (\pi 0.6^3 + 2\pi 0.6^3/3)d$	A1		Correct composite
		$d = 0.09$ m	A1	[4]	
	(ii)		M1		Table of moments idea (about O)
			A1		Correct elements
		$\frac{2}{3}\pi 0.6^3 \times \frac{3}{8} \times 0.6 - \pi \times 0.6^3 \times 0.3$ $+ 0.48A \times 0.36 = 0$	A1		
		$A = 3\pi/16$ m^2	A1	[4]	
		OR	M1		Table of moments idea (about O)
			A1		Correct elements
		$[\frac{2}{3}\pi \times 0.6^3 + \pi \times 0.6^3] \times 0.09 = 0.48A \times 0.36$	A1		
		$A = 3\pi/16$	A1		
	(iii)	Increase in length [$= 2 \times (0.6 - 0.48)$] $= 0.24$m	B1	[1]	Remove cylinder with centre of mass at O

7	**(i)**	$0.8g\sin30 = 20e/0.4$	M1	
		$e = 0.08$ m	A1 [2]	
	(ii)		M1	Conservation of KE, PE, EE
		$0.8v^2/2 + 20 \times 0.08^2/(2 \times 0.4)$	A1	Correct start terms, signs accurate
		$= 0.8g(0.4 + 0.08)\sin30$	A1	Correct final term, sign accurate
		$v = 2.1(0)$ ms^{-1}	A1 [4]	
	(iii)		M1*	
		$0.8gd\sin30 = 20(d - 0.4)^2/(2 \times 0.4)$	A1	$4d = 25(d - 0.4)^2$
		$25d^2 - 24d + 4 = 0$	D* M1	Obtains and solves a 3 term quadratic equation.
		$d = 0.745$ m	A1 [4]	