1	$0.05 \times 9^2 \times 0.4 = H$	M1	
	$H = 1.62$ N	A1	
	$R = 1.70$ N	A1 [3]	$\sqrt{1.62^2 + 0.5^2}$
2	$OG = 0.8\sin(\pi/3)/(\pi/3)$	B1	0.66159
	$OM = 0.8\cos(\pi/3)$	B1	0.4
		M1	For taking moments about O
	$0.65(m + 1.4) = 0.4m + 0.66159 \times 1.4$	A1	
	$0.25m = 0.01159 \times 1.4$	M1	For collecting like terms
	$m = 0.0649$	A1	
OR	$OG = 0.8\sin(\pi/3)/(\pi/3)$	B1	0.66159
	$OM = 0.8\cos(\pi/3)$	B1	0.4
		M1	Taking moments about M
	$(1.4 + m) \times 0.25 = 1.4 \times 0.26159$	A1	
	$0.25m = 1.4 \times 0.01159$	M1	For collecting like terms
	$m = 0.0649$	A1 [6]	
3	**(i)** $0.6 \times 1.5^2/(0.2\cos30°) = T\cos30°$	M1	Uses N2L horizontally with component of tension
	$T = 9$ N	A1	
	$R = 0.6g - 9\sin30°$	M1	Resolves vertically, 3 terms
	$R = 1.5$ N	A1 [4]	
	(ii) $T\sin30° = 0.6g$	M1	Resolves vertically, 2 terms
	$0.6v^2/(0.2\cos30°) = 12\cos30°$	M1	
	$v^2 = 3$, $v = 1.73$	A1 [3]	

4	**(i)** T x 0.8 = 70x1sinα + 220x2sinα	M1	Moments about A (3 terms)
	sinα = 1.5/1.7	A1	cosα = 0.8/1.7 α = 61.9°
	T = 562.5 N	A1 [3]	
	(ii) H = 562.5cosα = 265 N	B1	H = 264.70 N
	V = 562.5sinα – 70 – 220	M1	V = 206.3 N
	tanα = 265/206.3	M1	
	α = 52.1° (with vertical)	A1	Or 37.9 (with horizontal)
OR	X = (70+220)cosα = 136.6	B1	Resolving along the rod AB
	Y = 562.5 – (70+220)sinα = 306.7	M1	Resolving perpendicular to AB
	tanθ = 306.7/136.6	M1	
	θ = 65.99° or 66.0° (with beam)	A1 [4]	
5	**(i)** 2Tcosθ = 0.28g	M1	Tension component = weight
	2T x 0.7/2.5 = 2.8, T = 5	A1	
	5 = λ x 0.5/2	M1	Hookes Law
	λ = 20 N	A1 [4]	
	(ii) $0.28v^2/2 + 2x20x0.5^2/(2x2) = 0.28gx0.7 + 2x20x0.4^2/(2x2)$	M1 A1	PE/EE/KE conservation with 4 terms
	v = 2.75 ms^{-1}	A1 [3]	

6	**(i)** $81a = 135 - 9v$	M1	
	$\frac{9}{15-v}\,dv/dt = 1$ AG	A1 [2]	
	(ii) $\int \frac{1}{15-v}\,dv = \int \frac{1}{9}\,dt$	M1	
	$-\ln(15 - v) = t/9 (+ c)$	A1	
	$t = 0, v = 0$, hence $c = -\ln 15$	M1	
	$\ln(\frac{15}{15-v}) = t/9$ $15e^{-t/9} = 15 - v$ $v = 15(1 - e^{-t/9})$ AG	A1 [4]	
	(iii) $x = \int 15(1 - e^{-t/9})dt$	M1	
	$x = 15t + 15e^{-t/9}/(1/9) (+ c)$	A1	
	$t = 0, x=0$, hence $c = -135$ $x(9) = 15x9 + 15x9e^{-9/9} - 135$	M1	
	$x(9) = 49.7$ m	A1 [4]	
7	**(i)** $x = (10\cos45°)t$ and $y = (10\sin45°)t - gt^2/2$	B1	
	$y = (10\sin45° / 10\cos45°)x - 10(x/10\cos45°)^2/2$	M1	
	$y = x - x^2/10$	A1 [3]	
	(ii) $y/x = \tan30°$	M1	
	$1 - x/10 = \tan30°$	A1	
	$x = 4.23$	A1 [3]	4.2264…
	(iii) $dy/dx = 1 - 2x/10$	M1	$4.2264 = (10\cos45°)t$
	$\tan\theta = dy/dx$	B1	$t = 0.5977$
	$\tan\theta = 1 - 2x4.23/10 (= 0.15472..)$	M1	$\tan\theta = \frac{10\sin45° - 10x0.5977}{10\cos45°}$
	$\theta = 8.79°$	A1 [4]	