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1	$0.05 \times 9^2 \times 0.4 = H$	M1	
	$H = 1.62 \text{ N}$	A1	
	$R = 1.70 \text{ N}$	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) $0.6 \times 1.5^2 / (0.2\cos 30^\circ) = T\cos 30^\circ$	M1	Uses N2L horizontally with component of tension
	$T = 9 \text{ N}$	A1	
	$R = 0.6g - 9\sin 30^\circ$	M1	Resolves vertically, 3 terms
	$R = 1.5 \text{ N}$	A1 [4]	
	(ii) $T\sin 30^\circ = 0.6g$	M1	Resolves vertically, 2 terms
	$0.6v^2 / (0.2\cos 30^\circ) = 12\cos 30^\circ$	M1	
	$v^2 = 3, v = 1.73$	A1 [3]	

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4	(i) $T \times 0.8 = 70 \times 1 \sin \alpha + 220 \times 2 \sin \alpha$	M1	Moments about A (3 terms)
	$\sin \alpha = 1.5/1.7$	A1	$\cos \alpha = 0.8/1.7 \quad \alpha = 61.9^\circ$
	$T = 562.5 \text{ N}$	A1 [3]	
	(ii) $H = 562.5 \cos \alpha = 265 \text{ N}$	B1	$H = 264.70 \text{ N}$
	$V = 562.5 \sin \alpha - 70 - 220$	M1	$V = 206.3 \text{ N}$
	$\tan \alpha = 265/206.3$	M1	
	$\alpha = 52.1^\circ$ (with vertical)	A1	Or 37.9 (with horizontal)
OR	$X = (70+220) \cos \alpha = 136.6$	B1	Resolving along the rod AB
	$Y = 562.5 - (70+220) \sin \alpha = 306.7$	M1	Resolving perpendicular to AB
	$\tan \theta = 306.7/136.6$	M1	
	$\theta = 65.99^\circ$ or 66.0° (with beam)	A1 [4]	
5	(i) $2T \cos \theta = 0.28g$	M1	Tension component = weight
	$2T \times 0.7/2.5 = 2.8, T = 5$	A1	
	$5 = \lambda \times 0.5/2$	M1	Hooke's Law
	$\lambda = 20 \text{ N}$	A1 [4]	
	(ii) $0.28v^2/2 + 2 \times 20 \times 0.5^2 / (2 \times 2) = 0.28g \times 0.7 + 2 \times 20 \times 0.4^2 / (2 \times 2)$	M1 A1	PE/EE/KE conservation with 4 terms
	$v = 2.75 \text{ ms}^{-1}$	A1 [3]	

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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	
	$\ln\left(\frac{15}{15-v}\right) = t/9$ $15e^{-t/9} = 15 - v$ $v = 15(1 - e^{-t/9})$ 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 $c = -135$ $x(9) = 15 \times 9 + 15 \times 9e^{-9/9} - 135$	M1	
	$x(9) = 49.7 \text{ m}$	A1 [4]	
7	(i) $x = (10\cos 45^\circ)t$ and $y = (10\sin 45^\circ)t - gt^2/2$	B1	
	$y = (10\sin 45^\circ / 10\cos 45^\circ)x - 10(x/10\cos 45^\circ)^2/2$	M1	
	$y = x - x^2/10$	A1 [3]	
	(ii) $y/x = \tan 30^\circ$	M1	
	$1 - x/10 = \tan 30^\circ$	A1	
	$x = 4.23$	A1 [3]	4.2264...
	(iii) $dy/dx = 1 - 2x/10$	M1	4.2264 = $(10\cos 45^\circ)t$
	$\tan \theta = dy/dx$	B1	$t = 0.5977$
	$\tan \theta = 1 - 2 \times 4.23/10 (= 0.15472\dots)$	M1	$\tan \theta = \frac{10 \sin 45^\circ - 10 \times 0.5977}{10 \cos 45^\circ}$
	$\theta = 8.79^\circ$	A1 [4]	