1	**(i)** 2mx0.45 + mx0.3 = 3mv	M1	Table of values idea
	v = 0.4m (from AB)	A1	
	2mx0.45 + mx(0.9+0.3) = 3mh	M1	Table of values idea
	h = 0.7m (from AD)	A1 [4]	
	(ii) $\tan\alpha$ = 0.4/0.7	M1	
	α = 29.7°	A1ft [2]	Accept 0.519 radians
2	**(i)** $\tan\alpha$ = 5/(26cos30°)	M1	
	α = 12.5° (0.219rad) below the horizontal	A1	Accept 77.5°/1.35rad with downward vertical
	$5^2 = (26\sin30°)^2 - 2gs$	M1	
	s = 7.2m	A1 [4]	
	(ii) –(26sin30°) = (26sin30°) – gT	M1	Or time to greatest height if later doubled
	T = 2.6s	A1	
	OA = (26cos30°) × 2.6 = 58.5m	A1 [3]	Or B1 for OA = $26^2\sin(2 \times 30°)/10$ = 58.5
3	**(i)** T_{PQ} = (0.4g) = 4N	B1	
	$T_{BQ} = 0.4 \times 5^2 \times 0.3$	M1	Uses $F = m\omega^2 r$
	T_{BQ} = 3N	A1 [3]	
	(ii) $T\cos\alpha$ = 0.8g + 4	M1	Attempts to find either component of T
	$T\sin\alpha$ = 0.8x5^2x0.3	A1	Both components correct
	$T^2 = 12^2 + 6^2$	M1	Or any equivalent method to find T
	T_{AP} = 13.4N (= $6\sqrt{5}$ N)	A1	
	$\alpha°$ = $\tan^{-1}$ (6/12) = $\tan^{-1}$ (1/2) = 26.6°	B1ft	
OR	$T\cos\alpha$ = 0.8g + 4	M1	Attempts to find either component of T
	$T\sin\alpha$ = 0.8x5^2x0.3	A1	Both components correct
	$\tan\alpha$ = 6/12	M1	
	α = 26.6	A1	
	T_{AP} = 13.4N	B1ft [5]	

4	**(i)**	M1	Moments about A
	Fx1.2sin60° = 15 × 0.6cos60°	A1	
	F = 4.33N AG	A1 [3]	
	(ii) Fcos30° + Fr = 15cos60°	M1	Resolving parallel to the plane
	Fr = 3.75N	A1	
OR	15 × 0.6cos60° = 1.2Fr	M1	Moments about B
	Fr = 3.75N	A1	
OR	Fcos30° × 0.6 = Fr x 0.6	M1	Moments about centre of rod
	Fr = 3.75N	A1 [2]	
	(iii) R = 15cos30° + 4.33cos60°	M1	
	R = 15.2	A1	R = 15.155… Accept 15.1
	μ (= 3.75/15.2) = 0.247	B1ft [3]	From their F and R found but not R=W
5	**(i)** T = λ ($\sqrt{1.2^2 + 0.5^2}$ – 1)/1	B1	T = 0.3 λ or T = 0.3x26
	2xTx0.5/1.3 = 6	B1	
	T = 0.3 λ = 7.8	M1	
	λ = 26 AG	A1 [4]	
	(ii) $EE_1 = 2x26x0.3^2/2x1$	M1	(= 2.34) Use of EPE formula, either
	$EE_2 = 2x26(\sqrt{1.2^2 + 0.9^2} - 1)^2/2x1$	A1	(= 6.5) Both expressions correct
		M1	Conservation of energy (including KE/GPE/EPE)
	$0.6v^2/2 + 0.6x10x(0.9 – 0.5) = 6.5 – 2.34$	A1	
	V = 2.42ms^{-1}	A1 [5]	

6	**(i)**	M1	N2L with 3 force terms
	$0.2dv/dt = -0.5v - 0.2g\sin30° - 0.2g\cos30°/(2\sqrt{3})$	A1	$dv/dt = -2.5v - 5 - (5\sqrt{3})/(2\sqrt{3})$
	$dv/dt = -2.5(3 + v)$ AG	A1 [3]	
	(ii) $\int dv/(3 + v) = -2.5 \int dt$	M1	Separates variables and integrates
	$\ln(3 + v) = -2.5t (+ c)$	A1	
	$t = 0$, $v = 2$, hence $c = \ln5$		Or equivalent use of limits
	$\ln3 = 2.5T + \ln5$	M1	$[\ln(3 + v)]_2^0 = [-2.5]_0^T$
	$T = 0.204$	A1 [4]	$T = 0.4\ln(5/3)$
	(iii) $0.2dv/dt = 0.2g\sin30° - 0.2g\cos30°/(2\sqrt{3}) - 0.5v$	M1	$dv/dt = 5 - 2.5v - (5\sqrt{3})/(2\sqrt{3})$
	$\int dv/(1 - v) = 2.5 \int dt$	A1	
	$-\ln(1 - v) = 2.5t (+ c)$		
	$t = 0$, $v = 0$, hence $c = 0$	B1	Or equivalent
	$-\ln(1 - v) = 2.5x0.4\ln(5/3)$	M1	Uses $t = T$
	$v = 0.4ms^{-1}$	A1 [5]	