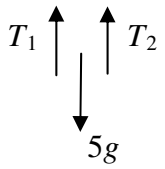
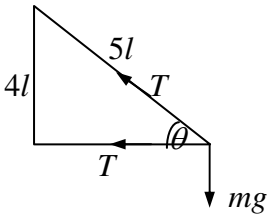
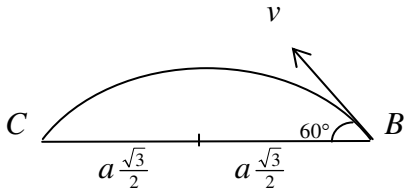
Question Number	Scheme	Marks
1.	 $T_1 = \dfrac{175\times 0.2}{1}$	B1
	$\dfrac{175\times 0.2}{1} + \dfrac{\lambda\times 0.3}{0.9} = 49$	M1 A 1
	$\Rightarrow \lambda = 42$	M1 A1 (5)
		(5 marks)
2. (*a*)	 3, 4, 5 Δ	B1
	R($\uparrow$) $T\sin\theta = mg$	M1
	$T = \dfrac{5mg}{4}$	A1 (3)
(*b*)	R ($\leftarrow$) $T + T\cos\theta = \dfrac{mv^2}{3l}$	M1 A2
	$\dfrac{8}{5}\times\dfrac{5mg}{4} = \dfrac{mv^2}{3l}$	M1
	$v = \sqrt{6gl}$	A1 (5)
(*c*)	Could not assume tensions same	B1 (1)
		(9 marks)
3. (*a*)	Cylinder: $\pi r^2 h\rho$; half-sphere: $\frac{2}{3}\pi r^3 6\rho$; toy: $\pi r^2 h\rho + \frac{2}{3}\pi r^3 6\rho$	M1 A1
	$\dfrac{h}{2} + r$; $\dfrac{5r}{8}$; d	B1 B1
	$\pi r^2 h\rho(\dfrac{h}{2} + r) + 4\pi r^3\rho\dfrac{5r}{8} = (\pi r^2 h\rho + 4\pi r^3\rho)d$	M1 A1
	$\Rightarrow d = \dfrac{h^2 + 2rh + 5r^2}{2(h+4r)}$ (*)	A1 (7)
(*b*)	$d = r, \Rightarrow$ $h^2 + 2rh + 5r^2 = 2r(h + 4r)$	M1, M1
	$h = \sqrt{3}r$	A1 (3)
		(10 marks)

https://xtremepape.rs/

Question Number	Scheme	Marks
4. (*a*)	$\frac{2\pi}{\omega} = \pi \Rightarrow \omega = 2$	B1
	$2.4^2 = 4\,(a^2 - 0.5^2)$	M1 A1ft
	$a = 1.3$ m	A1 (4)
(*b*)	$v_{max} = a\omega = 2.6$ m s^{-1}	B1 (1)
(*c*)	$\text{arct}_{max} = a\omega^2 = 5.2$ m s^{-2}	B1ft (1)
(*d*)	$0.5 = 1.3 \sin 2t$	M1
	$t = \frac{1}{2} \sin^{-1}\left(\frac{0.5}{1.3}\right)$	M1 A1
	$\therefore$ Total time $= 4t = 0.79$ (2 dp)	M1 A1 (5)
		(11 marks)
5. (*a*)	$800 \frac{dv}{dt} = \frac{48000}{(t+2)^2}$	M1
	$v = 60 \int \frac{dt}{(t+2)^2} = \frac{-60}{(t+2)} (+c)$	M1 A1
	$t = 0, v = 0 \Rightarrow c = 30$	M1 A1
	$v = 30 - \frac{60}{(t+2)} \Rightarrow v \to 30$ as $t \to \infty$	A1 (6)
(*b*)	$s = \int v\,dt = 30t - 60 \ln (t+2) (+c)$	M1 A1
	substitute in $t = 0$ and $t = 6$	M1
	$s = 180 - 60 \ln 8, - -60 \ln 2$	A1, A1
	≈ 96.8 m	A1 (6)
		(12 marks)

https://xtremepape.rs/

Question Number		Scheme	Marks
6.	(*a*)	$\frac{1}{2} \times \frac{58.8}{4} x^2 = 0.5 \times 9.8\,(x + 4)$	M1 A1 A1
		$3x^2 - 2x - 8 = 0$	M1 A1
		$(3x + 4)(x - 2) = 0, \quad x = 2$	
		Distance fallen = 6 m	M1 A1 (7)
	(b)	$\frac{1}{2} \times 0.5v^2 = \frac{1}{2} \times \frac{58.8}{4} \times 3^2 - 0.5 \times 9.8 \times 3$	M1 A1 A1
		$v = 14.3 \text{ m s}^{-1}$	M1 A1 (5)
			(12 marks)
7.	(*a*)	$\frac{1}{2}mu^2 - \frac{1}{2}mv^2 = mga\,(1 + \cos 60°)$	M1 A1
		$v^2 = u^2 - 3ga$	A1 (3)
	(*b*)	$R + mg\cos 60° = \frac{mv^2}{a}$	M1 A1
		$R = \frac{m}{a}(6ga - 3ga) - \frac{mg}{2}$	
		$= \frac{5mg}{2}$	A1 (3)
	(*c*)	$R = 0$ at $B \Rightarrow \frac{mg}{2} = \frac{mv^2}{a} \Rightarrow v^2 = \frac{1}{2}ag$	M1
		$\Rightarrow u^2 = \frac{7ga}{2} \Rightarrow u = \sqrt{\frac{7ga}{2}}$	M1 A1 (3)
	(*d*)		
		($\rightarrow$) B to C: $v\cos 60° \times t = a\sqrt{3}$	M1 A1
		$t = \frac{2a\sqrt{3}}{v}$	
		($\uparrow$) B to C: $0 = v\sin 60t - \frac{1}{2}gt^2$	M1 A1
		$\Rightarrow t = \frac{2v\sin 60°}{g} = \frac{v\sqrt{3}}{g}$	
		$\therefore \frac{2a\sqrt{3}}{v} = \frac{v\sqrt{3}}{g} \Rightarrow v^2 = 2ga$	M1 A1
		$\Rightarrow u^2 = 5ga$	
		$\Rightarrow u = \sqrt{5ga}$	A1 (7)
			(16 marks)

https://xtremepape.rs/