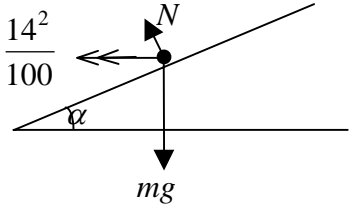
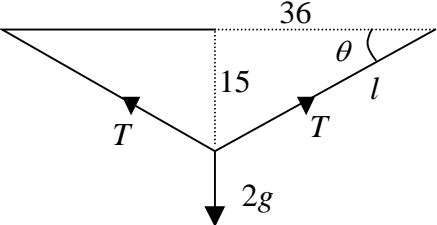
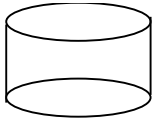

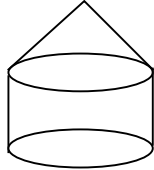
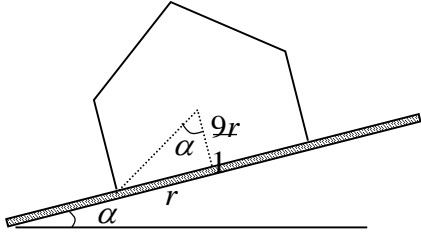
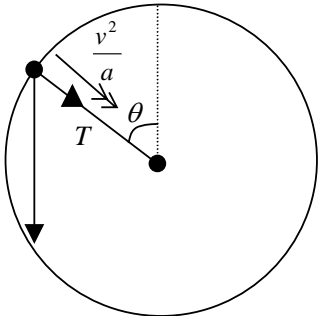
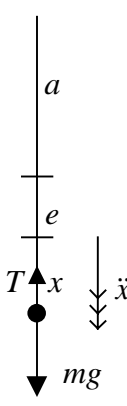


Question Number	Scheme	Marks
1.	<div></div> <div>$R(\uparrow) \quad N \cos \alpha = mg$$R(\rightarrow) \quad N \sin \alpha = \frac{m \cdot 14^2}{100}$$\therefore \tan \alpha = \frac{14^2}{100 \times 9.8} = 0.2$$\alpha \approx 11.3^\circ$</div>	M1 A1 M1 A1 M1 A1 ft A1 (7) (7 marks)
2. (a)	<div>$l^2 = 36^2 + 15^2$$\Rightarrow l = 39, \text{ ext} = 9 \text{ cm}$$T = \frac{\lambda \times 0.09}{0.3}$$2T \sin \theta = mg \Rightarrow \frac{2\lambda \times 0.09}{0.3} \times \frac{15}{39} = 2 \times 9.8$<div></div>$\lambda \approx 84.9$</div>	M1 A1 B1 M1 A1 A1 (6)
(b)	By taking P as single <u>point</u> from which to measure all distances	B1 (1) (7 marks)

Question Number	Scheme	Marks
3.	$0.5\ddot{x} = -\frac{2}{x^2}$ $v \frac{dv}{dx} = -\frac{4}{x^2}$ $\int v dv = -\int \frac{4}{x^2} dx$ $\left[\frac{1}{2} v^2 \right]_3^{\frac{3}{2}} = \left[\frac{4}{x} \right]_1^d$ <p style="text-align: right;">(limits or 'C')</p> $\frac{9}{8} - \frac{9}{2} = 4 \left(\frac{1}{d} - 1 \right) \Rightarrow d = \frac{32}{5} = 6.4 \text{ m}$	M1 M1 M1 M1 A1 A1 M1 A1 (8) (8 marks)
4. (a)	Elastic energy gained $= \frac{\lambda x^2}{2l}$ $\therefore \frac{\lambda \cdot 6^2}{2 \times 12} = \text{PE lost} = 75 \times 9.8 \times 18$ $\rightarrow \lambda = 8820 \text{ N}$	M1 M1 A1 M1 A1 ft (5)
(b)	At 2 m off ground $\frac{1}{2} \times 75 \times v^2 = 75 \times 9.8 \times 17 - \frac{1}{2} \times \frac{8820 \times 5^2}{12}$ $\rightarrow v^2 = 88.2$ $v \approx 9.39 \text{ ms}^{-1}$	M1 A1 A1ft M1 A1 (5) (10 marks)

Question Number	Scheme	Marks
5. (a)	   <p>Vol. πr^3 $\frac{1}{3}\pi r^2 h$ $\pi r^3 + \frac{1}{3}\pi r^2 h$</p> <p>Dist of CM $\frac{r}{2}$ $r + \frac{h}{4}$ \bar{x}</p> $\frac{\pi r^4}{2} + \frac{1}{3}\pi r^2 h \left(r + \frac{h}{4} \right) = \left(\pi r^3 + \frac{1}{3}\pi r^2 h \right) \bar{x}$ $\rightarrow \bar{x} = \frac{6r^2 + 4hr + h^2}{4(3r + h)}$	<p>M1 A1</p> <p>B1 B1</p> <p>M1 A1 A1ft</p> <p>A1 (8)</p>
(b)	 <p>$h = 2r \Rightarrow \bar{x} = \frac{18r}{20} = \frac{9r}{10}$</p> <p>$\therefore \tan \alpha = \frac{r}{9r/10} = \frac{10}{9}$</p> <p>$\alpha \approx 48^\circ$</p>	<p>M1 A1</p> <p>M1 A1 ft</p> <p>A1 (5)</p> <p>(13 marks)</p>

Question Number	Scheme	Marks
6.	 <p>(a) $R(\simeq) T + mg \cos \theta = \frac{mv^2}{a}$</p> <p>Energy $\frac{1}{2}mu^2 - \frac{1}{2}mv^2 = mga(1 + \cos \theta)$</p> <p>$u^2 = 3ga \rightarrow v^2 = ga(1 - 2 \cos \theta)$</p> <p>$\therefore T = -mg \cos \theta + \frac{mv^2}{a} = mg(-3 \cos \theta + 1)$</p> <p>$T = 0 \Rightarrow \cos \theta = \frac{1}{3}$</p> <p>(b) $v^2 = \frac{ga}{3}$</p> <p>$\sin^2 \theta = 1 - \left(-\frac{1}{3}\right)^2 = \frac{8}{9}$</p> <p>Ht = $\frac{v^2 \sin^2 \theta}{2g} = \frac{ga}{3} \cdot \frac{8}{9} \cdot \frac{1}{2g} = \frac{4a}{27}$</p>	<p>M1 A1</p> <p>M1 A1 A1</p> <p>M1 A1</p> <p>M1 A1 (9)</p> <p>B1</p> <p>M1 A1</p> <p>M1 M1 A1</p> <p>(6)</p> <p>(15 marks)</p>

Question Number	Scheme	Marks
7.	 <p>(a) In equilibrium $\frac{6mge}{a} = mg \Rightarrow e = \frac{a}{6}$</p> <p>(b) $m\ddot{x} = -\frac{6mg(e+x)}{a} + mg$ $\rightarrow \ddot{x} = -\frac{6g}{a}x \Rightarrow \text{SHM}$ Period = $\left(\frac{2\pi}{\omega}\right) = 2\pi\sqrt{\frac{a}{6g}}$</p> <p>(c) Greatest speed = $a\omega = \frac{a}{3}\sqrt{\frac{6g}{a}} = \frac{1}{3}\sqrt{6ga}$</p> <p>(d) $x = \frac{a}{3}\cos\omega t$ String slack $\Rightarrow x = -e \Rightarrow -\frac{a}{6} = \frac{a}{3}\cos\omega t$ $\Rightarrow \omega t = \frac{2\pi}{3}, t = \frac{2\pi}{3}\sqrt{\frac{a}{6g}}$</p>	<p>M1 A1 (2)</p> <p>M1 A1 A1</p> <p>M1 A1</p> <p>A1 (6)</p> <p>M1 A1 (2)</p> <p>M1</p> <p>M1 A1</p> <p>M1 A1 ft</p> <p>(5)</p> <p>(15 marks)</p>