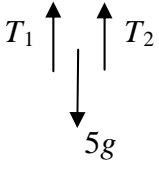
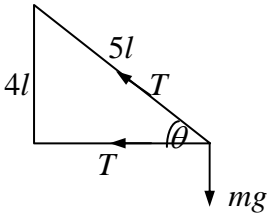
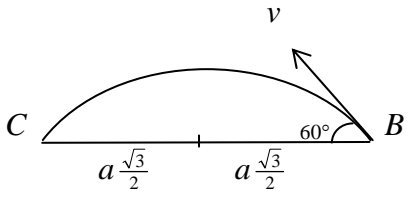


Question Number	Scheme	Marks																				
1.	 $T_1 = \frac{175 \times 0.2}{1}$ $\frac{175 \times 0.2}{1} + \frac{\lambda \times 0.3}{0.9} = 49$ $\Rightarrow \lambda = 42$	B1 M1 A1 M1 A1 (5) (5 marks)																				
2.	<p>(a)</p>  $3, 4, 5 \Delta$ $R(\uparrow) T \sin \theta = mg$ $T = \frac{5mg}{4}$ <p>(b) $R(\leftarrow)$</p> $T + T \cos \theta = \frac{mv^2}{3l}$ $\frac{8}{5} \times \frac{5mg}{4} = \frac{mv^2}{3l}$ $v = \sqrt{6gl}$ <p>(c) Could not assume tensions same</p>	B1 M1 A1 (3) M1 A2 M1 A1 (5) B1 (1) (9 marks)																				
3.	<p>(a)</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 33%;">Cylinder</td> <td style="text-align: center; width: 33%;">half-sphere</td> <td style="text-align: center; width: 33%;">toy</td> <td></td> </tr> <tr> <td style="text-align: center;">$\pi r^2 h \rho$</td> <td style="text-align: center;">$\frac{2}{3} \pi r^3 6 \rho$</td> <td style="text-align: center;">$\pi r^2 h \rho + \frac{2}{3} \pi r^3 6 \rho$</td> <td style="text-align: right;">M1 A1</td> </tr> <tr> <td style="text-align: center;">$\frac{h}{2} + r$</td> <td style="text-align: center;">$\frac{5r}{8}$</td> <td style="text-align: center;">d</td> <td style="text-align: right;">B1 B1</td> </tr> <tr> <td colspan="3" style="text-align: center;">$\pi r^2 h \rho \left(\frac{h}{2} + r\right) + 4 \pi r^3 \rho \frac{5r}{8} = (\pi r^2 h \rho + 4 \pi r^3 \rho) d$</td> <td style="text-align: right;">M1 A1</td> </tr> <tr> <td colspan="3" style="text-align: center;">$\Rightarrow d = \frac{h^2 + 2rh + 5r^2}{2(h + 4r)}$ (*)</td> <td style="text-align: right;">A1 (7)</td> </tr> </table> <p>(b) $d = r, \Rightarrow h^2 + 2rh + 5r^2 = 2r(h + 4r)$</p> $h = \sqrt{3}r$	Cylinder	half-sphere	toy		$\pi r^2 h \rho$	$\frac{2}{3} \pi r^3 6 \rho$	$\pi r^2 h \rho + \frac{2}{3} \pi r^3 6 \rho$	M1 A1	$\frac{h}{2} + r$	$\frac{5r}{8}$	d	B1 B1	$\pi r^2 h \rho \left(\frac{h}{2} + r\right) + 4 \pi r^3 \rho \frac{5r}{8} = (\pi r^2 h \rho + 4 \pi r^3 \rho) d$			M1 A1	$\Rightarrow d = \frac{h^2 + 2rh + 5r^2}{2(h + 4r)}$ (*)			A1 (7)	M1 A1 B1 B1 M1 A1 A1 (7) M1, M1 A1 (3) (10 marks)
Cylinder	half-sphere	toy																				
$\pi r^2 h \rho$	$\frac{2}{3} \pi r^3 6 \rho$	$\pi r^2 h \rho + \frac{2}{3} \pi r^3 6 \rho$	M1 A1																			
$\frac{h}{2} + r$	$\frac{5r}{8}$	d	B1 B1																			
$\pi r^2 h \rho \left(\frac{h}{2} + r\right) + 4 \pi r^3 \rho \frac{5r}{8} = (\pi r^2 h \rho + 4 \pi r^3 \rho) d$			M1 A1																			
$\Rightarrow d = \frac{h^2 + 2rh + 5r^2}{2(h + 4r)}$ (*)			A1 (7)																			

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

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