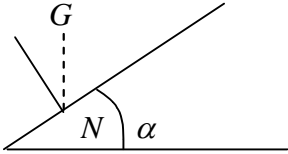


Question Number	Scheme	Marks
1.	<p>(a) $a = 0.25$</p> $\frac{2\pi}{\omega} = 2 \Rightarrow \omega = \pi$ $-0.125 = 0.25 \cos \omega t$ <p>(b) $t = \frac{1}{\pi} \cos^{-1}(-0.5)$</p> $= \frac{2}{3}$	<p>B1</p> <p>B1</p> <p>M1A1</p> <p>M1</p> <p>A1 (6)</p> <p>(6 marks)</p>
2.	<p>(a) (\uparrow) $3mg \cos \alpha^\circ = mg$</p> $\alpha = \cos^{-1}\left(\frac{1}{3}\right)$ $= 70.5$ <p>(b) (\leftarrow) $3mg \sin \alpha = mr \times 2gk$</p> $l \sin \alpha = r$ $l = \frac{3}{2}k$	<p>M1 A1</p> <p>M1</p> <p>A1 (4)</p> <p>M1 A1</p> <p>B1</p> <p>M1 A1 (5)</p> <p>(9 marks)</p>
3.	<p>(a) $2e^{-0.1x} = 2.5a$</p> $\frac{4}{5}e^{-0.1x} = v \frac{dv}{dx}$ $-8e^{-0.1x} = \frac{1}{2}v^2 (+c)$ $x = 0, v = 2 \Rightarrow c = -10$ $v^2 = 20 - 16e^{-0.1x}$ <p>(b) $16 = 20 - 16e^{-0.1x} \Rightarrow e^{-0.1x} = \frac{1}{4}$</p> $0.1x = \ln 4$ $x = 13.9$ <p>(c) Appropriate comment.</p>	<p>M1 A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1 (6)</p> <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>B1 (1)</p> <p>(10 marks)</p>

Question Number	Scheme	Marks															
<p>4. (a)</p> <p>(b)</p>	$\frac{1}{2} \times 0.2 \times 5^2 - \frac{1}{2} \times 0.2 \times u^2 = \frac{1}{2} \times \frac{20(0.5)^2}{1.5}$ $u^2 = \frac{25}{3}$ $u = 2.89 \text{ ms}^{-1}$ $\frac{1}{2} \times 0.2 \times 5^2 - \frac{1}{2} \times 0.2 \times 1.5^2 = \frac{1}{2} \times \frac{20x^2}{1.5}$ $x^2 = 0.34125$ $T = \frac{20x}{1.5} = 7.8 \text{ N}$	<p>M1 A1 A1</p> <p>M1</p> <p>A1 (5)</p> <p>M1 A1</p> <p>M1</p> <p>M1 A1 (5)</p> <p>(10 marks)</p>															
<p>5. (a)</p> <p>(b)</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 33%;">Cone</td> <td style="text-align: center; width: 33%;">Cylinder</td> <td style="text-align: center; width: 33%;">Whole</td> </tr> <tr> <td style="text-align: center;">$\frac{1}{3} \pi (2r)^2 h$</td> <td style="text-align: center;">$\pi r^2 h$</td> <td style="text-align: center;">$\frac{1}{3} \pi (2r)^2 h + \pi r^2 h$</td> </tr> <tr> <td style="text-align: center;">(4)</td> <td style="text-align: center;">(3)</td> <td style="text-align: center;">(7)</td> </tr> <tr> <td style="text-align: center;">$\frac{1}{4} h$</td> <td style="text-align: center;">$\frac{1}{2} h$</td> <td style="text-align: center;">\bar{x}</td> </tr> <tr> <td style="text-align: center;">$-4 \times \frac{1}{4} h$</td> <td style="text-align: center;">+ $3 \times \frac{1}{2} h$</td> <td style="text-align: center;">= $7 \bar{x}$</td> </tr> </table> $\bar{x} = \frac{1}{14} h$ <div style="display: flex; align-items: flex-start;"> <div style="flex: 1;">  </div> <div style="flex: 2; padding-left: 20px;"> <p>Use of G above N</p> $\tan \alpha = \frac{r}{h - \frac{1}{14} h} = \frac{7}{26}$ $r = \frac{1}{4} h$ </div> </div>	Cone	Cylinder	Whole	$\frac{1}{3} \pi (2r)^2 h$	$\pi r^2 h$	$\frac{1}{3} \pi (2r)^2 h + \pi r^2 h$	(4)	(3)	(7)	$\frac{1}{4} h$	$\frac{1}{2} h$	\bar{x}	$-4 \times \frac{1}{4} h$	+ $3 \times \frac{1}{2} h$	= $7 \bar{x}$	<p>M1 A1</p> <p>B1 B1</p> <p>M1 A1</p> <p>M1 A1 cso (8)</p> <p>M1</p> <p>M1 A1</p> <p>A1 (4)</p> <p>(12 marks)</p>
Cone	Cylinder	Whole															
$\frac{1}{3} \pi (2r)^2 h$	$\pi r^2 h$	$\frac{1}{3} \pi (2r)^2 h + \pi r^2 h$															
(4)	(3)	(7)															
$\frac{1}{4} h$	$\frac{1}{2} h$	\bar{x}															
$-4 \times \frac{1}{4} h$	+ $3 \times \frac{1}{2} h$	= $7 \bar{x}$															

Question Number	Scheme	Marks
<p>6. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	$mg = \frac{8mge}{4a}$ $\frac{9}{2}a = AO$ $mg - \frac{8mg}{4a}(e+x) = m\ddot{x}$ $\ddot{x} = -\frac{2g}{a}x$ $T = 2\pi\sqrt{\frac{a}{2g}} = \pi\sqrt{\frac{2a}{g}} \quad (*)$ $v = d\omega$ $\frac{1}{2}\sqrt{ga} = d\sqrt{\frac{2g}{a}}$ $d = \frac{a}{2\sqrt{2}} = a\frac{\sqrt{2}}{4} = 0.35a \text{ (awrt)}$ <p>Partly under gravity, partly SHM</p>	<p>M1</p> <p>A1 (2)</p> <p>M1 M1 A1</p> <p>M1 A1</p> <p>M1 A1 (7)</p> <p>M1</p> <p>A1 ft on ω</p> <p>A1 (3)</p> <p>B1 B1 (2)</p> <p>(14 marks)</p>
<p>7. (a)</p> <p>(b)</p> <p>(c)</p>	$\frac{1}{2}mu^2 = mgl(1 - \cos \theta)$ $u = \sqrt{\frac{2}{3}}gl$ $T - mg \cos \theta = \frac{mv^2}{l}$ $\frac{1}{2}mu^2 - \frac{1}{2}mv^2 = mgl(1 - \cos \theta)$ <p>eliminating v^2, $T = \frac{mg}{3}(9 \cos \theta - 4) \quad (*)$</p> $\max T, \theta = 0, T_{MAX} = \frac{5mg}{3}$ $\min T, \cos \theta = \frac{2}{3}, T_{MIN} = \frac{2mg}{3}$ $\frac{2mg}{3} \leq T \leq \frac{5mg}{3}$	<p>M1 A1 A1</p> <p>A1 (4)</p> <p>M1 A1</p> <p>M1 A1</p> <p>M1, A1 cso (6)</p> <p>M1</p> <p>M1 A1</p> <p>A1 (4)</p> <p>(14 marks)</p>

