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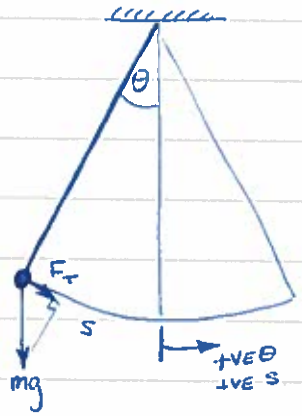
1 (a)



$s = l\theta$

$\dot{s} = l\dot{\theta}$

$\ddot{s} = l\ddot{\theta}$

Tangential force at extreme position

$F_T = mg\sin\theta$

$F = ma$

$mg\sin\theta = -m\ddot{s}$

$mg\sin\theta = -ml\ddot{\theta}$

$mg\theta = -ml\ddot{\theta}$ $\{\sin\theta = \theta$ for small $\theta\}$

$\therefore$

$\ddot{\theta} = -\frac{g}{l}\theta$ i.e. SHM about $\theta = 0$.

$n = \sqrt{\frac{g}{l}}$

$T = \frac{2\pi}{n} = \frac{2\pi}{\sqrt{\frac{g}{l}}} = \underline{\underline{2\pi\sqrt{\frac{l}{g}}}}$

(b) (i) $T = 2\pi\sqrt{\frac{0.3}{9.8}}$
$= \underline{\underline{1.8\text{ s}}}$

(ii) $T = 2\pi\sqrt{\frac{1.25}{9.8}}$
$= \underline{\underline{2.24\text{ s}}}$

(iii) $T = 2\pi\sqrt{\frac{0.5}{9.8}}$
$= \underline{\underline{1.42\text{ s}}}$

(c) (i) $l = \frac{g}{4\pi^2}T^2$
$= \frac{g}{4\pi^2}\left(\frac{4\pi^2}{49}\right)$
$= \underline{\underline{0.2\text{ m}}}$

(ii) $l = \frac{g}{4\pi^2}\left(\frac{\pi^2}{5}\right)$
$= \underline{\underline{0.49\text{ m}}}$

(iii) $l = \frac{g}{4\pi^2}(1)$
$= \underline{\underline{0.25\text{ m}}}$

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(2) $T = 2\pi\sqrt{\frac{l}{g}}$

$= 2\pi\sqrt{\frac{2}{9.8}}$

$= 2.84\text{ s}$

$T = 2\pi\sqrt{\frac{2.2}{9.8}}$

$= 2.98\text{ s}$

Period increases by 0.14 secs

(3) $T_1 = 2\pi\sqrt{\frac{l_1}{g}}$

$T_0 = 2\pi\sqrt{\frac{l_0}{g}}$

where T_1 = new period
and T_0 = original period, etc

do.

$$\left(\frac{T_1}{T_0}\right)^2 = \frac{l_1}{l_0}$$

$$\left(\frac{T}{2T}\right)^2 = \frac{l_1}{l_0}$$

$$\frac{1}{4} = \frac{l_1}{l_0}$$

$$l_1 = \frac{1}{4} l_0$$

ie original length should be shortened by 75%

(4) $\left(\frac{T_1}{T_0}\right)^2 = \frac{l_1}{l_0}$

$$\left(\frac{4T}{5T}\right)^2 = \frac{l_1}{l_0}$$

$$l_1 = \frac{16}{25} l_0$$

Original length has to be reduced by $\frac{9}{25}$ ie 36%