Pre-Semters Physics - Solutions Summer 2009

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1. Exercise

It is

$$\omega = 2\pi f = 3.77\frac{1}{s}$$

and

$$T = \frac{1}{f} = 1.67\,s$$

Therefore we have

$$m = \frac{D}{\omega^2} = \frac{D}{4\pi^2 f^2} = 8,44\,kg$$

2. Exercise

It is with $A = 0.1\,m$ and $\omega = \frac{2\pi}{T} = 0.785\frac{1}{s}$

$$x(t) = A\cos(\omega t) = 0.1\cos(0.785\,t)$$

The distance travelled is

$$\Delta x = A(1 - \cos(\frac{2\pi}{T})) = 0.03\,m$$

The velocity at the point $x = 0$ is

$$v = \frac{2\pi}{T}A = 0.078\frac{m}{s}$$

3. Exercise

With

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

we have

$$l = \frac{T^2 g}{4\pi^2} = 6.21\,m$$

4. Exercise

In the lecture we found

$$\omega = \sqrt{\frac{mgl}{\Theta}}$$

Here we have

$$\Theta = ml^2 + \frac{2}{5}mr^2$$

Thus

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{l^2 + \frac{2}{5}r^2}{gl}} = 2\pi\sqrt{\frac{l}{g}}\sqrt{1 + \frac{2r^2}{5l^2}}$$

5. Exercise

The ansatz leads to

$$\lambda^2 + 2\kappa\lambda + \omega^2 = 0 \quad \Rightarrow \quad \lambda = -\kappa \pm \sqrt{\kappa^2 - \omega^2}$$

For $\kappa < \omega$:

$$\lambda = -\kappa \pm i\sqrt{\omega^2 - \kappa^2}$$

and

$$x(t) = e^{-\lambda t}\cos(\sqrt{\omega^2 - \kappa^2}t)$$

For $\omega < \kappa$:

$$\lambda_1 = -\kappa + \sqrt{\kappa^2 - \omega^2} < 0, \quad \lambda_2 = -\kappa - \sqrt{\kappa^2 - \omega^2} < 0$$

and

$$x(t) = e^{\lambda_1 t} + e^{\lambda_2 t}$$