Chapter 13   Problem 46 [†]

Given

$m = 340\ g = 0.34\ kg$

$\Delta x = 30\ cm = 0.30\ m$

Solution

What is the period of the simple harmonic motion?

The period depends on the spring constant and the mass. The spring constant can be determined by how much the spring is displaced when the mass is attached.

From Hooke's law the force exerted by a spring is

$$\vec{F} = -k\Delta\vec{x}$$

Therefore, the spring constant is

$$k = \frac{F}{\Delta x} = \frac{mg}{\Delta x}$$

The sign has been dropped since it does not affect the magnitude of the spring constant. It only implies the direction of the force.

The period of the oscillator is

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{k}{m}}} = 2\pi\sqrt{\frac{m}{k}}$$

Substituting in the relationship for the spring constant gives

$$T = 2\pi\sqrt{\frac{m}{\left(\frac{mg}{\Delta x}\right)}} = 2\pi\sqrt{\frac{\Delta x}{g}} = 2\pi\sqrt{\frac{(0.30\ m)}{(9.8\ m/s^2)}}$$

$$T = 1.10\ s$$