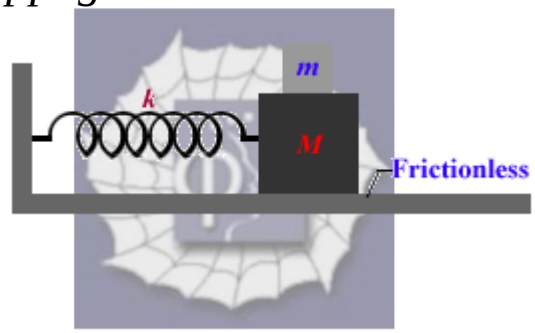
**102.**

**Problem 16.25P (HRW)**

*Two blocks* (*m*=1.0 kg *and M*=10 kg) *and a spring* (*k*=200 N/m) *are arranged on a horizontal, frictionless surface as shown in the figure. The coefficient of static friction between the two blocks is* 0.40. *We have to find the maximum possible amplitude of simple harmonic motion if no slippage is to occur between the blocks.*




**Solution:**

Data of the problem are:

$m = 1.0$ kg

$M = 10.0$ kg

$k = 200$ N m$^{-1}$ .

Maximum acceleration, $a_{max}$, with which the upper block of mass *m*=1.0 kg can move without slipping on the block of mass *M*=10 kg is determined by the maximum force of static friction between the two blocks.

Coefficient of static friction between the two blocks is $\mu = 0.40$. Therefore,

$$a_{\max} = \frac{\mu m g}{m} = \mu g = 0.40 \times 9.8 \text{ m s}^{-2} = 3.92 \text{ m s}^{-2}.$$

Maximum amplitude for motion determines the maximum spring force exerted on the system of two blocks. We therefore have the equation

$$k\, x_{\max} = (m + M)\, a_{\max} \ .$$

This gives

$$x_{\max} = \frac{(m + M)\, a_{\max}}{k},$$

or

$$x_{\max} = \frac{11.0 \times 3.92}{200} \text{ m} = 22 \text{ cm}.$$