Answer on Question #60176-Physics-Mechanics-Relativity

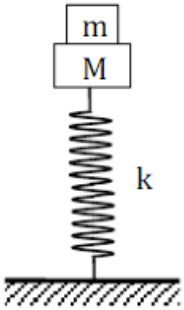
A small block of mass m is kept on a bigger block of mass M which is attached to a vertical spring of spring constant k as shown in the figure. The system oscillates vertically.

(a) Find the resultant force on the smaller block when it is displaced through a distance x above its equilibrium position.

(b) Find the normal force on the smaller block at this position. When is this force smallest in magnitude?

(c) What can be the maximum amplitude with which the two blocks may oscillate together?

Solution



(a) Since the mass attached to the spring is m+M, at the equilibrium position the angular frequency

$$\omega = \sqrt{\frac{k}{m+M}}$$

acceleration of smaller block at position is

$$-\omega^2 x = \frac{kx}{m+M}$$

The resultant force F on block of mass m when it is displaced through a distance x above equilibrium position is

$$F = -m\omega^2 x = \frac{kmx}{m+M}$$

(b) The normal force N on block of mass m exerted by block of mass M when it is displaced through a distance x above its equilibrium position is

$$N = mg - kx = mg - \frac{kmx}{m+M}.$$

Clearly this force will be smallest at the highest point.

(c) The two blocks will oscillate together as long as N is greater than zero i.e. till

$$mg = \frac{kmx}{m+M}.$$

$$x = \frac{(m+M)g}{k}.$$