Answer on Question #41999 – Physics – Other

Question.

If the period of vibration for a spring is 3.0s and the spring is attached to a 5.2kg mass, what is the spring constant for the spring?

Given:

$T = 3\ s$ is a period of spring pendulum

$m = 5.2\ kg$ is a mass of spring pendulum

Find:

$k = ?$ is a spring constant of given spring pendulum

Solution.

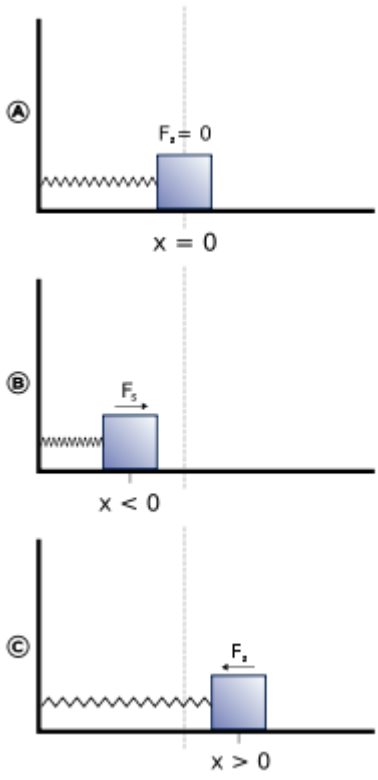

Fig.1. Motion of spring pendulum.

Newton's second law for spring pendulum:

$$ma = -kx$$

where a is an acceleration, x is a displacement.

The equation of motion for spring pendulum:

$$\ddot{x} + \frac{k}{m}x = 0$$

$$\ddot{x} + \omega^2 x = 0$$

That's why,

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

But,

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

So,

$$T^2 = 4\pi^2\frac{m}{k} \to k = \frac{4\pi^2 m}{T^2}$$

Calculate:

$$k = \frac{4 \cdot 3.14^2 \cdot 5.2}{9} = 22.8\ \frac{N}{m}$$

Answer.

$k = \frac{4\pi^2 m}{T^2} = 22.8\ \frac{N}{m}$