1. The mass attached to a vibrating string is increased four times. What is the affect on the time period and frequency of oscillation of the mass-spring system?

Solution

Angular frequency of oscillations of a mass-spring system is given by:

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

If the mass, attached to a vibrating, string is increased four times:

$$\omega` = \sqrt{\frac{k}{4 \cdot M}} = \frac{1}{2} \cdot \sqrt{\frac{k}{M}} = \frac{\omega}{2}$$

Then since $\omega = 2\pi f$ and since $T = 1/f$ where T is the time period,

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

If the mass, attached to a vibrating, string is increased four times:

$$T` = 2 \cdot \pi \cdot \sqrt{\frac{4 \cdot m}{k}} = 2 \cdot \left(2 \cdot \pi \sqrt{\frac{4 \cdot m}{k}} \right) = 2 \cdot T$$

Answer

Time period doubles.

Frequency of oscillation is halved.