Answer on Question #47014-Physics-Mechanics-Kinematics-Dynamics

A sonometer wire under a tension of $T = 40\ N$, vibrates in unison with a tuning fork of frequency $N = 384\ Hz$. find the number of beats produced in 2 sec when the tension in the wire is reduced by 1.24 N.

Solution

Let N is a frequency of tuning fork. Then frequency of wire when a tension is 40 N is N.

The frequency of wire when a tension is reduced by 1.24 N is N-k. Hence,

$$N = \frac{1}{2L}\sqrt{\frac{T}{m}};\ N - k = \frac{1}{2L}\sqrt{\frac{T - \Delta T}{m}}.$$

$$\frac{N-k}{N} = \sqrt{\frac{T-\Delta T}{T}} \to k = N\left(1 - \sqrt{\frac{T-\Delta T}{T}}\right) = 384\left(1 - \sqrt{\frac{40-1.24}{40}}\right) = 6\frac{beats}{s} = 12\frac{beats}{2s}.$$

Answer: 12.

2.] A conical pendulum has length 1 m and bob of mass 0.1 kg the angular speed of the bob is 14/√10 rad/sec, find the tension in the string.

Solution

The object is subject to two forces: the gravitational force mg which acts vertically downwards, and the tension force T which acts upwards along the string. The tension force can be resolved into a component $T\ cos\theta$ which acts vertically upwards, and a component $T\sin\theta$ which acts towards the centre of the circle. Force balance in the vertical direction yields

$$T\ cos\theta = mg.$$

Since the object is executing a circular orbit, radius r, with angular velocity ω, it experiences a centripetal acceleration $\omega^2 r$. Hence, it is subject to a centripetal force $m\omega^2 r$. This force is provided by the component of the string tension which acts towards the centre of the circle. In other words,

$$T\sin\theta = m\omega^2 r.$$

Note that if l is the length of the string then $r = l\ \sin\theta$. It follows that

$$T = m\omega^2 l = 0.1 \cdot \left(\frac{14}{\sqrt{10}}\right)^2 \cdot 1 = 1.96\ N.$$

Answer: $1.96\ N$.