Teacher notes
Topic C

Standing waves and SHM

Two identical strings have length L = 2.0 m and are subject to the same tension. A standing wave is established on each string. The two standing waves are shown on the same graph. Two points, P and Q, on each string have been marked. P and Q have the same mass.
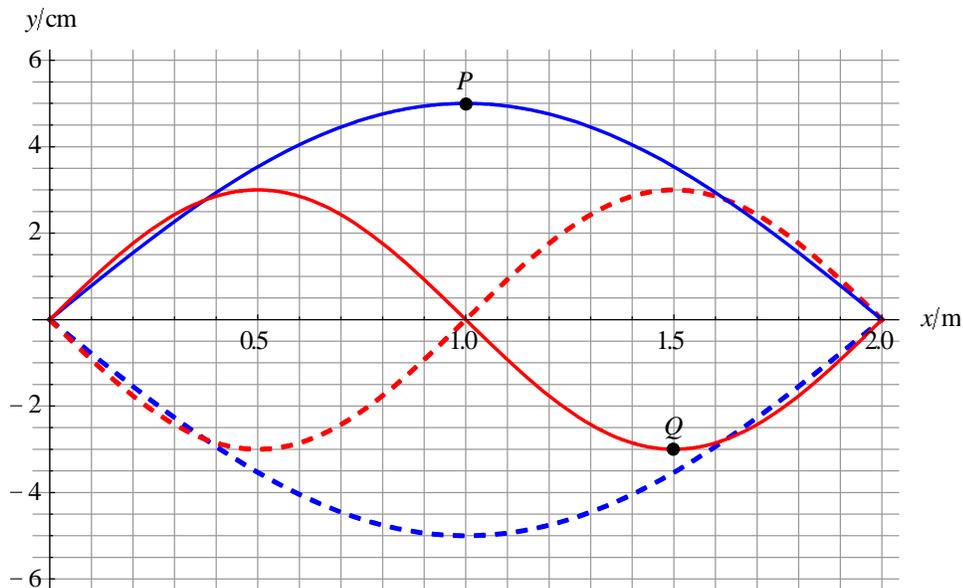
(a) Describe the motion of P and Q.

(b) Determine the ratio $\dfrac{K_P}{K_Q}$ of the maximum kinetic energy of P to that of Q.

Answers

(a) P and Q are executing simple harmonic oscillations. The amplitude of P is 5.0 cm and that of Q is 3.0 cm. Since the blue wave is the first harmonic of the string and the red wave is the second harmonic the frequency of Q is double that of P, $\omega_Q = 2\omega_P$.

(b) The maximum kinetic energy in SHM is given by $K_{max} = \frac{1}{2}m\omega^2 x_0^2$. Hence

$$\frac{K_P}{K_Q} = \frac{\frac{1}{2}m\omega^2 \times 5.0^2}{\frac{1}{2}m(2\omega)^2 \times 3.0^2} = \frac{1}{4} \times \frac{25}{9} = \frac{25}{36}.$$