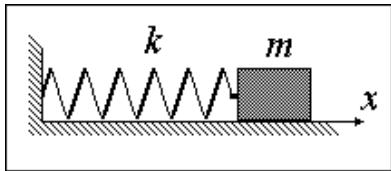


Show that when a particle is moving in a SHM, its velocity at a distance of $x_1 = \sqrt{3/2} * A$ from the central position is half of its velocity in the central position.

Solution



$$ma = -kx \iff \ddot{x} + \frac{k}{m}x = 0$$

$$\ddot{x} = \frac{dv}{dt}$$

$$v = \int -\frac{k}{m} * x dx$$

$$v_1 = \int_A^{\sqrt{3/2} * A} -\frac{k}{m} * x dx = -\frac{k}{m} * \left(\frac{3/2 * A^2}{2} - \frac{A^2}{2}\right) = \frac{k * A}{2} * \left(-\frac{3}{2} + 1\right) = \frac{k * A}{2} * \left(-\frac{1}{2}\right)$$

velocity at a distance of $x_1 = \sqrt{3/2} * A$

$$v_2 = \int_A^0 -\frac{k}{m} * x dx = -\frac{k}{m} * \left(0 - \frac{A^2}{2}\right) = \frac{k * A}{2} * (0 + 1) = \frac{k * A}{2} * 1$$

velocity at a distance of $x_0 = 0$

$$\frac{v_1}{v_2} = -\frac{1}{2}$$