Torsional Pendulum: lecture 3

\[ \tau = I \frac{d^2 \theta}{dt^2} = -\kappa \theta \]

\( \kappa \) is the torsion constant of the support wire

so

\[ \omega = \sqrt{\frac{\kappa}{I}} \]

Energy in SHM

\[ x(t) = A \cos(\omega t + \phi) \]

\[ K = \frac{1}{2} m v^2 = \frac{1}{2} \, m \, \omega^2 \, A^2 \, \sin^2 (wt + \phi) \]

\[ U = \frac{1}{2} k x^2 = \frac{1}{2} k A^2 \cos^2 (wt + \phi) \]

\[ E_{total} = \frac{1}{2} k A^2 \]

since \( \omega^2 = \frac{k}{m} \)
Total Energy is Conserved

$U$ and $K$ swap during the cycle

$$E(t) = U(t) + K(t) = \frac{1}{2} kA^2$$

This is a constant

A Model for Vibrations in Materials