Probability density

The probability of finding the particle between \( x \) and \( (x + dx) \) is \( \frac{|\psi|^2}{2} dx \)

\( \Rightarrow \frac{|\psi|^2}{x^2} \)

A free particle is totally delocalized

- A free particle is well-defined, \( k = \frac{2\pi}{\lambda} \)
- In fact, any wave with well-defined \( k \) is delocalized over all space (whether it's a quantum wave, sound wave, rope wave, etc).
- To create a localized wave, we must superpose waves with many different \( k \)s.

\( \Rightarrow \Delta x \Delta k \approx \text{constant.} \)

\( p = \text{i} \hbar k \)

Viscous damping

At speeds low enough that there is no turbulence:

\( F_{\text{damp}} = -bx \)

Young's modulus

\( k = \frac{EA}{L} \)

Where \( E \) is "Young's modulus".

\( \omega = \sqrt{\frac{mg}{k_{\text{effective}}} \Rightarrow k_{\text{effective}} = \frac{mg}{k} } \)

Pendulum

\( m \)

\( l \)

Heisenberg uncertainty relation

\( \Delta x \Delta p \geq \frac{\hbar}{2} \)