In searching for a differential equation for the de Broglie’s wave hypothesis for a free particle, Schrodinger considered the following wave function:

\[ \psi_{\text{right}}(x, t) = e^{-i\omega t - ikx} \]

This wave function represents a wave moving to the right.

1) Write a similar equation for a wave that is moving to the left.

\[ \psi_{\text{left}} = e^{i\omega t + ikx} \]

2) Combine the right moving and the left moving waves and write the equation for the superposition of the two waves.

\[ \psi_{\text{combine}} = e^{-i\omega t - ikx} + e^{i\omega t + ikx} \]

3) Simplify your results of part (2) and explain why Schrodinger decided that this solution was a possible candidate for the wave function of a free particle.

\[ \psi_{\text{combine}} = e^{-i\omega t} \left( \frac{e^{-ikx} + e^{ikx}}{2 \cos kx} \right) \]

\[ \frac{2 \sin kx}{2 \cos kx} = e^{-i\omega t} \sin kx \]

This cannot be zero everywhere at any instant of time.