Gasiorowicz 3rd edition Jan 25, 2008

P2-9.

Consider the example in Problem 8. Calculate A so that $\psi(x)$ is probably normalized.

[Problem 2-8:
Consider a wave function of the form

$$\psi(x) = Ae^{-\mu|x|}$$

Calculate the wave function in momentum space $\phi(p)$.]

Solution: $\psi(x) = Ae^{-\mu|x|}$

$$\int_{-\infty}^{\infty} \psi^*(x)\psi(x)dx = 1 \Rightarrow \int_{-\infty}^{\infty} \left(Ae^{-\mu|x|}\right)^2 dx = 1$$

$$\Rightarrow \int_{-\infty}^{\infty} A^2 e^{-2\mu|x|}dx = 1$$

$$\Rightarrow A^2\left(\int_{-\infty}^{0} e^{2\mu x}dx + \int_{0}^{\infty} e^{-2\mu x}dx\right) = 1$$

$$\Rightarrow A^2\left(\frac{1}{2\mu}\left[e^{2\mu x}\right]_{-\infty}^{0} + \frac{1}{-2\mu}\left[e^{-2\mu x}\right]_{0}^{\infty}\right) = 1$$

$$\Rightarrow A^2\left[\frac{1}{2\mu} + \left(-\frac{1}{-2\mu}\right)\right] = 1$$

$$\Rightarrow A^2\left[\frac{1}{\mu}\right] = 1$$

$$\Rightarrow A^2 = \mu$$

$$\Rightarrow A = \underline{\underline{\sqrt{\mu}}}$$