Problem 8

Let $A' = 2Ai$ such that

$$\Psi(x) = A' \sin(kx).$$

Now, normalization is accomplished as follows

$$1 = \int_0^L \left(A'A'^*\right) \sin^2(kx)\, dx$$

$$= \int_0^L |A'|^2 \sin^2(kx)\, dx$$

$$= |A'|^2 \left[\frac{1}{2}\left(x - \frac{L}{2\pi n}\sin\left(\frac{2\pi n x}{L}\right)\right)\right]_0^L$$

$$= |A'|^2 \left[\frac{L}{2} - \frac{L}{2\pi n}\sin(2\pi n) - \left(0 - \sin(0)\right)\right]$$

$$\underset{0}{\underbrace{}} \qquad \underset{0}{\underbrace{}}$$

$$= |A'|^2 \cdot \frac{L}{2} \implies A' = \sqrt{\frac{2}{L}}$$

$$\implies \Psi(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right).$$