Problem 8

Let $A' = 2Ai$ such that

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

Now, normalization is accomplished as follows

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

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

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

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

($\sin(2\pi n) = 0$, $\sin(0) = 0$)

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

$|A'|^2 = \left(\sqrt{0^2 + (2Ai)^2}\right)^2 = (2Ai)^2 \implies |A'| = 2Ai$

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