26. Consider a particle in a one dimensional square well of length L with infinite walls at $x=0$ and $x=L$.

a) Calculate probability of finding particle between $x-\lambda/2$ and $x+\lambda/2$.

$$P(x;\lambda) = \int_{x-\lambda/2}^{x+\lambda/2} dx \left(\frac{2}{L}\right)\sin^2\left(\frac{n\pi x}{L}\right) = \frac{2}{L}\int_{x-\lambda/2}^{x+\lambda/2} dx \left(\frac{1-\cos\left(\frac{2n\pi x}{L}\right)}{2}\right)$$

$$P(x;\lambda) = \frac{x}{L}\Big|_{x-\lambda/2}^{x+\lambda/2} - \frac{2}{L}\left(\frac{1}{2}\right)\left(\frac{L}{2n\pi}\right)\sin\left(\frac{2n\pi x}{L}\right)\Big|_{x-\lambda/2}^{x+\lambda/2}$$

$$P(x;\lambda) = \frac{\lambda}{L} - \frac{1}{2n\pi}\left[\sin\left(\frac{2n\pi(x+\lambda/2)}{L}\right) - \sin\left(\frac{2n\pi(x-\lambda/2)}{L}\right)\right]$$

b) For a classical probability; there is no preferred location for the particle. The total probability of finding the particle in the well is 1 and the portion of the well between $x-\lambda/2$ and $x+\lambda/2$ is λ/L of the entire well. The probability is $1\cdot\frac{\lambda}{2} = \frac{\lambda}{2}$.

c). As $n\to\infty$:

$$\lim_{n\to\infty} \frac{\lambda}{L} - \frac{1}{2n\pi}\left[\sin\left(\frac{2n\pi(x+\lambda/2)}{L}\right) - \sin\left(\frac{2n\pi(x-\lambda/2)}{L}\right)\right] = \frac{\lambda}{L}$$

As the quantum number becomes large, we recover the classical limit.