TL 6-33 ((Calculating expectation values))

- Find $\sigma_x \equiv \sqrt{\langle x^2\rangle - \langle x\rangle^2}$

$$\sigma_p \equiv \sqrt{\langle p^2\rangle - \langle p\rangle^2}$$

and $\sigma_x \sigma_p$ for electron in ground state of ∞ square well.

- Take $\langle p\rangle = 0$ and $\langle p^2\rangle = \langle 2mE\rangle$

- For a ∞ square well of width L, $\langle x\rangle = \frac{L}{2}$ (6-45)

$$\langle x^2\rangle = \frac{L^2}{3} - \frac{L^2}{2n^2\pi^2} \quad (6\text{-}47)$$

$$= L^2\left(\frac{1}{3} - \frac{1}{2\pi^2}\right) \text{ if } n=1$$

So $\sigma_x = \sqrt{L^2\left(\frac{1}{3} - \frac{1}{2\pi^2}\right) - L^2\left(\frac{1}{4}\right)}$

$$= L\sqrt{\frac{1}{3} - \frac{1}{2\pi^2} - \frac{1}{4}} = \boxed{0.1808L}$$

- Also: $\langle p\rangle = 0$ and $\langle p^2\rangle = \frac{\hbar^2\pi^2}{L^2}$ (Ex 6-5)

So $\sigma_p = \sqrt{\frac{\hbar^2\pi^2}{L^2} - 0} = \frac{\hbar\pi}{L} = \boxed{\frac{h}{2L}}$

- Thus $\sigma_x\sigma_p = (0.1808\cancel{L})\left(\frac{h}{2\cancel{L}}\right) = \cancel{0.00}\ \boxed{0.09h}$