Problem W10:

The wave function for a particle in the ground state of an infinite square well is

\[ \psi(x) = \sqrt{\frac{2}{L}} \sin \frac{\pi}{L} x. \]

Find the following quantities for a particle of mass \( m \) in this state:

(a) \( \langle x \rangle \);
(b) \( \langle x^2 \rangle \);
(c) \( \langle p \rangle \);
(d) \( \langle p^2 \rangle \);
(e) the uncertainty product \( \Delta p \Delta x \) (see Eq. (6.34)).