Schrödinger equation, wave function, probability density, expectation values, particle in the box

1. Problem 1.7 in Griffiths
2. Problem 1.8 in Griffiths
3. Problem 1.16 in Griffiths

4. A particle of mass \( m \) moves in an infinite square well \((0 < x < a)\). The initial wave function is given by

\[
\Psi(x, t = 0) = A \cos \frac{\pi x}{a} \sin \frac{3 \pi x}{a}.
\]

(a) Determine the normalization constant \( A \).

(b) Expand the wavefunction at the initial time in terms of the eigenfunctions \( \phi_n(x) \) of the infinite square well, i.e. determine the coefficients \( c_n \) that define \( \Psi(x, 0) \) as a superposition of eigenstates of the infinite square well.

(c) Determine the time-dependent wave function, \( \Psi(x, t) \).

(d) Is the motion periodic? If so, what is the period?

(e) If a measurement of the energy is made, what will be the outcome(s) and, with what probability will those value(s) be measured?

(f) What is the average energy of the particle? How does it change with time (assuming that no measurement is performed)?

(g) Will the particle’s energy change if an energy measurement is made?

Found an error or need a clarification? Email the instructor at sergiy.bubin@nu.edu.kz