Homework Assignment 2
Review

Practice Problems

These problems are graded on effort only.

Griffiths: P1.4, P1.14a

Additional Problems

Problem 1: Consider the discrete probability distribution function $P(n)$ with:

$$\begin{aligned} P(0) &= \frac{1}{4} \\ P(1) &= \frac{1}{4} \\ P(4) &= \frac{1}{2} \end{aligned}$$

and $P(n) = 0$ for all other n.

(a) Is $P(n)$ properly normalized? Show your work.

(b) Find the expectation value $\langle n \rangle$ of the random variable n.

(b) Find the variance of the random variable n.

Problem 2: Suppose the wave function for a particle is:

$$\Psi(x,t) = \begin{cases} \sqrt{\frac{\pi}{2L}}\, e^{it/t_0} \sqrt{\sin\left(\frac{\pi x}{L}\right)} & 0 \le x \le L \\ 0 & \text{otherwise} \end{cases}$$

(a) Plot $|\Psi(x,t)|^2$ as a function of x. Does the time t matter?

(b) Is Ψ properly normalized? Show how you determined this.

(c) For any position b what is the probability that you observe the particle with $x \le b$? (Hint: consider three cases $b < 0$, $0 \le b \le L$, and $b > L$.)

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Problem 3: Suppose the wave function for a particle is:

$$\Psi(x,t) = A\,\sin(\kappa x)\,\exp(-i\omega t - \kappa|x|)$$

(a) Is $d\Psi/dx$ continues at $x = 0$? (Hint: evaluate derivative for both cases of $|x|$ and evaluate at $x = 0$.)

(b) Suppose that Ψ satisfies the Schrodinger equation from some potential V. What is the potential for V(x) for $x > 0$?

Problem 4: Define $P_{ab}(t)$ as the probability of measuring a particle in the range $a < x < b$, at time t. Show that:

$$\frac{dP_{ab}}{dt} = J(a,t) - J(b,t),$$

where:

$$J(x,t) \equiv \frac{i\hbar}{2m}\left(\Psi\frac{\partial\Psi^*}{\partial x} - \Psi^*\frac{\partial\Psi}{\partial x}\right)$$

Hint: look closely at the section on Normalization in Chapter 1 of the *lecture notes*.