

Homework 2: due on Sep. 15th

1. Based on the wave function representation relation between in the

configuration space and momentum space, show that $\int_{-\infty}^{\infty} |\phi(p, t)|^2 dp = 1$.

2. Show $\langle p \rangle = \langle p \rangle^*$ if $\langle p \rangle = \int_{-\infty}^{\infty} \psi^*(x, t) (-i\hbar \frac{\partial}{\partial x}) \psi(x, t) dx$.

3. Textbook Problem 1.3.

4. Gaussian and Square wave packets:

(a) Find $\psi(x, 0)$ for a Gaussian wave packet $\phi(k) = A \exp[-a^2(k - k_0)^2 / 4]$, where A is a normalization factor to be found. Calculate the probability of finding the particle in the region $-\frac{a}{2} \leq x \leq \frac{a}{2}$.

(b) Find $\phi(k)$ for a square wave packet $\psi_0(x) \equiv \psi(x, 0) = \begin{cases} A \exp(ik_0 x) & \text{for } |x| \leq a \\ 0 & \text{for } |x| > a \end{cases}$.