Physics 214: Introduction to Quantum Mechanics
Spring 2016

Exam 2 Study Guide

This document contains information about the take home exam to be distributed Friday 1 April. It is a closed book 3 hour take-home exam, but you may prepare one page of notes (front and back) to use during the exam. It is due on Wed 6 April in class. The exam will cover the material though Problem Set 7, which corresponds to the textbook through the end of Chapter 3 plus the lecture notes on position and momentum space wavefunctions. The exam will consist of a combination of conceptual questions and shorter computations in Part I, and more substantive problems in Parts II and III. You will have 3 hours to complete the exam.

You should understand the following topics, though not every one of them will appear on the exam (continued on other side):

1. Normalization and the probability interpretation of $\Psi(x,t)$.

2. Heisenberg’s uncertainty principle.

3. The relation between the position space wavefunction $\psi(x) = \Psi(x,0)$ and momentum space wavefunction $\tilde{\psi}(p) = \tilde{\Psi}(p,t)$ at $t = 0$. Computation of $\langle p \rangle$, $\langle p^2 \rangle$ and $\Delta p$ using either $\psi(x)$ or $\tilde{\psi}(p)$.

4. Conservation of probability in 1-dimension, and its relation to probability current $j_x(x,t)$.

5. Ehrenfest’s theorem.

6. Separable solutions to the full time-dependent Schrödinger equation: stationary states $\Psi_E(x,t) = \psi_E(x)e^{-iEt/\hbar}$.

7. The time-independent Schrödinger equation, which determines the energy eigenfunctions $\psi_E(x)$.

8. Stationary states $\Psi_n(x,t) = \psi_n(x)e^{-iE_n t/\hbar}$ and energies $E_n$ for the particle in a box.

10. Computation of the coefficients $c_n$ of the expansion of an arbitrary wavefunction in stationary states, given $\Psi(x,0)$ and the energy eigenfunctions $\psi_n(x)$.

11. Determination of the time dependence of an arbitrary wavefunction by expansion in stationary states, given $\Psi(x,0)$ and the energy eigenfunctions $\psi_n(x)$.

12. The relation of $c_n$ to the probability of measuring energy $E = E_n$.

13. Computation of $\langle E \rangle$, $\langle E^2 \rangle$ and $\Delta E$, given the coefficients $c_n$ and energies $E_n$.

The exam will NOT cover:

Chapter 4 (the finite square well, qualitative sketches of wavefunctions given $V(x)$, the Dirac delta-function, the harmonic oscillator, and beyond).

If you have any questions, please do not hesitate to ask.