Review Topics for FInal

Chapter 2 - Relativity

1. Apply length contraction and time dilation equations. Use binomial approximation when $v \ll c$. (HW 2, problems 4, 5, 8, 18)
2. Apply Lorentz transformations (HW 2, Problem 20, C-2)
3. Apply velocity transformations. (HW 2, problems 10, 14, 15, C-1)
4. Apply Doppler shift formula (HW 2, Problem 13)
5. Use momentum, energy, and kinetic energy relations (HW 3, problems 26, 27, 37,
6. Calculate mass of relativistic systems using conservation equations (HW 3, problems 38, 39, 40, 42, 43)
7. Derivations of relativistic quantities (HW 3, problems C-1, C-2, C-3, C-4)
8. Given KE (or E or p) and E_0 determine which approximation is valid: Newtonian, relativistic or highly relativistic. (HW 3, problems 37, C-5)

Chapter 3 - Light waves as particles

1. What experiments support the wave nature of light? Explain. (notes and book)
2. Describe 3 failures of classical physics that were solved by invoking the particle theory of light. (notes and book)
3. Photoelectric effect calculations (HW 3, problems 8, 9 12)
4. Blackbody radiation (HW 3, problems 16, 19, 20 , 21)
5. Compton effect calculations and derivations. (HW 3, problems 24, 26)

Chapter 4 - Particles as waves

6. Calculate the de Broglie wavelength of a particle (such as an electron) given its velocity, momentum and/or kinetic energy. When would you need to use relativity equations and when are Newtonian equations ok? (HW 4, problems 1, 5)
7. Describe one experiment that supports the wave nature of an electron. (book)
8. Describe how the properties of a particle (momentum and energy) are "encoded" in a wave function. (book & notes)
9. Be able to apply position-momentum and energy-time uncertainty principles. (HW 4, problems 17, 18, 21)
10. Be able to sketch a wave function for a variety of potentials: infinite potential well, finite potential well, etc. Describe the general behavior of a wave function in classically allowed regions and classically forbidden regions. (notes)

Complex Numbers

11. Convert between $z = a + bi$ form and polar form $z = |z|e^{i\phi}$ (HW 7, problems 1-3)
12. Given a complex number z, find its complex conjugate, real part, imaginary part and angle in the complex plane (HW 7, problems 1-3)
13. Apply Euler's formula (HW 7, problems 4-6)
14. Know the form of a complex traveling wave (moving right or left) and harmonic standing waves. (HW 7, problems 6-8)

15. Add, subtract, multiply and divide complex numbers (HW 7, all problems)

Chapter 5 - Schrödinger's Equation

16. Be able to plug a wave function into either the time-dependent or time-independent Schrödinger equation to determine if it is a solution. (notes, lecture)
17. Conceptually draw standing wave functions for a given potential well or barrier to show how the amplitude and wavelength vary in space as the potential changes in both classically allowed and classically forbidden regions. (HW 8, problems 30, 32, lab activity)
18. Calculate probability of finding a particle in a region $a < x < b$ given its wave function (HW 8, problem 8, 10, 14)
19. Evaluate the expectation value of x and x^2 given a wave function. Use these values to calculate the uncertainty in the position Δx. (HW 8, problem 10, 33, 34)
20. Use boundary conditions to simplify general solutions to the Schrödinger equation and find constraints on the allowed energy states (HW 8, problems 28, 30)
21. Create energy level diagrams for the infinite potential well in 1D, 2D and 3D. Identify any degeneracies present (HW 9, problems 16, 17, 19)
22. Follow the steps for solving the 1D Schrödinger equation given a problem using piece-wise constant potentials. (notes, as wells a parts of many of the Chapter 5 homework problems)
23. Use the normalization condition to solve for amplitude parameter of a wave function. Be able to do this for piece-wise functions defined on multiple domains. (HW 8, problems 8, 10, 13)
24. Calculate the probability for transmission and reflection from a step potential (notes, lecture)
25. Calculate the probability for tunneling through a potential barrier (HW 9, Chappell 1)
26. Describe the paradox of Schrödinger's cat. What aspect of quantum mechanics is Schrödinger's cat meant to highlight? (notes, lecture)

Chapter 7 - Hydrogen Atom, Angular Momentum and Spin

27. Be able to list all the quantum numbers for the hydrogen atom for a given principle quantum number n in the hydrogen atom. Don't forget spin.
28. For a given l and m_l value, calculate the magnitude of the angular momentum vector, the z-component of the angular momentum vector and the angle $\vec{\mathbf{L}}$ makes with the z axis.

Know the contributions of the following Physicists:

Thomas Young	Albert Michelson
Albert Einstein	J.J. Thomson
Ernest Rutherford	Marie Curie
Max Planck	Arthur Compton
Luis de Broglie	George Thomson
Werner Heisenberg	Niels Bohr
Erwin Schrodinger	