Modern Physics John U. Free
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Study Guide #3

Chapters 8, 9*, 10*, 11*, and 12 * indicates part of the chapter

Objectives:
After studying this chapter you should:

The Schrödinger's Equation in Three Dimensions

1. Know how quantum numbers arise in the solution of the Schrödinger equation in more than one dimension.
2. be able to discuss the general features of the solution to Schrödinger equation for the three dimensional infinite square well.
3. Be able to discuss the general features of the wave functions found for a spherically symmetric potential (central force).
4. be able to pick the probability distribution for a given spherical harmonic.
5. Know the origin of the quantum numbers n, l, and m_l: know the possible values for these numbers; and know their relation to the quantization of angular momentum and energy.
6. be able to sketch the wave functions and probability distribution functions for the different states of hydrogen.
7. be able to discuss the similarities and differences between the Bohr model and Schrödinger -equation treatment of the hydrogen atom.

Atomic Physics

1. Know the connection between magnetic moment and angular momentum.
2. be able to explain space quantization.
3. be able to describe the Stern-Gerlach experiment.
4. be able to explain the Zeeman effect.
5. be able to discuss qualitatively the spin-orbit effect.
6. Know the rules for the combination of two angular-momentum vectors.
7. be able to discuss the effect of electron spin on the periodic table, and understand the origin of the electron configurations for the ground states of atoms.
8. Understand the general features of the energy-level diagram of a one-electron atom such as sodium, and of a two-electron atom such as mercury.
9. Understand spectroscopic notation for atomic spectra.
10. be able to state and use the selection rules.

Molecular Structure and Spectra

1. be able to discuss ionic and covalent bonding.
2. Know the general features of the energy-level diagram for a diatomic molecule and be able to discuss the vibration-rotation spectrum.
3. be able to use figure 11.17 to explain the energy diagrams, figures 11.16, 11.20, and 11.21
4. Know why only certain lines are seen in the emission and absorption spectrum.

Statistical Physics

1. be able to state and discuss the Maxwell-Boltzmann distribution
4. be able to state and discuss the Fermi-Dirac distributions.
5. be able to create Figure 10.1 for all three distributions and from this get Figures 10.2, 10.6, and 10.7.
6. be able to discuss the Fermi-Dirac statistics for a free-electron gas.
7. be able to define and discuss density of states, Fermi energy, Fermi velocity, and Fermi temperature.
8. be able to discuss Figures 10.11 and 10.12.
9. be able to explain why the heat capacity for electrons is so small.

The Solid State

1. be able to discuss the Druda model for conduction.
2. Explain how the Druda model is modified by Quantum theory.
3. be able to state and discuss the Widermann-Franz law.
4. be able to discuss the band theory for solids using the isolated atom approach.
5. be able to discuss the band theory of solids using the Kroning-Penny model.
6. be able to discuss semiconductors using the band theory.
7. be able to discuss doping in semiconductors using band theory.
8. be able to discuss or explain: p-type, n-type, donor, acceptor, extrinsic, intrinsic, majority carriers, and minority carriers.
9. Be able to discuss how a diode, LED, CCD, solid state laser, and FET work.