

Chapter 21: Atomic Physics

Holt Text Sections

- 21-1 Quantization of Energy
- 21-2 Models of the Atom
- 21-3 Quantum Mechanics

Summary

Chapter 21 discusses the beginning of quantum physics, which treats the behavior of microscopic systems. Quantization, the photon and its interactions with matter, wave-particle duality and its implications for subatomic particles, early models of the atom, de Broglie's hypothesis, and atomic spectra are presented. The chapter ends with information on the early quantum mechanical model of hydrogen. Data are presented that are inconsistent with the earlier atomic models but support the quantum model. Also, the Heisenberg Uncertainty Principle is discussed

Major Concepts

By the end of the chapter, you should understand each of the following and be able to demonstrate their understanding in problem applications as well as in conceptual situations.

- Quantization of energy
 - Planck's constant
- Photons
 - Energy
 - Momentum
- Photoelectric effect
 - Work function
 - Cutoff frequency
- Wave-particle duality
- The de Broglie hypothesis
- Early models of the atom
 - Thomson model
 - Rutherford model
- Bohr model
 - Hydrogen spectrum
 - Assumptions
 - Orbits and energies
- Heisenberg Uncertainty Principle

Formulas

$$\frac{e}{m} = \frac{E}{B^2 r}$$

$$E = nhf \quad \text{where } h = 6.63 \times 10^{-34} \text{ js}$$

$$KE_{\text{MAX}} = hf - hf_T \quad \text{where } hf_T \text{ is called the work function}$$

$$KE_{\text{MAX}} = q_e V_0$$

$$p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$$

$$\lambda = \frac{h}{p} \quad \text{you may substitute "mv" for "p" for objects with mass}$$

$$L = mvr_n = n \frac{h}{2\pi}, \quad n = 1, 2, 3, \dots$$

$$r_n = r_1 (n^2/Z) \quad \text{where } Z \text{ is the number of } + \text{ charges in the nucleus}$$

For hydrogen, $r_1 = 0.529 \times 10^{-10} \text{ m}$

$$E_n = -13.6 \text{ eV } (Z^2/n^2) \quad \text{For hydrogen, } E_1 = -13.6 \text{ eV}$$