Reading and Problem Assignment #3

Reading Assignment:
Oxtoby: Chapter 1, section 4 (pp. 15-19)
Chapter 15, pp. 522-537.

Problem Assignment
Chapter 1, problem 43
Chapter 15, odd-numbered problems 1-23, 65-69.

Additional Problems III

1. Describe briefly what J. J. Thomson's experiments revealed about the properties of the electron.

2. Describe briefly what Robert Millikan's "oil drop" experiments revealed about the properties of the electron.

3. Discuss briefly the important conclusion about the electron that was reached by combining the results of Thomson's and Millikan's experiments.

4. The density of gold metal is 19.3 g/cm³. Assuming that the metal is made up of a lattice of closest-packed spherical atoms in which the atoms occupy 74% of the available space, calculate the radius of these atoms.

5. Explain why the results of Rutherford's experiments were surprising. As a result of his experiments, what did Rutherford conclude about the distribution of charge within an atom? Explain how he arrived at this conclusion.

6. A helium-neon laser emits an intense monochromatic light beam with a wavelength of 6328 Å. Calculate the angles at which the first- and second-order diffractions will be observed using a diffraction grating with 13,400 lines/inch.

7. The details of the wavelength dependence of the intensity of blackbody radiation were inconsistent with the predictions of "classical" physics. Explain what is meant by "the ultra-violet catastrophe". Explain the revolutionary postulate proposed by Max Planck to explain the wavelength dependence of the intensity of blackbody radiation. In what way did this postulate differ from the predictions of classical physics?

8. Describe the postulate introduced by Einstein to explain the photoelectric effect. Discuss briefly the similarities between this postulate and that proposed by Planck to explain blackbody radiation.

9. In the classical wave theory of light, intensity was associated with the squares of the maximum amplitudes of the electric and magnetic fields associated with the oscillating electromagnetic (EM) wave. In the particle theory of light, what property of the model is associated with the intensity of light?