Practice Problems

For problems 33–34, see Sample Problem D.

33. How fast must an electron move if it is to have a de Broglie wavelength of 5.2×10^{-11} m?

34. Calculate the de Broglie wavelength of a 0.15 kg baseball moving at 45 m/s.

MIXED REVIEW

35. A light source of wavelength λ illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 1.00 eV. A second light source of wavelength $\frac{1}{2}\lambda$ ejects photoelectrons with a maximum kinetic energy of 4.00 eV. What is the work function of the metal?

36. A 0.50 kg mass falls from a height of 3.0 m. If all of the energy of this mass could be converted to visible light of wavelength 5.0×10^{-7} m, how many photons would be produced?

37. Red light ($\lambda = 670.0$ nm) produces photoelectrons from a certain material. Green light ($\lambda = 520.0$ nm) produces photoelectrons from the same material with 1.50 times the previous maximum kinetic energy. What is the material's work function?

38. Find the de Broglie wavelength of a ball with a mass of 0.200 kg just before it strikes the Earth after it has been dropped from a building 50.0 m tall.

Alternative Assessment

1. Calculate the de Broglie wavelength for an electron, a neutron, a baseball, and your body, at speeds varying from 1.0 m/s to 3.0×10^{7} m/s. Organize your findings in a table. The distance between atoms in a crystal is approximately 10^{-10} m. Which wavelengths could produce diffraction patterns using crystal as a diffraction grating? What can you infer about the wave characteristics of large objects? Explain your conclusions.

2. Bohr, Einstein, Planck, and Heisenberg each received the Nobel Prize for their contributions to twentieth-century physics. Their lives were also affected by the extraordinary events of World War II. Research their stories and the ways the war affected their work. What were their opinions about science and politics during and after the war? Write a report about your findings and about the opinions in your groups regarding the involvement and responsibility of scientists in politics.

3. Conduct research on the history of atomic theory. Create a timeline that shows the development of modern atomic theory, beginning with John Dalton's contributions in 1808. Include the discoveries of J.J. Thomson, Ernest Rutherford, Niels Bohr, and Erwin Schrodinger. You may also include other significant discoveries in the history of atomic theory. In addition, add historical events to the timeline to provide context for the scientific discoveries, and include illustrations with key entries.

4. Choose a simple element, and then create three-dimensional models of an atom of this element. Create at least three different models, corresponding to different versions of atomic theory throughout history. Include information about which historical theories you are representing in each model, and which parts of those theories are no longer accepted today. Also include information about the limitations of your models.