Problem 11.34. Within the Rosette Nebula shown in the photograph opening this chapter, a hydrogen atom emits light as it undergoes a transition from the $n = 3$ state to the $n = 2$ state. Calculate (a) the energy, (b) the wavelength, and (c) the frequency of the radiation.

Problem 11.35. (a) What value of $n_i$ is associated with the 94.96 nm spectral line in the Lyman series of hydrogen? (b) Could this wavelength be associated with the Paschen series or the Balmer series?

Problem 11.36. For a hydrogen atom in its ground state, use the Bohr model to compute (a) the orbital speed of the electron, (b) the kinetic energy of the electron, and (c) the electric potential energy of the atom.

Problem 11.37. Four possible transitions for a hydrogen atom are as follows:

(i) $n_i = 2; n_f = 5$  
(ii) $n_i = 5; n_f = 3$  
(iii) $n_i = 7; n_f = 4$  
(iv) $n_i = 4; n_f = 7$

(a) In which transition is light of the shortest wavelength emitted? (b) In which transition does the atom gain the most energy? (c) In which transition(s) does the atom lose energy?

Problem 11.38. How much energy is required to ionize hydrogen (a) when it is in the ground state and (b) when it is in the state for which $n = 3$?

Problem 11.41. Two hydrogen atoms collide head-on and end up with zero kinetic energy. Each atom then emits light with a wavelength of 121.6 nm ($n = 2$ to $n = 1$ transition). At what speed were the atoms moving before the collision?