7-1: (a) Using Equations (7.4) and (6.41), the energy difference is
\[ \Delta E = 2 \mu_{zz} B = 2 \mu_B B = 2 \left( 5.788 \times 10^{-5} \text{ eV/T} \right) \left( 1.20 \text{ T} \right) = 1.39 \times 10^{-4} \text{ eV}. \]

(b) The wavelength of the radiation that corresponds to this energy is
\[ \lambda = \frac{hc}{\Delta E} = \frac{1.240 \times 10^{-6} \text{ eV} \cdot \text{m}}{1.389 \times 10^{-4} \text{ eV}} = 8.93 \text{ mm}. \]

Note that a more precise value of \( \Delta E \) was needed in the intermediate calculation to avoid roundoff error.

7-6: Because the system of electrons has the minimum total energy possible, each of the lowest five energy states is occupied by two electrons, with one of each spin. The lowest unoccupied level is the sixth, and the energy of the photon would be
\[ \Delta E = \frac{\hbar^2}{8 mL^2} \left( 6^2 - 1^2 \right) = \frac{(6.626 \times 10^{-34} \text{ J} \cdot \text{s})^2}{8 \left( 9.1095 \times 10^{-31} \text{ kg} \right) \left( 1.00 \times 10^{-9} \text{ m} \right)} = 2.11 \times 10^{-18} \text{ J} = 13.1 \text{ eV}. \]

7-13: All of the atoms are hydrogen-like, in that there is a completely filled subshell that screens the nuclear charge and causes the atom to “appear” to be a single charge. The outermost electron in each of these atoms is further from the nucleus for higher atomic number, and hence has a successively lower binding energy.

7-25: The possible values of \( l \) are \( j + \frac{1}{2} = 3 \) and \( j - \frac{1}{2} = 2 \).

7-31: The two 3s electrons have no orbital angular momentum, and their spins are aligned oppositely to give no net angular momentum. The 3p electron has \( l = 1 \), so \( L = 1 \), and in the ground state \( J = \frac{1}{2} \). The term symbol is \(^2P_{1/2}\).

7-40: Equation (7.21) is solved for \( Z \) in terms of \( \lambda = \frac{c}{\nu} \) as
\[ (Z - 1)^2 = \frac{4}{3R\lambda}, \quad Z = 1 + \sqrt{\frac{4}{3R\lambda}}. \]

Using the given value for the wavelength,
\[ Z = 1 + \sqrt{\frac{4}{3 \left( 1.097 \times 10^7 \text{ m}^{-1} \right) \left( 0.144 \times 10^{-9} \text{ m} \right)}} = 30 \]
to the nearest integer, which is the atomic number of zinc.