

7 • Atomic Structure

CALCULATION PRACTICE — 2

Formulas and Constants

$c = \lambda \nu$	$E = h\nu$	$E = \frac{hc}{\lambda}$	$E_n = -\frac{Rhc}{n^2}$	$\lambda = \frac{h}{mv}$	$\frac{1}{\lambda} = R \left(\frac{1}{2^2} - \frac{1}{n^2} \right)$
$c = 2.998 \times 10^8 \text{ m/s}$	$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$	$Rhc = 2.18 \times 10^{-18} \text{ J}$	$R = 1.0974 \times 10^7 \text{ m}^{-1}$		

- Sketch the electron energy levels (n=1 through n=5) for the hydrogen atom.
- Calculate the energy of an electron in the n=2 energy level of hydrogen. Calculate the energy of an electron in the n=3 energy level. What is the difference in energy of these two levels? If a photon of light had this energy, what would its wavelength be?
- Use the Rydberg equation above to calculate the wavelength of a photon when n=3. How does this compare with your answer in question 2?
- An electron moves from the n=5 to the n=1 quantum level and emits a photon with an energy of $2.093 \times 10^{-18} \text{ J}$. How much energy must the atom absorb to move an electron from n=1 to n=5? What is the wavelength of this energy?
- An electron moves with a velocity of $2.5 \times 10^8 \text{ cm/s}$. What is its wavelength? (The mass of an electron is $9.109 \times 10^{-28} \text{ g}$.)
- Calculate the wavelength (in nanometers) associated with a $1.0 \times 10^2 \text{-g}$ golf ball moving at $30. \text{ m/s}$ (about 67 mph). How fast must the ball travel to have a wavelength of $5.6 \times 10^{-3} \text{ nm}$?