Session #5: Homework Solutions

Problem #1

A line of the Lyman series of the spectrum of hydrogen has a wavelength of 9.50×10^{-8} m. What was the "upper" quantum state (n_i) involved in the associated electron transition?

Solution

The Lyman series in hydrogen spectra comprises all electron transitions terminating in the ground state (n=1). In the present problem it is convenient to convert λ into $\bar{\nu}$ and to use the Rydberg equation. Since we have an "emission spectrum", the sign will be negative in the conventional approach. We can avoid the sign problem, however:

$$\bar{\nu} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = R\left(1 - \frac{1}{n_i^2}\right)$$

$$\frac{\bar{\nu}}{R} = \left(1 - \frac{1}{n_i^2}\right)$$

$$\frac{1}{n_i^2} = 1 - \frac{\bar{\nu}}{R} = \frac{R - \bar{\nu}}{R}$$

$$n_i^2 = \frac{R}{R - \bar{\nu}}$$

$$n_i^2 = \sqrt{\frac{R}{R-\bar{\nu}}} \qquad \bar{\nu} = \frac{1}{9.5 \times 10^{-8}\text{m}} = 1.053 \times 10^7 \ \text{m}^{-1}$$

$$n_i = \sqrt{\frac{1.097 \times 10^7}{1.097 \times 10^7 - 1.053 \times 10^7}} = 5$$

Problem #2

List the possible values of the four quantum numbers for a 2p electron in boron.

Solution

For 2p

n	l	m	s
2	1	-1	½
2	1	-1	-½
2	1	0	½
2	1	0	-½
2	1	1	½
2	1	1	-½