44. (a) The calculation is shown in Sample Problem 40-6. The difference in the values obtained in parts (a) and (b) of that Sample Problem is $122\,\text{nm} - 91.4\,\text{nm} \approx 31\,\text{nm}$.

(b) Fig. 40-17 shows that the width of the Balmer series is $656.3\,\text{nm} - 364.6\,\text{nm} \approx 292\,\text{nm}$. This can be confirmed with a calculation very much like the one shown in Sample Problem 40-6, but with the longest wavelength arising from the $3 \to 2$ transition, and the series limit obtained from the $\infty \to 2$ transition.

(c) We use Eq. 39-1. For the Lyman series,

$$\Delta f = \frac{2.998 \times 10^8\,\text{m/s}}{91.4 \times 10^{-9}\,\text{m}} - \frac{2.998 \times 10^8\,\text{m/s}}{122 \times 10^{-9}\,\text{m}} = 8.2 \times 10^{14}\ \text{Hz}$$

or 8.2×10^2 THz. For the Balmer series,

$$\Delta f = \frac{2.998 \times 10^8\,\text{m/s}}{364.6 \times 10^{-9}\,\text{m}} - \frac{2.998 \times 10^8\,\text{m/s}}{656.3 \times 10^{-9}\,\text{m}} = 3.65 \times 10^{14}\ \text{Hz}$$

which is equivalent to 365 THz.