

36. (a) The “home-base” energy level for the Balmer series is $n = 2$. Thus the transition with the least energetic photon is the one from the $n = 3$ level to the $n = 2$ level. The energy difference for this transition is

$$\Delta E = E_3 - E_2 = -(13.6 \text{ eV}) \left(\frac{1}{3^2} - \frac{1}{2^2} \right) = 1.889 \text{ eV} .$$

Using the result of problem 3 in Chapter 39, the corresponding wavelength is

$$\lambda = \frac{hc}{\Delta E} = \frac{1240 \text{ eV} \cdot \text{nm}}{1.889 \text{ eV}} = 658 \text{ nm} .$$

- (b) For the series limit, the energy difference is

$$\Delta E = E_\infty - E_2 = -(13.6 \text{ eV}) \left(\frac{1}{\infty^2} - \frac{1}{2^2} \right) = 3.40 \text{ eV} .$$

The corresponding wavelength is then

$$\lambda = \frac{hc}{\Delta E} = \frac{1240 \text{ eV} \cdot \text{nm}}{3.40 \text{ eV}} = 366 \text{ nm} .$$