

3.091 Fall Term 2009
Homework Quiz #2A
 solution outline

Morning sections' question.

- (a) Show by means of a calculation that blue light of wavelength, $\lambda = 444 \text{ nm}$, is not capable of exciting electrons in $\text{Li}^{2+}(\text{g})$ from the state $n = 2$ to $n = 4$.

let's equate the energy required to excite electrons in $\text{Li}^{2+}(\text{g})$ from the state $n = 2$ to $n = 4$ with the minimum energy needed from an incident photon to cause the excitation

$$\frac{hc}{\lambda} = KZ^2 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$\therefore \lambda = \frac{hc}{KZ^2 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)} = \frac{6.6 \times 10^{-34} \times 3.00 \times 10^8}{2.18 \times 10^{-18} \times 3^2 \left(\frac{1}{2^2} - \frac{1}{4^2} \right)}$$

$$= 5.38 \times 10^{-8} \text{ m} = 53.8 \text{ nm} < 444 \text{ nm}$$

\therefore since E scales with $1/\lambda$, blue light of wavelength $\lambda = 444 \text{ nm}$ does not have enough energy per photon to cause the excitation

- (b) Is the value of the energy of transition from the state $n = 2$ to $n = 4$ in Li^{2+} , $\Delta E_{2 \rightarrow 4}$, greater than or less than the value of the energy of transition from the state $n = 1$ to $n = 2$ in Li^{2+} , $\Delta E_{1 \rightarrow 2}$? Explain with the use of an energy level diagram. There is no need to calculate the values of the two quantities.

