

3.091 Fall Term 2002  
**Homework Quiz #2A**  
solution

Are photons of wavelength,  $\lambda = 3.091 \times 10^{-8}$  m, capable of ionizing ground-state electrons in  $\text{He}^+$ ? Support your answer with calculations.

the criterion is this: is the energy of the incident photon greater than the ionization energy?

if  $E_{\text{incident photon}} > \text{I.E.}$ , then the answer is yes.

$$E_{\text{incident photon}} = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34})(2.998 \times 10^8)}{3.091 \times 10^{-8}} = 6.427 \times 10^{-18} \text{ J}$$

$$\text{I.E.} = E_{\infty} - E_1 = 0 - \left(-\frac{KZ^2}{n^2}\right), \text{ where } Z = 2 \text{ and } n = 1 \text{ for the ground-state of } \text{He}^+$$

$$\frac{KZ^2}{n^2} = \frac{(2.180 \times 10^{-18})(2^2)}{1^2} = 8.721 \times 10^{-18} \text{ J}$$

since  $E_{\text{incident photon}} < \text{I.E.}$ , the photons are not capable of ionizing ground-state electrons in  $\text{He}^+$