Chapter 34 Problem 27 [†]

Solution
Find the maximum wavelength to ionize hydrogen.

For a hydrogen atom in the ground state the energy of the electron is $-13.6\ eV$. To ionize the atom $13.6\ eV$ must be gained by an incident photon. Converting this energy into joules gives

$$E = 13.6\ eV\left(\frac{1.6\times10^{-19}\ J}{1\ eV}\right) = 2.18\times10^{-18}\ J$$

The relationship between energy and frequency is

$$E = h\cdot f \tag{1}$$

and the relationship between frequency and wavelength is

$$c = \lambda\cdot f \tag{2}$$

Using equation (2) to eliminate frequency is equation (1) gives

$$E = \frac{hc}{\lambda}$$

Solving for wavelength gives

$$\lambda = \frac{hc}{E}$$

The minimum wavelength is then

$$\lambda = \frac{(6.63\times10^{-34}\ J\cdot s)(3.00\times10^{8}\ m/s)}{2.18\times10^{-18}\ J} = 9.12\times10^{-8}\ m$$

$$\lambda = 91.2\ nm$$

This wavelength falls within the ultraviolet range of the electromagnetic spectrum.

[†]Problem from Essential University Physics, Wolfson