Answer on Question #48374-Physics-Atomic Physics

1. What is the frequency of a photon with a wavelength of $\lambda = 1040\ nm$. Report your answers to three significant digits.

The frequency is = _____ s-1

2. What is the energy of a photon with a wavelength of 260 nm. Report your answers to three significant digits.

3. In the Bohr model of the hydrogen atom, the n=1 to n=4 electronic transition corresponds with an _____ of energy; the change in the energy of the atom in this process is a _____ value.

Solution

1. The frequency of a photon is

$$f = \frac{c}{\lambda} = \frac{3 \cdot 10^8 \frac{m}{s}}{1040 \cdot 10^{-9} m} = 2.88 \cdot 10^{14} Hz.$$

2. The energy of a photon is

$$E = hf = h\frac{c}{\lambda} = 6.63 \cdot 10^{-34} J \cdot s \cdot \frac{3 \cdot 10^8 \frac{m}{s}}{260 \cdot 10^{-9} m} = 7.65 \cdot 10^{-19} J.$$

3. According to Bohr's equation, the energy change for the atom is

$$\Delta E = R\left(\frac{1}{1^2} - \frac{1}{4^2}\right) = 2.179 \cdot 10^{-18}\left(\frac{15}{16}\right) J = 2.04 \cdot 10^{-18} J.$$

In the Bohr model of the hydrogen atom, the n=1 to n=4 electronic transition corresponds with an increasing of energy; the change in the energy of the atom in this process is a $2.04 \cdot 10^{-18} J$ value.