Quiz 6.1 – Light and the Bohr Model

Name: Key

Question 1

What is the frequency and energy-per-photon of light with $\lambda = 2.5 \times 10^{-6} m$?

$$E = \frac{hc}{\lambda} = \frac{6.626 \cdot 10^{-34}\ J\cdot s \cdot 2.998 \cdot 10^{8}\ m/s}{2.5 \cdot 10^{-6}\ m} = 7.9 \cdot 10^{-20}\ J$$

$$\nu = \frac{c}{\lambda} = \frac{2.998 \cdot 10^{8}\ m/s}{2.5 \cdot 10^{-6}\ m} = 1.2 \cdot 10^{14}\ s^{-1}$$

Question 2

SUU broadcasts a radio station at $91.1 MHz$, or $9.11 \times 10^{7} s^{-1}$. What is the wavelength and energy-per-photon of the light emitted by SUUs radio tower?

$$\lambda = \frac{c}{\nu} = \frac{2.998 \cdot 10^{8}\ m/s}{9.11 \cdot 10^{7}\ s^{-1}} = 3.29\ m$$

$$E = h\nu = 6.626 \cdot 10^{-34}\ J\cdot s \cdot 9.11 \cdot 10^{7}\ s^{-1} = 6.04 \cdot 10^{-26}\ J$$

Question 3

Give the energy of the hydrogen atom state $n = 5$

$$E = -2.179 \cdot 10^{-18}\ J \cdot \frac{1}{25} = -8.716 \cdot 10^{-20}\ J$$

Question 4

Give the energy and wavelength of light emitted by the $2 \leftarrow 4$ transition in a H-spectrum

$$\Delta E = 2.179 \cdot 10^{-18}\ J \left(\frac{1}{4} - \frac{1}{16}\right) = 4.086 \cdot 10^{-19}\ J$$

$$\frac{1}{\lambda} = 1.097 \cdot 10^{7}\ m^{-1} \left(\frac{1}{4} - \frac{1}{16}\right) = 2.057 \cdot 10^{6}\ m^{-1} \rightarrow \lambda = \frac{1}{2.057 \cdot 10^{6}\ m^{-1}}$$

$$\lambda = 4.862 \cdot 10^{-7}\ m$$

$$486.2\ nm$$