Answer on Question 58593, Physics, Quantum Mechanics

Question:

An atom absorbs a photon having wavelength $375\ nm$ and immediately emits another photon having wavelength of $580\ nm$. What was the net energy absorbed by atom in this process?

Solution:

The net energy absorbed by the atom in this process is simply the difference of energies of two photons:

$$\Delta E = E_1 - E_2.$$

There is an inverse relationship between the energy of the photon and the wavelength of the light given by the equation:

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

here, $h = 6.626 \cdot 10^{-34}\ J \cdot s$ is Planck's constant, c is the speed of light, λ is the wavelength of the light.

Therefore, we can rewrite the first formula:

$$\Delta E = E_1 - E_2 = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_2} = hc\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right).$$

Let's substitute the numbers:

$$\Delta E = hc\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right) =$$

$$= 6.626 \cdot 10^{-34}\ J \cdot s \cdot 3 \cdot 10^8\ \frac{m}{s} \cdot \left(\frac{1}{375 \cdot 10^{-9}\ m} - \frac{1}{580 \cdot 10^{-9}\ m}\right) =$$

$$= 1.87 \cdot 10^{-19}\ J.$$

Answer:

$\Delta E = 1.87 \cdot 10^{-19}\ J.$