

Answer on Question #66976 - Chemistry - General Chemistry

Question: A photon of violet light has a wavelength of 423 nm. Calculate the frequency, the energy in joules per photon and the energy in kilojoules for a mole of photons.

Solution

1) The frequency of the photon can be calculated by the equation ($c \approx 3 \cdot 10^8$ m/s – speed of light in vacuum, λ – wavelength (m)):

$$f = \frac{c}{\lambda} = \frac{3 \cdot 10^8 \text{ m/s}}{423 \cdot 10^{-12} \text{ m}} \approx 7.092 \cdot 10^{17} \text{ s}^{-1}.$$

2) The energy of the photon can be calculated by the equation ($h \approx 6.626 \cdot 10^{-34}$ J*s – Planck constant):

$$E = \frac{h \cdot c}{\lambda} = h \cdot f = 6.626 \cdot 10^{-34} \text{ J} \cdot \text{s} \cdot 7.092 \cdot 10^{17} \text{ s}^{-1} \approx 4.699 \cdot 10^{-16} \text{ J}.$$

3) The energy for a mole of photons can be calculated by the equation ($N_A \approx 6.022 \cdot 10^{23}$ mol⁻¹ – Avogadro constant):

$$E_M = E \cdot N_A = 4.699 \cdot 10^{-16} \text{ J} \cdot 6.022 \cdot 10^{23} \text{ mol}^{-1} \approx 2.829 \cdot 10^8 \text{ J} = 2.829 \cdot 10^5 \text{ kJ}.$$

Answer: the frequency of the photon is $7.092 \cdot 10^{17} \text{ s}^{-1}$, the energy of the photon is $4.699 \cdot 10^{-16} \text{ J}$, the energy for a mole of photons is $2.829 \cdot 10^5 \text{ kJ}$.