

Q- A 150 W light bulb emits about 8 W of visible light. (The other 142 W are emitted as infrared radiation or lost as heat to the surroundings.) The average wavelength of the visible light is about 510 nm, so make the simplifying assumption that all the visible light has this wavelength.

(a) What is the (average) frequency of the emitted light?

The frequency of any wave is related to its wavelength as

$$\nu = \frac{c}{\lambda}$$

Here c is the wave velocity and λ is the wavelength.

Hence the frequency of the emitted light is given by

$$\nu = \frac{c}{\lambda} = \frac{3 * 10^8}{510 * 10^{-9}} = 5.88 * 10^{14} \text{ Hz}$$

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(b) How often are visible-light photons emitted by the bulb?

The energy of a photon is given by

$$U = h * \nu = 6.63 * 10^{-34} * 5.88 * 10^{14} = 3.90 * 10^{-19} \text{ J}$$

Hence the number of photons emitted per second is given by

$$n = P/U = 8 / (3.90 * 10^{-19}) = 2.05 * 10^{19}$$

$$2.05 * 10^{19} \text{ photons/s}$$

(c) Parts (a) and (b) are both a 'number of something' per second. Should your answers to parts (a) and (b) be the same?

No as (a) gives the number of oscillations per second in the light wave and (b) gives the number of light particles emitted per second.