Problem-solving Example 5:

If the frequency of a laser light is 4.85 x 10^{16} Hz, calculate the energy associated with :

a) **One quantum**
b) **One particle**
c) **One mole of particles**

Solution

Solution :

Given : $\nu = 4.85 \times 10^{16}\ Hz$

$$E = h\nu = (6.626 \times 10^{-34}\ Js)(4.85 \times 10^{16}\ Hz)$$

$$= 3.21 \times 10^{-17}\ J\,particle^{-1} \quad (Ans)$$

$$= 3.21 \times 10^{-17}\ J\,quantum^{-1} \quad (Ans)$$

$$= 3.21 \times 10^{-17} \times \left(\frac{6.023 \times 10^{23}\ particles}{1\ mole}\right)$$

$$= 1.93 \times^{7}\ J\,mole^{-1}\ particles \quad (Ans)$$

(E in $J\,particle^{-1}$ OR $J\,quantum^{-1}$)

Review Questions

Which has more energy : one quantum of red light or blue light which have wavelength of 657.8 nm and 431.7 respectively.

Remember !

$$E = h\nu = \frac{hc}{\lambda} = hc\bar{\nu}$$

$$\left(\because \nu = \frac{c}{\lambda} \; ; \; \bar{\nu} = \frac{1}{\lambda}\right)$$

Note that E is proportional to ν (frequency) and to $\bar{\nu}$ (wave number) but inversely proportional to λ.

ie $E \propto \nu$ and $E \propto \bar{\nu}$ but $E \propto \frac{1}{\lambda}$

unit : $J\,photon^{-1}$ @ $J\,quantum^{-1}$ @ $J\,particle^{-1}$

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