**Answer on** Question #65231, Physics / Optics

Two energy levels of an atomic system are separated by energy corresponding to frequency 3.0 × $10^{14}$ Hz. Assume that all atoms are in one or the other of these two energy levels, compute the fraction of atoms in the upper energy level at temperature 400 K. Take k = 1.38×$10^{-23}$JK−1 and h = 6.6×$10^{-34}$Js.

**Find:** $\frac{N_2}{N_1} - ?$

**Given:**

Δυ=3.0 × $10^{14}$ Hz

T=400 K

k=1.38×$10^{-23}$J×$K^{-1}$

h=6.6×$10^{-34}$J×s

**Solution:**

Boltzmann factor:

$\frac{N_2}{N_1} = \exp^{-\frac{E_1 - E_2}{kT}}$ (1), where level 2 ($N_2$) is higher than level 1 ($N_1$)

Energy difference:

$E_1 - E_2 = h\Delta\upsilon$ (2)

(2) in (1): $\frac{N_2}{N_1} = \exp^{-\frac{h\Delta\upsilon}{kT}}$ (3)

Of (3) $\Rightarrow \frac{N_2}{N_1} = \exp^{-\frac{6.6\times10^{-34}\times3.0\times10^{14}}{1.38\times10^{-23}\times400}} = \exp^{-35.9} \approx 0$