$$\boxed{\frac{n_{E_1}}{n_{E_0}}} = e^{-\frac{8,22\cdot 10^{-20}\,J}{1,3806\cdot 10^{-23}\,J/K\cdot 298K}} = \boxed{2\cdot 10^{-9}\,J}$$

Errotazionala

$$B = \frac{h}{8\pi^2 \times I \times c} \Rightarrow I = \frac{h}{8\pi^2 \times B \times c}$$

$$E_J = \frac{h^2 \cdot J\cdot(J+1)}{8\cdot \pi^2 \cdot I}$$

$$E_J = \frac{h^{\cancel{2}}\cdot J(J+1)}{\cancel{8\pi^2}\cdot \frac{\cancel{h}}{\cancel{8\pi^2}\cdot B\cdot c}} = B\cdot c\cdot h\cdot J(J+1)$$

$$E_{J_1} = 20,956\,cm^{-1}\cdot 2,998\cdot 10^{10}\,cm/s\cdot 6,62608\cdot 10^{-34}\,J/s\cdot 1\cdot(1+1) = 8,326\cdot 10^{-22}\,J$$

$$E_{J_0} = 0$$

$$\Delta E_J = 8,326\cdot 10^{-22}\,J$$

$$\boxed{\frac{n_{E_1}}{n_{E_0}}} = e^{-\frac{8,326\cdot 10^{-22}\,J}{1,3806\cdot 10^{-23}\cdot 298K}} = \boxed{0,817}$$

(3) Zein abiaduratan seituratu beharko litzateke kotxe bat argi gorri bat (660nm) argi berdea bezala (520nm) balitz bezala ikusteko?

$$\nu_{ikus} = \nu_{igor}\cdot\sqrt{\frac{1+s/c}{1-s/c}} \Rightarrow \left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2 = \frac{1+s/c}{1-s/c} \Rightarrow \left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2\cdot(1-s/c) = 1+s/c \Rightarrow$$

$$\left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2 - \left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2\cdot\frac{s}{c} = 1+\frac{s}{c} \Rightarrow \left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2 - 1 = \frac{s}{c}\ \left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2\cdot\frac{s}{c} \Rightarrow$$

$$\left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2 - 1 = \left(1+\left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2\right)\cdot\frac{s}{c} \Rightarrow \frac{c\left[\left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2 - 1\right]}{1+\left(\frac{\nu_{ikus}}{\nu_{igor}}\right)^2} = s$$

$$\nu = \frac{c}{\lambda} \Rightarrow \nu_{ikus} = \frac{2,998\cdot 10^8\,m/s}{520\cdot 10^{-9}\,m} = 5,77\cdot 10^{14}\,s^{-1}$$

$$\nu_{igor} = \frac{2,998\cdot 10^8\,m/s}{660\cdot 10^{-19}\,m} = 4,54\cdot 10^{14}\,s^{-1}$$

$$\boxed{s} = \frac{2,998\cdot 10^8\cdot\left[\left(\frac{5,77\cdot 10^{14}}{4,54\cdot 10^{14}}\right)^2 - 1\right]}{1+\left(\frac{5,77\cdot 10^{14}}{4,54\cdot 10^{14}}\right)^2} = \boxed{7,05\cdot 10^7\,m/s}$$