HW 10 due 12/6/2017

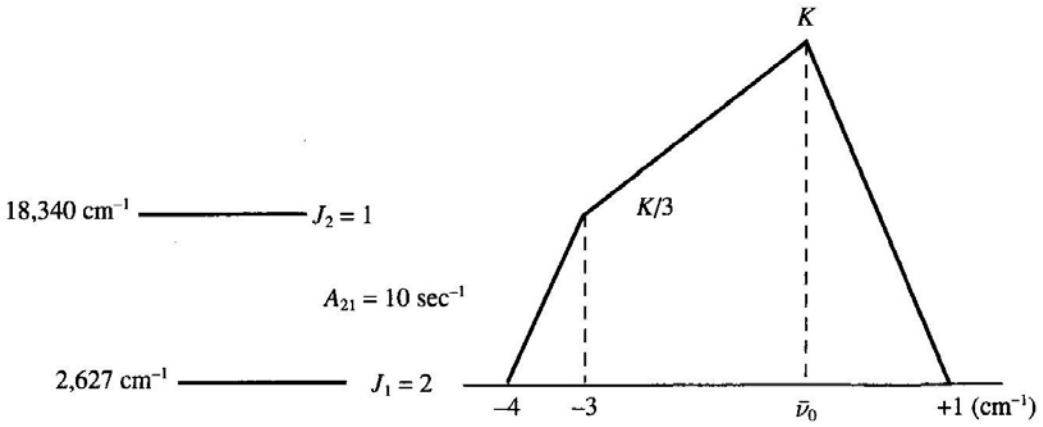
1) Consider a HeNe laser with a laser wavelength of 632.8nm and a linewidth of 1.5 GHz. Assume the length of the gain region is 30cm long, the index of refraction of the cavity is 1, the spontaneous lifetime is 20ms, the population in the upper-level laser state is 10^{16} atoms/cm^3 and the population in the lower state is 5×10^{14} atoms/cm^3. Assume that the degeneracy g_2 of the upper state is 3 and of the lower state g_1 is 5. Assume the line shape is **Gaussian, i.e. inhomogeneous lineshape**.

a) Calculate the emission cross section at central wavelength.
b) Calculate the gain coefficient γ at the central wavelength.
c) Calculate the gain for one pass. (10 points)

2) Exercise 14.1-1 (page 537) (1st Ed. Exercise 13.1-1 page 466) (10 points).

4) The spontaneous emission profile from a certain transition can be approximated by the shape shown in the diagram.

a) Find $\bar{\upsilon}_0$ in cm^{-1}.
b) What is the value of K? (make use of the definition of g(ν))
c) What is the stimulated emission cross section at $\bar{\upsilon}_0$? (10 points)



Extra-credit

6) The following is a tractable representation of the line shape for the helium/neon transition at $\lambda_0 = 632.8\text{nm}(3s_2 - 2p_4)$ which has A coefficient of $6.56\times10^6\ \text{sec}^{-1}$.

a) What is the value of $g(\upsilon_0)$?
b) What is the emission cross section υ_0? (10 points)