

Physics 100
Laser Module

Homework #4

Remember that you can consult with each other on how to approach problems, but that you should write up solutions on your own. *Please write explanations in **words*** for your solutions - do not just write equations and numbers.

1. In a simulation of a laser prototype, assume that there are a total of 10^{20} atoms.
 - a. If there are just 3 energy levels possible, with energies of -10 eV, -9.8 eV, and -9.4 eV, find the equilibrium populations of each state at room temperature (300 K). Remember that these are given by the Boltzmann distribution where the ratio of populations at equilibrium are $N_2 / N_1 = e^{-(E_2 - E_1)/k_B T}$, where $k_B = 1.38 \times 10^{-23}$ J/K and T is in K.
 - b. If the atoms are heated to 5000 K, find the equilibrium populations of the 3 states.
 - c. Assuming now that the -9.8 eV level is a metastable state, find the wavelength of the laser emission. What type of electromagnetic radiation does this laser emit?