Laser

1. Using Einstein's theory, check the possibility of amplification of radiation in optical region (say 5000 Å at 300K. [amplification not possible]

2. Show that, under thermal equilibrium, laser action is not possible in visible region at room temperature. At what temperature the laser action is possible and is it realizable? [Not realizable]

3. When in thermal equilibrium at T = 300 K, population ratio of upper level to lower level of a two-level atomic system is $1/e$. Calculate the frequency of this transition. In what region of the EM spectrum does this frequency fall? [6248 GHz, IR region]

4. What fraction of sodium atom is in the first excited state in a sodium vapour lamp at a temperature of 300 °C? [3.155×10^{-19}]

5. The population ratio of higher to lower energy level is 1.059×10^{-30}. Find the wavelength of light emitted at 330 K. [632 nm]

6. Consider a transition between a metastable state E_3 and an energy state $E_2 = 0.4 \times 10^{-19}$ J, which is just above the ground state. If the emission is at 1.1 μm, find the energy of metastable state. [2.2×10^{-19} J]

7. A He-Ne laser of wavelength 6328 Å is emitting a beam with an average power of 4.5 mW. Find the number of photons emitted per second by the laser. [1.46×10^{16}]

8. A He-Ne laser of wavelength 632.8 nm, focused on a circle of radius 2 mm, is emitting 9.55×10^{17} photons/minute. Compare the intensity of the laser with the intensity of a 100 W bulb on a person standing 10 m away from the bulb. [$I_L = 397.8$ Wm^{-2}, $I_B = 0.07957$ Wm^{-2}, $I_L/I_B = 4999$]

9. A semiconductor laser of wavelength 6500 Å having power of 1 mW is focused on a circle of radius 2 mm. Find the intensity of the focused beam. Compare this with intensity of 80 W bulb on a person standing 5 m away. [$I_L = 79.5$ Wm^{-2}, $I_B = 0.25$ Wm^{-2}, $I_L/I_B = 318$]

10. A He-Ne laser emits light at a wavelength of 632.8 nm and has an output power of 2.3 mW. How many photons are emitted in one minute by this laser? [4.39×10^{17}]

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