King Fahd University of Petroleum & Minerals

Physics Department

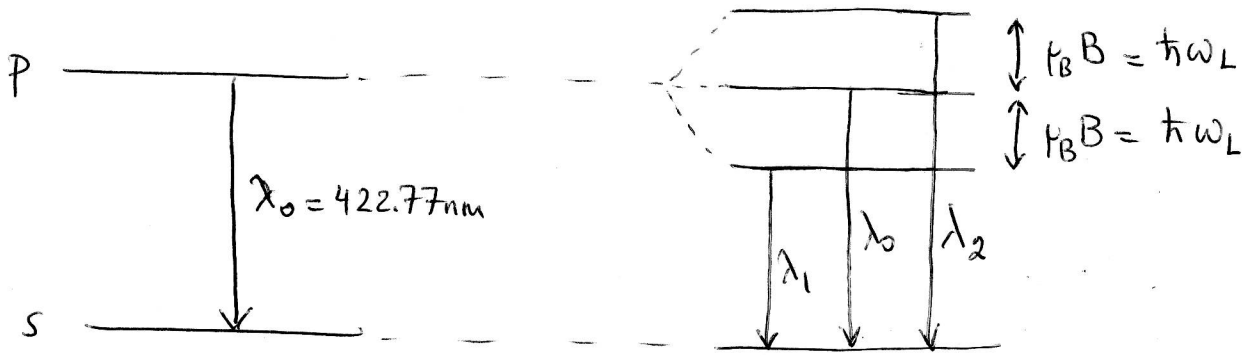
Phys212- Quiz#8

Name: Key ID#:

One of the most prominent spectral lines of calcium is the one with wavelength λ = 422.77 nm (from p→s). Calcium atoms exhibit normal Zeeman effect when placed in a uniform magnetic field of 4T.

Show a diagram of the transitions before and after the application of the magnetic field.

Calculate the wavelength of the three components of the normal Zeeman pattern and the separation between them.



Spectrum

$$\lambda_1 = \frac{hc}{\Delta E_1} = \frac{hc}{\hbar(\omega_0 - \omega_L)} = \frac{2\pi c}{\omega_0 - \omega_L} = 4.2276 \times 10^{-7}\ m$$

$$\lambda_2 = \frac{hc}{\Delta E_2} = \frac{hc}{\hbar(\omega_0 + \omega_L)} = \frac{2\pi c}{\omega_0 + \omega_L} = 4.2269 \times 10^{-7}\ m$$

$$\omega_0 = \frac{2\pi c}{\lambda_0} = \frac{2\pi \times 3 \times 10^8}{422.77 \times 10^{-9}} = 4.459 \times 10^{15}\ rad/s$$

$$\omega_L = \frac{eB}{2m_e} = \frac{1.6 \times 10^{-19} \times 4}{2 \times 9.1 \times 10^{-31}} = 3.516 \times 10^{11}\ rad/s$$