Gasiorowicz 3rd edition April 22, 2008
P7-7.

A system is described by the Hamiltonian

$$H = \frac{L^2}{2I} + \alpha L_z$$

What is the energy spectrum of the system?

Solution:

$$H|\ell, m> = \frac{L^2}{2I}|\ell, m> + \alpha L_z |\ell, m>$$

$$= \frac{\ell(\ell+1)\hbar^2}{2I}|\ell, m> + \alpha m\hbar |\ell, m>$$

$$= \left(\frac{\ell(\ell+1)\hbar^2}{2I} + \alpha m\hbar\right)|\ell, m>$$

Hence the energy spectrum is

$$\underline{\underline{E = \frac{\ell(\ell+1)\hbar^2}{2I} + \alpha m\hbar}}$$