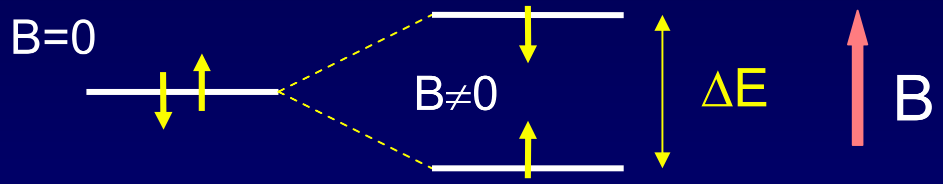
Solution

Magnetic resonance imaging (MRI) depends on the absorption of electromagnetic radiation by the nuclear spin of the hydrogen atoms in our bodies. The nucleus is a proton with spin ½, so in a magnetic field B there are two energy states. The proton's magnetic moment is $\mu_p = 1.41 \times 10^{-26}$ J /Tesla.



1) The person to be scanned by an MRI machine is placed in a strong (1 Tesla) magnetic field. What is the energy difference between spin-up and spin-down proton states in this field?

$$\Delta E = 2\mu_p B$$
$$= 2\cdot(1.41\times10^{-26}\ \text{J/T})\cdot(1\ \text{T})$$
$$= 2.82\times10^{-26}\ \text{J} = 1.76\times10^{-7}\ \text{eV}$$

2) What photon frequency, f, will be absorbed?

$$f = E/h$$
$$= (2.82\times10^{-26}\ \text{J})/(6.63\times10^{-34}\ \text{J}\cdot\text{s})$$
$$= 4.26\times10^{7}\ \text{Hz}$$