

Solutions

2.1 C $m_l + 2m_s = 1 - 1 = 0$. This statement uses the uncoupled regime.

Compare the rejected options: $-2\mu_B B$; $-\mu_B B$; $+\mu_B B$; $+2\mu_B B$. Use the stated model and conditions.

2.2 E Photon energy is $E_{\text{upper}} - E_{\text{lower}}$, so the change is $2u - (-u) = 3u$.

Compare the rejected options: $-3u$; $-u$; 0 ; $+u$. Use the stated model and conditions.

2.3 2/3. $1 + [3/4 + 3/4 - 2] / (2 \cdot 3/4) = 2/3$.

2.4 False. Off-diagonal dipole couplings can produce a quadratic shift; degeneracy changes the leading-order treatment.

3.1 Degenerate shifts are $\pm dF$, with eigenstates $(1, \pm 1)/\sqrt{2}$; splitting is $2|dF|$. With a large gap, each parity state's first-order diagonal shift is zero. Off-diagonal coupling instead gives ground shift approximately $-(dF)^2/\Delta$. Award shifts, states, splitting, vanishing nondegenerate first order and quadratic correction/condition.