g directly gives the relative separation of the Zeeman levels of all the different terms.

$g = 1 + \frac{J^2 + S^2 - L^2}{2J^2}$ (3)

We consider the example of splitting of a $^2P_{3/2}$ level in a weak magnetic field. Here $J = \frac{3}{2}$, there are four magnetic levels $m = \pm\frac{3}{2}$ and $\pm\frac{1}{2}$ shifted from the field free level by mg $= \frac{6}{3}, \frac{2}{3}, -\frac{2}{3}$ and $-\frac{6}{3}$.

The following table gives the quantum numbers necessary for the determination of mg

Magnetic Interaction Energy:

$\Delta T = mgL \ cm^{-1}$

$L = \frac{He}{4\pi mc^2}$ (Lorentz unit)

Terms	l	S	J	g	m_J	$m_J g$
$2S_{1/2}$	0	$\frac{1}{2}$	$\frac{1}{2}$	2	$\frac{1}{2}$ $-\frac{1}{2}$	1 -1
$2P_{1/2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	$2/3$	$\pm\frac{1}{2}$	$\pm\frac{1}{3}$
$2P_{3/2}$	1	$\frac{1}{2}$	$3/2$	$4/3$	$\pm\frac{3}{2}$ $\pm\frac{1}{2}$	$\pm\frac{6}{3}$, $\pm\frac{2}{3}$
$2D_{3/2}$	2	$\frac{1}{2}$	$3/2$	[illegible]	$\pm\frac{3}{2}$ $\pm\frac{1}{2}$	[illegible]
$2D_{5/2}$	2	$\frac{1}{2}$	$5/2$	$6/5$	[illegible]	[illegible]
[illegible]	3	$\frac{1}{2}$	[illegible]		[illegible]	
[illegible]	3	$\frac{1}{2}$	$7/2$		[illegible]	
$2G_{7/2}$	4	$\frac{1}{2}$	$7/2$			
$2G_{9/2}$	4	$\frac{1}{2}$	$9/2$			

(1) $g = 1 + \frac{J(J+1) - S(S+1) - l(l+1)}{2J(J+1)} = \frac{\frac{1}{2}(\frac{1}{2}+1) + \frac{1}{2}(\frac{1}{2}+1) - 0(0+1)}{2\frac{1}{2}(\frac{1}{2}+1)}$

$= 1 + \frac{\frac{1}{2}(\frac{3}{2}) + \frac{1}{2}(\frac{3}{2})}{3/2} \quad 1 + \frac{\frac{3}{4} + \frac{3}{4}}{3/2} = 1 + \frac{6}{4} \cdot \frac{2}{3} = 1 + 1 = 2$

(2) $g = 1 + \frac{\frac{1}{2} \times \frac{3}{2} + \frac{1}{2} \times \frac{3}{2} - 1 \times 2}{2\frac{1}{2}(\frac{1}{2}+1)} \quad 1 + \frac{\frac{3}{4} + \frac{3}{4} - 2}{3/2} \quad 1 + \frac{\frac{6}{4} - \dots}{3/2}$

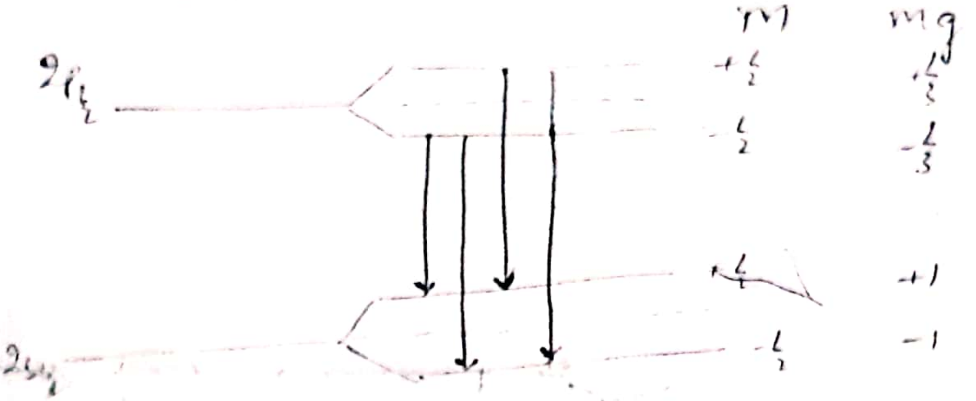
(3) $g = 1 + \frac{\frac{3}{2} \times \frac{5}{2} + \frac{1}{2} \times \frac{3}{2} - 1 \times 2}{2\frac{3}{2}(\frac{3}{2}+1)} \quad 1 + \frac{\frac{15}{4} + \frac{3}{4} - 2}{3 \times \frac{5}{2}}$

$= 1 + \frac{18 - 8}{\dots} \quad 1 + \frac{10}{4} \times \dots$

Since m_J has $(2J+1)$ values ranging from $-J$ to $+J$, a given level is split up into $(2J+1)$ { for $J = \frac{1}{2}$ states levels 2; for $J = \frac{3}{2}$ states levels 4 } (3)A

We get $(2J+1)$ levels with the application of magnetic field. Whereas m_J is subject to selection rule $\Delta m_J = 0, \pm 1$ we get the following transitions for the sodium D lines. The longer wavelength component $3^2S_{\frac{1}{2}} - 3^2P_{\frac{1}{2}}$ splits up into four lines, while the shorter wavelength component $3^2S_{\frac{1}{2}} - 3^2P_{\frac{3}{2}}$ splits into six lines.

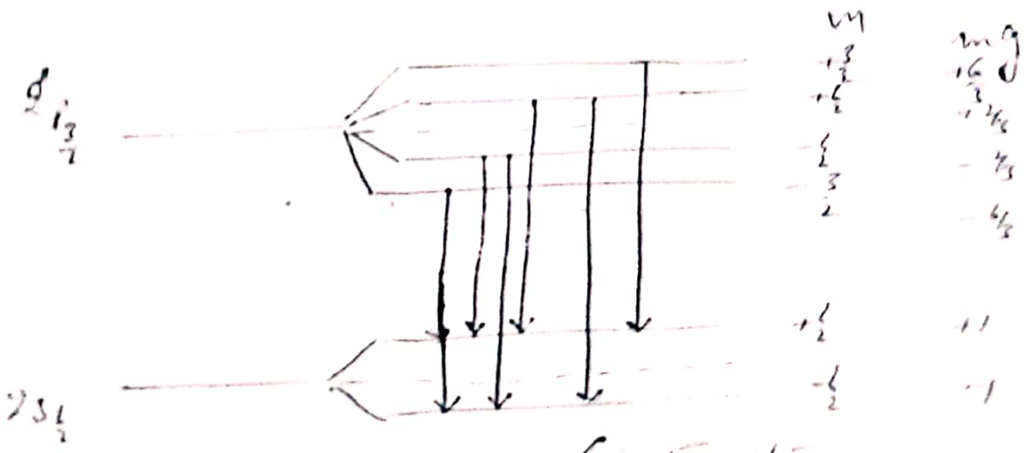
1583



$J = \frac{1}{2}$, $L = 1$, $S = \frac{1}{2}$, $g = \frac{2}{3}$

$g = 1 + \frac{J^2 + S^2 - L^2}{2J^2}$

Selection Rule $\Delta m = 0, \pm 1$



Six transitions