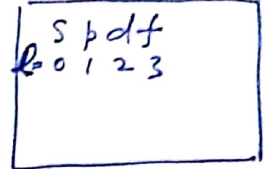


Important Problems

①

on
L-S / J-S couplings

① Prove that the no. of terms (Spectral) for 'pd' configuration is the same for both L-S and J-S couplings.



Ans -

p
 $l_1 = 1$
 $s_1 = \frac{1}{2}$

d
 $l_2 = 2$
 $s_2 = \frac{1}{2}$

(a) L-S coupling

$$L = l_2 + l_1 = 2 + 1 = 3, 2, 1$$

$$S = s_1 + s_2 = \frac{1}{2} + \frac{1}{2} = 0, 1$$

- | | | | |
|--------------|---------|--|----------------------------------|
| i) $L = 3$ | $S = 0$ | $\Rightarrow J = L \pm S = 3 \pm 0 = 3$ | } MF
= 2L+1
= 2*3+1
= 7 |
| ii) $L = 2$ | $S = 0$ | $\Rightarrow J = L \pm S = 2 \pm 0 = 2$ | |
| iii) $L = 1$ | $S = 0$ | $\Rightarrow J = L \pm S = 1 \pm 0 = 1$ | |
| iv) $L = 3$ | $S = 1$ | $\Rightarrow J = L \pm S = 3 \pm 1 = 4, 2$ | } MF
= 2L+1
= 7 |
| v) $L = 2$ | $S = 1$ | $\Rightarrow J = L \pm S = 2 \pm 1 = 3, 1$ | |
| vi) $L = 1$ | $S = 1$ | $\Rightarrow J = L \pm S = 1 \pm 1 = 2, 0$ | |

Terms -
 i) 1F_3 ii) 1D_2 iii) 1P_1
 iv) $^3F_{4,3,2}$ v) $^3D_{3,2,1}$ vi) $^3P_{0,1,2}$
 Total Spectral terms = 12

M.F. = multiplicity factor = (2S+1)

(b) $\bar{j}-\bar{j}$ Couplings

p

$$l_1 = 1$$

$$s_1 = \frac{1}{2}$$

$$\begin{aligned} \bar{J}_1 &= l_1 \pm s_1 \\ &= 1 \pm \frac{1}{2} = \frac{3}{2}, \frac{1}{2} \end{aligned}$$

d

$$l_2 = 2$$

$$s_2 = \frac{1}{2}$$

$$\begin{aligned} \bar{J}_2 &= l_2 \pm s_2 \\ &= 2 \pm \frac{1}{2} \\ &= \frac{5}{2}, \frac{3}{2} \end{aligned}$$

i) $\bar{J}_1 = \frac{3}{2}, \bar{J}_2 = \frac{5}{2}$

ii) $\bar{J}_1 = \frac{3}{2}, \bar{J}_2 = \frac{3}{2}$

iii) $\bar{J}_1 = \frac{1}{2}, \bar{J}_2 = \frac{5}{2}$

iv) $\bar{J}_1 = \frac{1}{2}, \bar{J}_2 = \frac{3}{2}$

i) $\bar{J} = \bar{J}_1 \pm \bar{J}_2 = \left. \begin{aligned} &\frac{3}{2} \pm \frac{5}{2} \\ &= \frac{5}{2} \pm \frac{3}{2} \end{aligned} \right\} = 4 \text{ to } 1 \quad 4 \ 3 \ 2 \ 1$

ii) $\bar{J} = \bar{J}_1 \pm \bar{J}_2 = \frac{3}{2} \pm \frac{3}{2} = 3 \text{ to } 0 \quad 3 \ 2 \ 1 \ 0$

iii) $\bar{J} = \bar{J}_1 \pm \bar{J}_2 = \left. \begin{aligned} &\frac{1}{2} \pm \frac{5}{2} \\ &= \frac{5}{2} \pm \frac{1}{2} \end{aligned} \right\} = 3 \text{ to } 2 \quad 3 \ 2$

iv) $\bar{J} = \bar{J}_1 \pm \bar{J}_2 = \left. \begin{aligned} &\frac{1}{2} \pm \frac{3}{2} \\ &= \frac{3}{2} \pm \frac{1}{2} \end{aligned} \right\} = 2 \text{ to } 1 \quad 2 \ 1$

Total Spectral Lines = 12
"Also solve similar problems"