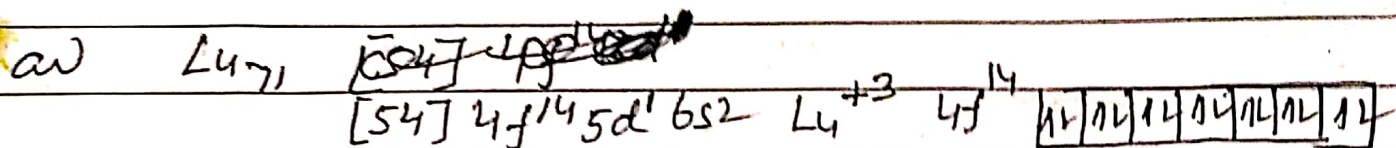
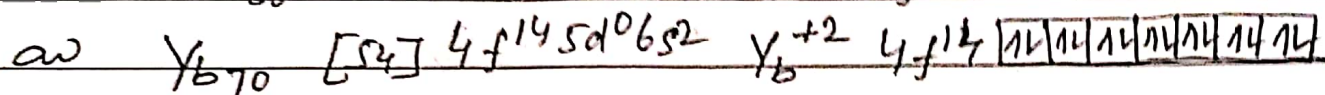
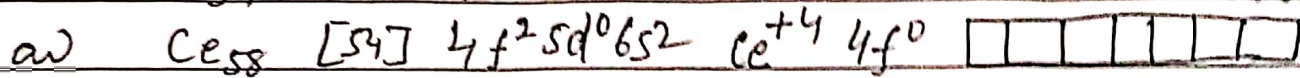
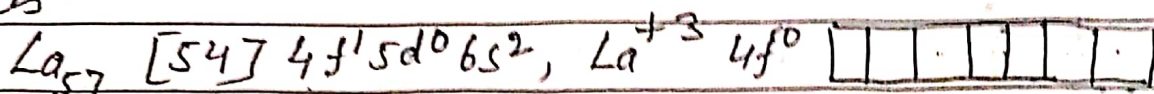


B.Sc. III PAPER-VI

Magnetic properties of lanthanides

For study of magnetic properties of lanthanides, we must know the electronic configuration of lanthanides series of elements. La^{+3} and Ce^{+4} ions have no 4f electrons and Lu^{+3} and Yb^{+2} ions have 14 electrons in 4f orbitals.



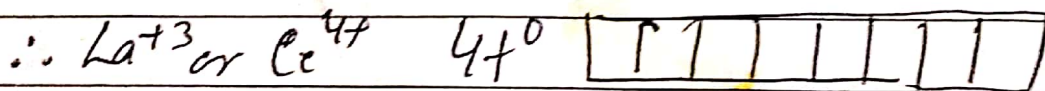
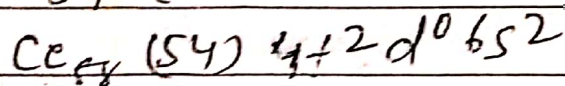
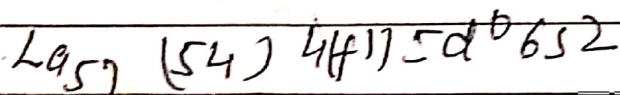
All these ions are diamagnetic in nature because they have either paired electrons or no electrons in 4f orbital. Except above four ions of lanthanides, all other f-state contains unpaired electrons and are paramagnetic with spin and orbital momentum. Here the energy difference between two successive levels of a multiplet i.e. multiplet width is larger than thermal energy kT i.e. strong L-S coupling. For these ions, the effective magnetic moment is given by -

$$\mu_{\text{eff}} = g \sqrt{J(J+1)} \text{ B.M.}$$

Where g (Lande splitting factor) is given by

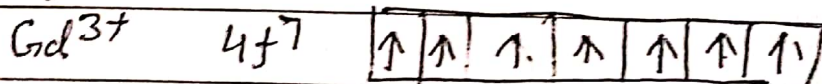
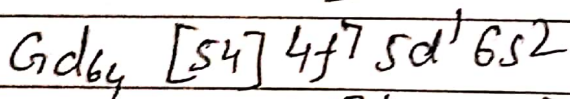
$$g = 1 + \frac{S(S+1) - L(L+1) + J(J+1)}{2J(J+1)}$$

But La^{+3} or $\text{Ce}^{4+} (4f^0)$, $\text{Gd}^{3+} (4f^7)$ and Lu^{3+} or $\text{Yb}^{2+} (4f^{14})$ ions have s term, $L=0$ no orbital effect.



$$\therefore L = \sum ml = 0$$

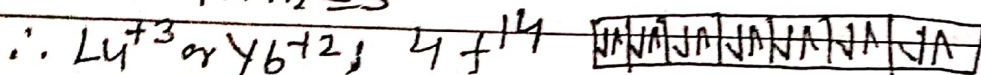
$$\therefore \text{Term} = S$$



$$\therefore L = \sum ml = -3 - 2 - 1 + 0 + 1 + 2 + 3 = 0$$

$$\therefore \text{term} = S$$

For Lu_{71} and Yb_{70} , $L = \sum ml = -6 - 4 - 2 + 0 + 2 + 4 + 6 = 0$
term = S



For these ions when $L=0, J=S$, hence $g=2$

$$\mu_s = \sqrt{4S(S+1)} = \sqrt{n(n+2)} \text{ B.M.}$$