Magnetic properties of the 2nd and 3rd transition series:-

For the Complexes of the 1st transition series, the observed magnetic moment is very close to $\mu_{spin\text{-}only}$ value.

Spin only value ⟶ No. of unpaired $e^{\ominus}$

But for heavier transition metal the process becomes complicated.

Some factors are given below ⇒

1) High Spin orbit Coupling
2) Orbital Contribution
3) Magnetic exchange interaction
4) Metal - metal bond.

4d } Spatially larger than 3d.
5d }

For heavier atom,

Spin - orbit Coupling is larger than thermal energy (KT).

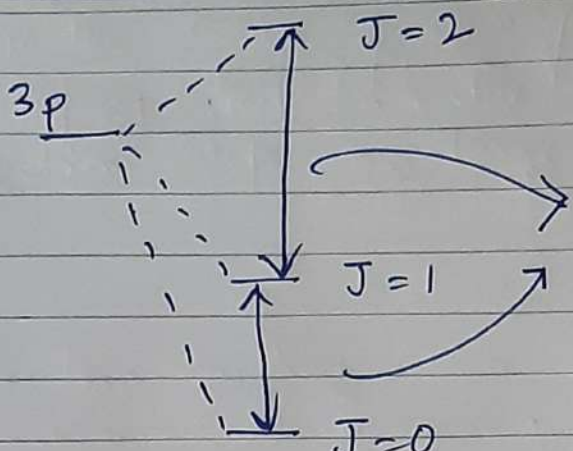
When Multiple width > KT

then $\mu_J = g_J \sqrt{J(J+1)}\ B.M.$

J = a new quantum no. which is a good quantum number for this case.

The formula can be applicable for Lanthanides also.

What is multiple width :-



Multiplet width

$L = 1$, $S = 1$ → $L+S = 2$, $L-S = 0$

$J = 0, 1, 2$

Ground state term

$[RuCl_6]^{2-}$: Ru (IV) → t_{2g}^4 → $^3T_{1g}$

$[OsCl_6]^{2-}$: Os (IV) → t_{2g}^4 → $^3T_{1g}$

(Low spin Complex)

Relate topic :-

1. What is g_e and g ?
2. What is S, L, J and s, l and j ?
3. Spin orbit Coupling ?
4. Calculate the $\mu_{spin-only}$ value of Ru (IV) in $[RuCl_6]^{2-}$
5. Ground and excited state terms Symbol for free ions and in complex.
6. Heavier metal (2nd and 3rd row) generally form low spin Complexes than 1st row metal Complex. Why ?