

Determination of Stability Constant

By Spectro Photometric Method.

Most of the Complexes absorb light differently than the metal ion from which they are made.

Now the relation between the absorbance or optical density (A) at a particular wave length and concentration is expressed by Beer's Law as follows

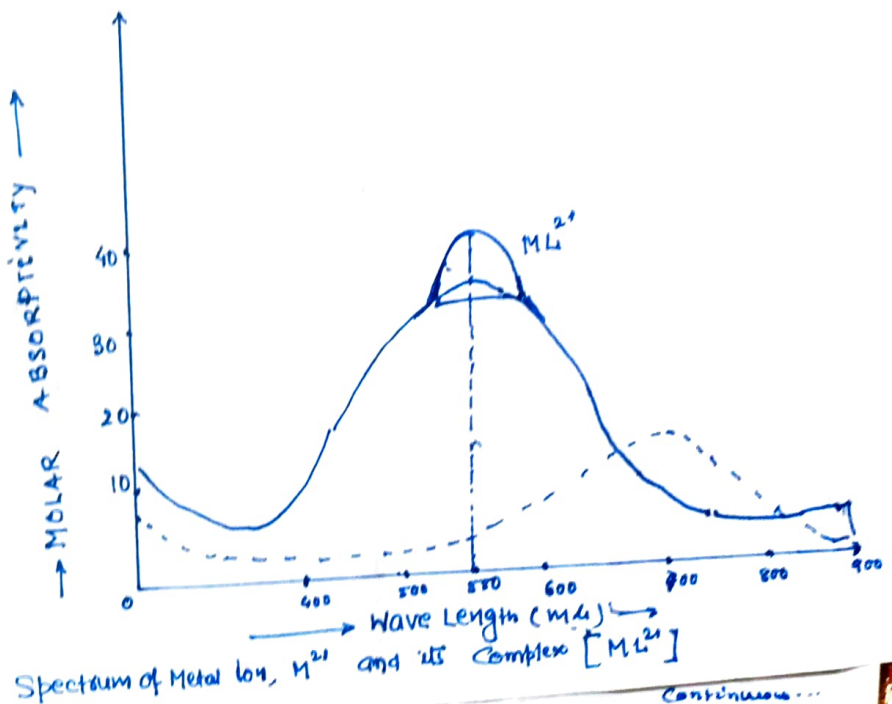
$$A = \epsilon \cdot l \cdot C$$

Where ϵ = molar extinction coefficient
 l = Length of the absorption cell
 C = Concentration of Complex.

If we measure the absorption (A) from a Spectrophotometer and knowing the extinction coefficient (ϵ) at that wave length and the cell length (l). Then the concentration C can be calculated from Beer's Law.

It has been shown in fig that, How the spectrum of a metal ion M^{2+} changes on co-ordination with ligand L^- , which contains representative spectra of Metal ion M^{2+} (shown by broken lines) and its complex ion ML^{2+} (shown by unbroken lines)

It will be seen that the absorption by the complex takes place over the entire region of the metal ion absorption, while at 550 m μ only the complex absorbs.



Clearly, the value of K_f (Formation Constant)

for the reaction $M^{2+} + L \xrightleftharpoons{K_f} ML^{2+}$ will be given by

$$K_f = \frac{[ML^{2+}]}{[M^{2+}][L]} \quad \text{--- (1)}$$

In order to obtain the value of formation constant K_f , solution containing known amounts of total M^{2+} and total L are equilibrated. The absorption of these solutions at 550 m μ is measured and the value of K_f is calculated as follows:

We know that

$$C_M = [M^{2+}] + [ML^{2+}] \quad \text{--- (2)}$$

$$C_L = [L] + [ML^{2+}] \quad \text{--- (3)}$$

and $A = \epsilon_{(ML^{2+})} \cdot l \cdot [ML^{2+}]$ { From Beer's Law }

$$\text{or } [ML^{2+}] = \frac{A}{\epsilon_{(ML^{2+})} \cdot l} \quad \text{--- (4)}$$

Here, C_M = Total concentration of the metal ion } Known
 C_L = Total concentration of the ligand }

On putting the value of $[ML^{2+}]$ in eqⁿ (2) and (3) (which is obtained from eqⁿ (4)) we get the values of $[M^{2+}]$ and $[L]$

$$\text{Thus, } [M^{2+}] = C_M - \frac{A}{\epsilon_{(ML^{2+})} \cdot l} \quad \text{--- (5)}$$

$$[L] = C_L - \frac{A}{\epsilon_{(ML^{2+})} \cdot l} \quad \text{--- (6)}$$

In this way we get the values of $[ML^{2+}]$, $[M^{2+}]$ and $[L]$ and on putting these values in equation (1) we get the value of K_f

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