SUBJECT - CHEMISTRY

CLASS - B.Sc(Hons) PART - III

PAPER - V

TOPIC - THEORY OF INDICATORS

Dr. Hari Mohan prasad Singh
Department of Chemistry
Dr. L.K.V.D College Tajpur Samastipur

Q what are acid-base indicators? Discuss briefly the theory of acid-base indicators with special reference to methyl orange and phenolphthalein. Describe the limitation of their uses in acid-base titration.

Ans. Acid-base indicators are complex weak organic acids or bases. So they have their own pH values. They change their colours with a definite pH range e.g.

Indicator	pH range	Acid medium	Colar in Neutral medium	Alkaline medium
Litmus	4.5-7.4	red	—	blue
Methyl orange	3.1-4.5	red	orange	yellow
phenolphthalein	8-9.5	Colourless	Colourless	pink

An indicator is used to determine the end-point in titrations. When two solutions are titrated, then the slight excess of one solution is revealed by the colour change in the solution. This stage is called end point. The acid-base indicators show a change of colour at a particular pH or we can say that an indicator has one colour in acid solution and another colour in alkaline solution.

(1) Ostwald theory: According to this theory, an indicator is considered as a weak electrolyte which give coloured ion under the influence of strong acid and/or strong base e.g phenolphthalein (PhH) being a weak acid, ionises into H^+ & Ph^- ions.

$$\underset{\text{Colourless}}{PhH} \rightleftharpoons \underset{\text{(pink)}}{Ph^-} + H^+$$

In acidic solution, H^+ concentration is high, hence the dissociation of PhH is practically nil due to which the solution remains colourless. In alkaline solution, OH^- concentration is high which reacts with H^+ to form feebly ionised H_2O shifting the equilibrium towards right i.e the formation of Ph^- takes place fastly. Hence in alkaline solution, phenolphthalein appears pink.

The unionised methyl orange (MeOH) is yellow. Being a weak base, it gives red Me^+ ion on ionisation.

$$\underset{\text{yellow}}{MeOH} \rightleftharpoons \underset{(\text{red})}{Me^+} + OH^-$$

In presence of alkali which increases OH^- concentration, suppresses the ionisation of MeOH so that solution becomes yellow but when an acid is added in slight excess, the H^+ ion of acid combines with the OH^- of MeOH to form feebly ionised H_2O. Under this condition more and more MeOH ionises to form red Me^+ ions in solution. Hence in acidic medium, methyl orange appears red.