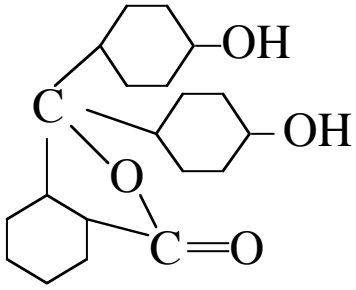
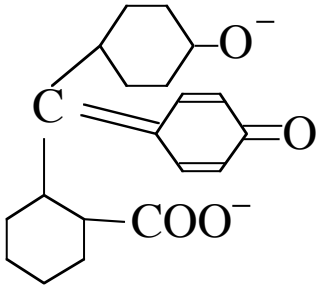
Phenolphthalein

Stock solutions contain 0.5 - 1.0 g of indicator per litre of solvent. Phenolphthalein is dissolved in 70-90% ethanol. The colour change of phenolphthalein is accompanied by a structural change (shown below).



colourless (acid structure)



red-violet (basic structure)

When the colour change is not sharp a mixture of indicators can be used to give a more pronounced colour change at a more definite pH.

e.g. Take (i) 0.1% phenolphthalein and (ii) 0.1% methylene green.
Mix 1 volume (i) with 2 volumes (ii).
The colour in acid will be green. At pH 8.8 colour will be pale blue. At pH >9 colour will be violet.

Titration of Carbon Dioxide

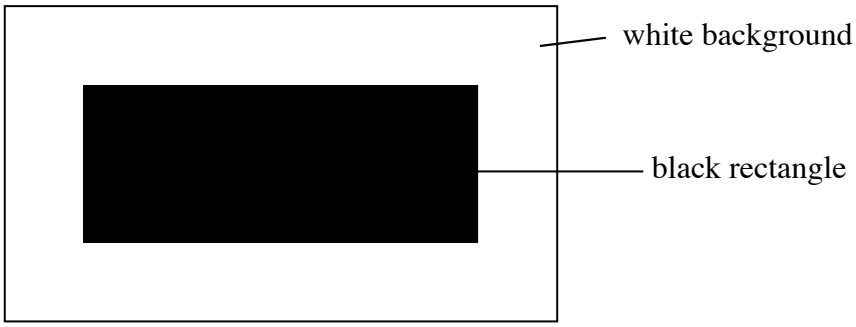
In most water sources carbon dioxide exists as free CO_2. These waters can be titrated as a monobasic acid by using the mixed indicator phenolphthalein to detect the end point. Any colour change occurs before the end point since most CO_2 is free and <1% is present as carbonic acid (via $CO_2 + H_2O <=> H_2CO_3$). During titration the carbonic acid reacts with the base immediately. This disturbs the equilibrium and free CO_2 slowly forms carbonic acid before reacting further. This means that when titrated using phenolphthalein the pink colour change will occur early and then after a short time (1 minute or less usually) the liquid will turn colourless. This will continue to occur until all the CO_2 has been transformed into bicarbonate (via $OH^- + H_2CO_3 -> HCO_3^- + H_2O$). Note that the bicarbonate does not react with the base.

The endpoint is therefore reached when the basic pink colour persists for about 5 minutes. This is step one, the preliminary titration to permanent end point. CO_2 will escape from solution during titration so a second titration is then performed when nearly all the base is added at once to bring the solution to near end point and then the titration is completed carefully to end point.

Card for reading Meniscus

When a liquid is strongly coloured, the upper edge of the meniscus should be read.

When the liquid is colourless a card for reading the meniscus (shown below) can be used.



The upper edge of the dark rectangle should be held about 1 millimetre below the bottom of the meniscus for reading.

Cleaning Glassware Hints

Fatty substances will, after use, stick to glassware and this can be a problem particularly for apparatus used in titremetric analysis. Here are some recipes for cleaning glassware of fatty deposits.

(i) potassium hydroxide in ethanol.
Soak glassware for a short time (not very long as this will attack the glass).
Care: Highly corrosive to skin. Please conduct your own risk assessment before use.

(ii) Aqueous sodium hydroxide containing dissolved potassium permanganate.
Leave glassware in solution for up to five minutes. Rinse with concentrated hydrochloric acid.
MnO_2 deposits can then be removed using a solution containing sulfite ions.
Care: Corrosive to skin. Please conduct your own risk assessment before use.

Reference

I.M.Kolthoff Quantitative Chemical Analysis 4th Ed., Macmillan, London, 1952.