

colour. Dilute with H_2O (fractionating, if necessary, to reduce volume) till colour changes to yellow. At what normal concentration of acid?

Find the conc. of HCl at which the same change colour occurs.

Compare "acidity" as defined by titration with an alkali, and by colour of an indicator.

NOTE.—Strong acids differ from weak in degree of dissociation into their ions (in dilute solutions acids almost completely dissociated). It is the dissociated hydrogen ions that determine the colour of the indicator and not the total acid.

(b) **Acid Taste.** Determine on which of the factors mentioned in the last paragraph "acidity" of taste depends by comparing the total acid and the H ion concentrations of HCl and HA_c , that give equal or just perceptible acid taste (H -ion concentration compared by colour with methyl orange).

Correlate general chemical activity of acids with their degree of dissociation.

The same results apply to strong and weak bases as have been illustrated for acids—alkalinity is usually ascribed to hydroxyl (OH) — ions, but since the number of OH — in a watery solution always varies inversely as the H^+ we can employ a scale of acidity and alkalinity which takes account only of H -ion conc. even in alkaline solutions. The scale is a normality one, as in total acid measurement: normal sol. = 1 gram-atom of H -ions in 1 litre solution. (Under what conditions would figure for H ion concentration and total acid concentration correspond?)

The symbol pH commonly used = $\log \frac{1}{H\text{-ion conc.}}$

Thus $[H] 10^{-3} = pH3$.

3. Table of Indicators.

Consult Bayliss p. 189. See also Ch. II. Clark (above cited).

4. Buffer Action.

1. Phosphates (and acid salts generally).

From the table det. the $[H^+]$ of .1N $Na_2HP O_4$ and .1N $Na H_2PO_4$.

Mix them so as to give $[H^+]$ of H_2O .

Now determine by titration with .1N HCl and .1N $Na OH$. the amounts required to shift the $[H^+]$ to that of the pure salts.

Compare the effect of infinitesimal amounts of the acid and alkali on pure H_2O .

Consider the chemical reactions that produce this absorbing or "buffer" action.

2. Salts of weak acids.

(a) To equal quantities in t.t.'s of .1N Na acetate and of H_2O resp. add a few drops of Methyl Red. Add a drop .1N HA_c to H_2O tube and note colour. How much .1N HA_c must be added to the $Na A_c$ to give the same $[H^+]$?

What do you infer as to the dissociation of a weak acid in presence of its salt?

(b) Repeat with $Na A_c$ and HCl . Explain.

$HCl + NaA_c$ (both strongly dissoc.) $\rightleftharpoons NaCl + HA_c$ (both weakly dissoc.)

(c) Repeat (for comparison) with $Na Cl$ (salt of strong acid) and HCl .

Other weak acids—carbonic and boric.

3. Proteins and amphoteric electrolytes generally.

Determine how much acid and alkali are required to markedly shift the $[H^+]$ of gelatin solution. Compare with H_2O .

4. **Colour Standards.** While approximate determination of $[H^+]$ may be made by estimating colours and colour changes, accurate work requires standards for comparison. It is impossible to maintain standards of pure acid and alkali at a constant $[H^+]$ owing to the effect of CO_2 of atmosphere, solution of glass, etc. By using buffers to stabilise the $[H^+]$ this difficulty is largely obviated.

Prepared Buffer Standards Exhibited.

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|---------------------------------|---------------|------------------|--------|-------------|
| I. $H A_c$ and $Na A_c$ | (Walpole's) | most useful bet. | pH . | 3.5 and 5.5 |
| II. KH_2PO_4 and $Na_2H PO_4$ | (Sorensen's) | " " " | " | 5.5 " 7.5 |
| III. Borax and Boric Acid | (Palitzsch's) | " " " | " | 7.5 " 9.5 |

For higher and lower $[H^+]$ HCl or $NaOH$ is mixed with various buffers.

5. **Exercises.** 1. Determine accurately by comparison with standards the $[H^+]$ of solutions provided.

2. Turbid or coloured solutions.

(a) Walpole's method.

Superimpose a tube of coloured solution over the standard and indicator; and superimpose the coloured solution and indicator over clear water.

Look down through equal depths.

(b) Dilution method; a well buffered solution has its $[H^+]$ little affected by dilution, e.g. urine. Determine $[H^+]$ of same.