Buffer solutions

- Mixture of weak acid + conjugate base
  or weak base + conj. acid

- maintains a relatively constant pH.
  when acids or bases added.

- Buffer amount must be larger than H^+ or OH^- added.

Buffer Capacity

- ability to resist change in pH.
- the amount of H^+ or OH^- added without causing
  change of 1 unit in pH.
- BC ↑ [A/CB] ↑. → ↑ H^+ + OH^-

Common buffers

CH_3COOH + $NaCH_3COO$

H_2CO_3 / HCO_3^- - blood.

$H_2PO_4^-$ / HPO_4^{2-} - blood.

Volumetric Analysis.

- quantitative method.
- known conc. is reacted with unknown conc.
- comparing volumes can find the unknown conc.

Titration – one soln added to another until complete reaction.

1. Acid-base
2. Redox

* **Primary standard** – large M.
– high purity./known formula.
– no reaction in air.
– soluble in water.

($NaCO_3$
$H_2C_2O_4 . 2H_2O$)
oxalic acid.

* mass → moles → [ ]

Standardised HCl. (not known purity as gas dissolved).

$[\text{known}] \xrightarrow{\text{moles}}$ eq^n ratio → n(unknown). → [unknown].

Standardised NaOH. (deliquescent).

When determining volume
calc must be within 0.20mL
Best 3 – then average.

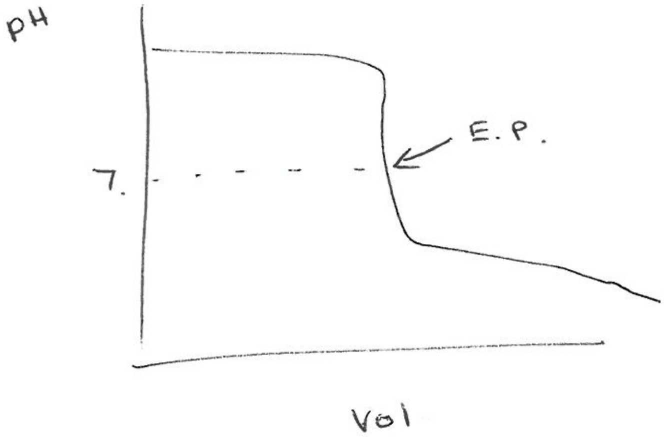
Indicators

- weak acid or base that changes colour as they change to conj. form.

Equivalence pt - reactants in stoich proportions.

End pt - colour change due to pH.

a) Strong acid / base

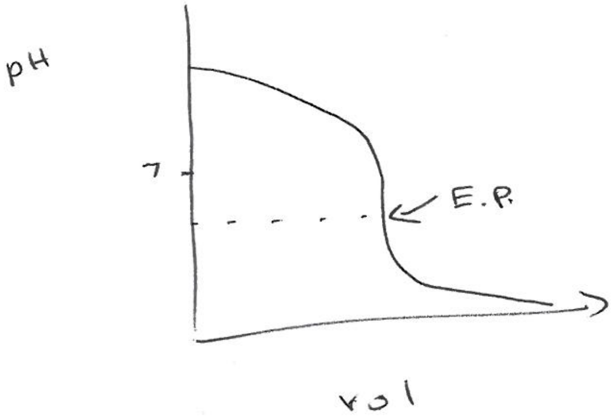


Equivalence pt pH = 7.

methyl red.

red → yellow

b) Strong acid / weak base

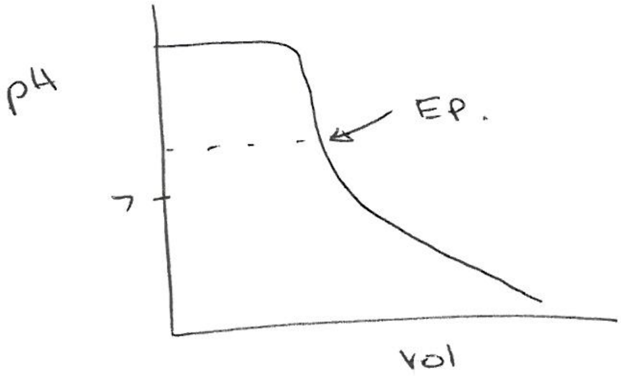


Eq pt ≈ 5.5

methyl orange

red → yellow

c) Strong base / weak acid



Eq pt ≈ 9.

phenolphthalein

colourless → pink.

d) weak acid / weak base

Eq pt ≈ 7.

not clear cut. *

Complex Problems.

A 3·002 g sample of cleaning product containing mostly NaOH was dissolved and made up to 250 mL using a volumetric flask. A 20·00 mL aliquot of this was titrated against 0·0999 mol L^{-1} HCl and needed 22·85 mL of acid to reach end pt. Calc. % mass of NaOH in cleaning product.

Known.

$n(HCl) = c.V$

$= 0·0999 \times 0·02285$

$= 0·00228272$ mol. ← Keep large.

$1.HCl + \underset{?}{1.NaOH} \rightarrow NaCl + H_2O$.

$n(HCl) = n(NaOH)$.

$n(NaOH) = 0·00228272$. in 20 ml

Work Backwards

$n(NaOH)$ in 250 mL

$= 0·00228272 \left(\frac{250}{20}\right)$

$= 0·0285 3394$ mol.

∴ $m(NaOH)$ in original sample

$m = n.M$

$= (0·0285 3394)(40·00)$

$= 1.1413$ g.

% (NaOH) in original sample

$$= \frac{1·1413}{3·002} \times 100$$

$= 38·02\%$