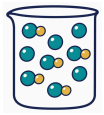
Buffers Map

Cambridge International AS & A Level Chemistry · Topic 25 Equilibria · 25.1 Buffer solutions

1 What a buffer is

25.1.5(a)

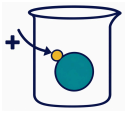
- **Resists pH change**
- Small amounts of acid or alkali
- Not a fixed pH
- Large amounts of **HA and A⁻**
- Dilution: ratio unchanged



2 How it works

25.1.5(c)

- Large reservoirs of HA and A⁻
- Add H⁺: **A⁻ + H⁺ → HA**
- Add OH⁻: **HA + OH⁻ → A⁻ + H₂O**
- Ratio barely changes
- Basic: $NH_3 + H^+ \rightarrow NH_4^+$

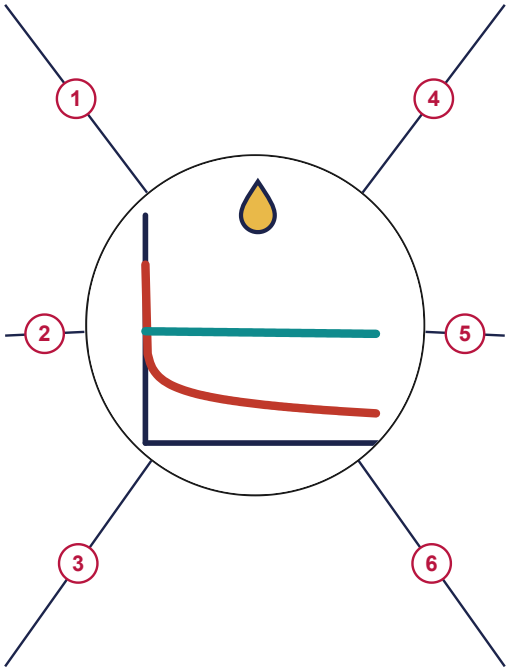


3 Buffer pH

25.1.6

- **$[H^+] = K_a[HA] \div [A^-]$**
- $pH = pK_a + \log([A^-] \div [HA])$
- [HA] = acid; $[A^-]$ = salt
- Mixtures: use **moles**
- Equal amounts: $pH = pK_a$





4 Making a buffer

25.1.5(b)

- **Weak acid + its salt**
- e.g. $CH_3COOH + CH_3COONa$
- Or excess weak acid + NaOH
- **Weak base + its salt**
- e.g. $NH_3 + NH_4Cl$



5 Blood and cells

25.1.5(d)

- Blood pH **7.35–7.45**
- **$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$**
- Lungs remove CO_2
- Cells: $H_2PO_4^-$ / HPO_4^{2-}
- Enzymes need steady pH



6 Food

25.1.5(d)

- **Bacteria and fungi**
- release acids: pH changes
- Spoils taste and texture
- Citric acid + sodium citrate
- Buffer keeps food longer



Some buffers

pH = $pK_a + \log([A^-] \div [HA])$; values at 298 K except blood (310 K)

Buffer pair (acid / base)	pK_a	Example ratio $[A^-] \div [HA]$	pH
citric acid / dihydrogencitrate	3.13	1.48	3.30
CH_3COOH / CH_3COO^-	4.76	1.00	4.76
H_2CO_3 / HCO_3^- (blood)	6.10	20.0	7.40
$H_2PO_4^-$ / HPO_4^{2-} (cells)	7.21	1.55	7.40
NH_4^+ / NH_3	9.25	1.50	9.43

Worked examples

Buffer pH

- 0.100 CH_3COOH + 0.150 CH_3COONa
- $[H^+] = 1.16 \times 10^{-5}$
- **pH 4.94**

Partial neutralisation

- 50.0 cm^3 0.100 acid + 20.0 cm^3 NaOH
- HA 3.00, A^- 2.00 × 10^{-3} mol
- **pH 4.58**

After adding acid

- 0.150 CH_3COOH + 0.150 CH_3COO^-
- + 0.0200 mol HCl per dm^3
- **pH 4.64**

The solubility product, K_{sp}, and the common ion effect follow in 25.1.

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