

Fact sheet: brilliant buffers

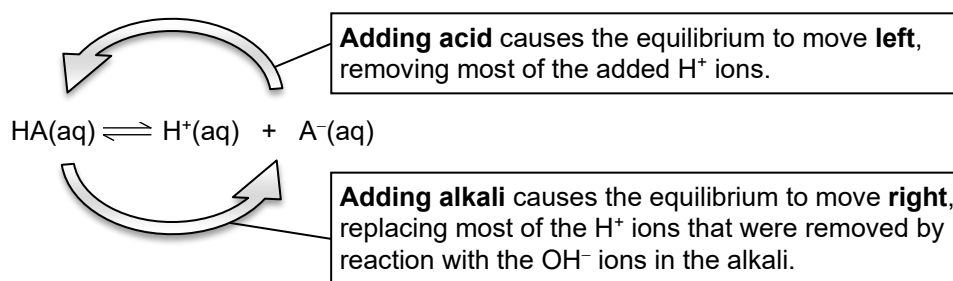
Education in Chemistry

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<https://rsc.li/3GbHZIb>

Changes in pH can have a big impact on natural systems, so it's important that the hydrogen ion concentration stays relatively constant. Buffers minimise the change in pH that would otherwise happen if an acid or alkali were added to an aqueous solution.

A buffer is created when a **weak acid** and its **salt** are both present in solution. This can be done by dissolving both the acid and the salt, or by partially **neutralising** the weak acid with a **strong base**. The buffer solution utilises the **reversible reaction** involving the **loss of a proton from the weak acid** to stabilise the pH when hydrogen ions are added to, or removed from, the solution.



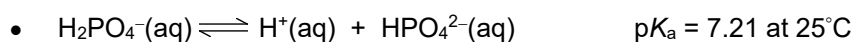
The pH of a buffer solution can be calculated using the **Henderson–Hasselbalch** equation, which is derived from the **equilibrium constant** equation for dissociation of a weak acid with general formula HA.

$$\text{pH} = \text{p}K_{\text{a}} + \log_{10} \frac{[\text{A}^{-}]}{[\text{HA}]}$$

Covid-19 lateral flow test

The lateral flow test for Covid-19 contains antibodies to a protein that is produced by the. The binding of the antibody to the virus protein **will only work if the pH is about 7.4**.

The sample taken from the nose is mixed with a **phosphate buffer** solution to prevent any acids or alkalis in the sample from changing the pH too much.



Did you know ...?

The **pH of nasal mucus** can vary from **5.5 to 7.0**.

Healthy hair

The ideal pH for the scalp is around 5.5. Shampoo ingredients are often more **alkaline** than this, which could damage the scalp and change the properties of the hair.

In a pH balanced shampoo, a buffer is added to keep the pH at 5.5 or lower. **Citric acid** is often used as it can control the pH at any value from 3 to 7.

- | | pK _a at 25°C |
|---|-------------------------|
| • Dissociation of the first H ⁺ ion: C ₆ H ₈ O ₇ (aq) ⇌ H ⁺ (aq) + C ₆ H ₇ O ₇ ⁻ (aq) | 3.13 |
| • Dissociation of the second H ⁺ ion: C ₆ H ₇ O ₇ ⁻ (aq) ⇌ H ⁺ (aq) + C ₆ H ₆ O ₇ ²⁻ (aq) | 4.76 |
| • Dissociation of the third H ⁺ ion: C ₆ H ₆ O ₇ ²⁻ (aq) ⇌ H ⁺ (aq) + C ₆ H ₅ O ₇ ³⁻ (aq) | 6.39 |

Did you know ...?

As the pH of hair **increases**, the fibres gain more **negative charge**. This causes repulsion, which makes hair more difficult to style.

Oceans in peril

The increased level of **atmospheric carbon dioxide** due to human activity is leading to a **decrease in pH** of the oceans. This is affecting marine ecosystems, in particular the survival of plankton, molluscs and coral that depend on **dissolved carbonate ions** to make their shells.

Dissolved carbon dioxide increases the **ratio of hydrogen carbonate to carbonate** in the natural buffer system that helps control ocean acidity.

- $\text{HCO}_3^-(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$ pK_a = 10.32 at 25°C

Did you know ...?

Since the 1980s, over half the coral that makes up Australia's Great Barrier Reef has died.