

Exercise walk-through

Acid-Base Reactions and Buffers ■ 8.4

eXercise

You must be able to

- describe a **buffer** 缓冲溶液 (a weak acid + its conjugate base)
- explain how a buffer resists pH change
- identify a buffer mixture

Method — What a buffer is

A **buffer** is a mixture of a **weak acid and its conjugate base** (or a weak base and its conjugate acid) in comparable amounts. It **resists** changes in pH when small amounts of acid or base are added.

Method — How it resists acid

The conjugate **base** part neutralizes added H^+ : $\text{A}^- + \text{H}^+ \rightarrow \text{HA}$. So added acid is mopped up and pH barely moves.

Method — How it resists base

The weak **acid** part neutralizes added OH^- : $\text{HA} + \text{OH}^- \rightarrow \text{A}^- + \text{H}_2\text{O}$.

Method — Identifying a buffer

A buffer needs **both** members of a conjugate pair. $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$ is a buffer; $\text{HCl} + \text{NaCl}$ is **not** (HCl is strong, no weak-acid reservoir).

Practice 2.1 ■ 1 mark

What two components make a buffer?

Solution 2.1

Worked steps

A weak acid and its conjugate base (in comparable amounts) **B1**.

Practice 2.2 ■ 1 mark

Which part of a buffer neutralizes added H^+ ?

Solution 2.2

Worked steps

The conjugate base **B1**.

Practice 2.3 ■ 2 marks

Is $\text{HCl} + \text{NaCl}$ a buffer? Give a reason.

Solution 2.3

Method: Identifying a buffer

Worked steps

No — HCl is a strong acid with no weak-acid reservoir and Cl^- is not a base, so it cannot resist pH change both ways **M1** **A1**.

Exam-style 3.1 ■ 1 mark

A buffer is made from a weak acid and its

A conjugate base

B strong acid

C metal

D water only

Solution 3.1

A conjugate base



B strong acid

C metal

D water only

Worked steps

A — its conjugate base.

Exam-style 3.2 ■ 2 marks

A buffer contains CH_3COOH and CH_3COO^- .

- (a) Write the reaction when a small amount of OH^- is added.
- (b) Explain why the pH changes only slightly.

Solution 3.2

Method: What a buffer is

Worked steps

(a) $\text{CH}_3\text{COOH} + \text{OH}^- \rightarrow \text{CH}_3\text{COO}^- + \text{H}_2\text{O}$ **M1 A1**. (b) The weak acid neutralizes the added base, so free OH^- is consumed and the pH stays nearly constant **M1 A1**.

Exam-style 3.3 ■ 2 marks

State which of these is a buffer and why: (i) $\text{NH}_3 + \text{NH}_4\text{Cl}$; (ii) $\text{NaOH} + \text{NaCl}$.

Solution 3.3

Method: Identifying a buffer

Worked steps

(i) is a buffer — NH_3 (weak base) with its conjugate acid NH_4^+ ; (ii) is not — NaOH is a strong base with no conjugate weak-acid partner **M1** **A1**.