

8.4 Acid-Base Reactions and Buffers

Name: _____ Class: _____ Date: _____ **Total: 11 marks****KEY WORDS** buffer 缓冲溶液 • pH 值 • acid 酸 • weak acid 弱酸 • base 碱

Objective

Build the skills to answer exam questions on **acid-base reactions and buffers** — the idea of a buffer.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ 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.

■ 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.

■ How it resists base

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

■ 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).

2 Practice

Now apply the methods above.

2.1 What two components make a buffer? [1]

2.2 Which part of a buffer neutralizes added H^+ ? [1]

2.3 Is $\text{HCl} + \text{NaCl}$ a buffer? Give a reason. [2]

3 Exam-style questions

3.1 A buffer is made from a weak acid and its [1]

- **A** conjugate base
- **B** strong acid
- **C** metal
- **D** water only

3.2 A buffer contains CH_3COOH and CH_3COO^- .

(a) Write the reaction when a small amount of OH^- is added. [2]

(b) Explain why the pH changes only slightly. [2]

3.3 State which of these is a buffer and why: (i) $\text{NH}_3 + \text{NH}_4\text{Cl}$; (ii) $\text{NaOH} + \text{NaCl}$. [2]

Solutions

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

2.2 The conjugate base.

2.3 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.

3.1 A — its conjugate base.

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

3.3 (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.