

8.4 Acid-Base Reactions and Buffers

Name: _____ Class: _____ Date: _____

Total: 11 marks

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^+ : $A^- + H^+ \rightarrow HA$. So added acid is mopped up and pH barely moves.

■ How it resists base

The weak **acid** part neutralizes added OH^- : $HA + OH^- \rightarrow A^- + H_2O$.

■ Identifying a buffer

A buffer needs **both** members of a conjugate pair. $CH_3COOH + CH_3COONa$ is a buffer; $HCl + NaCl$ 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]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **8.4 Acid-Base Reactions and Buffers** lesson on the **Learn** page;

- read the **Acid-Base Reactions and Buffers** section of the AP Chemistry handout on the **Know** page.

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.