

8.10 Buffer Capacity

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS buffer capacity 缓冲容量 • buffer 缓冲溶液 • acid 酸 • base 碱 • pH 值

Objective

Build the skills to answer exam questions on **buffer capacity**.

You must be able to:

- define **buffer capacity** 缓冲容量 (how much acid/base a buffer absorbs)
- link capacity to the **amounts** of the buffer components
- compare two buffers' capacities

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.

■ Buffer capacity

Buffer capacity is how much added acid or base a buffer can neutralize before its pH changes significantly. It depends on the **amounts** (moles) of the weak acid and its conjugate base.

■ More moles, more capacity

A **concentrated** buffer (more moles of both components) has a **larger** capacity than a dilute one with the same ratio — same pH, but it can absorb more.

■ Ratio vs capacity

The **ratio** sets the **pH**; the **amounts** set the **capacity**. Two buffers can have the same pH but very different capacities.

■ Best capacity near 1:1

Capacity is greatest when $[A^-] \approx [HA]$ (near $\text{pH} = \text{p}K_a$), because there is plenty of both to react with either added acid or base.

2 Practice

Now apply the methods above.

2.1 What does buffer capacity measure? [1]

2.2 Which sets the pH: the ratio or the amounts? [1]

2.3 Two buffers have the same ratio but one is more concentrated. Which has the greater capacity? [1]

3 Exam-style questions

3.1 Buffer capacity depends mainly on the [1]

- **A** ratio of base to acid
 - **B** amounts (moles) of the components
 - **C** temperature only
 - **D** color
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3.2 Buffer P is 1.0 M acid + 1.0 M base; buffer Q is 0.10 M acid + 0.10 M base (same pK_a).

(a) Compare their pH. [1]

(b) Compare their buffer capacities, with a reason. [2]

3.3 Explain why a buffer has its greatest capacity when $[A^-] \approx [HA]$. [2]

Solutions

2.1 How much added acid or base it can neutralize before the pH changes much.

2.2 The ratio sets the pH.

2.3 The more concentrated one.

3.1 B — the amounts (moles) of the components.

3.2 (a) Same pH (same ratio and pK_a). (b) Buffer P has the greater capacity — more moles of both components, so it can absorb more added acid or base.

3.3 With comparable amounts of both, there is plenty of conjugate base to neutralize added acid **and** plenty of weak acid to neutralize added base, so it resists change in either direction most effectively.