Exercise walk-through

Buffer Capacity ▪ 8.10

eXercise

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

Method — 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.

Method — 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.

Method — Ratio vs capacity

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

Method — Best capacity near 1:1

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

Practice 2.1 ▪ 1 mark

What does buffer capacity measure?

Solution 2.1

Worked steps

How much added acid or base it can neutralize before the pH changes much B1.

Practice 2.2 ▪ 1 mark

Which sets the pH: the ratio or the amounts?

Solution 2.2

Method: Ratio vs capacity

Worked steps

The ratio sets the pH B1.

Practice 2.3 ▪ 1 mark

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

Solution 2.3

Method: More moles, more capacity

Worked steps

The more concentrated one B1.

Exam-style 3.1 ▪ 1 mark

Buffer capacity depends mainly on the

A ratio of base to acid

B amounts (moles) of the components

C temperature only

D color

Solution 3.1

Method: Buffer capacity

A ratio of base to acid

B amounts (moles) of the components ✓

C temperature only

D color

Worked steps

B — the amounts (moles) of the components.

Exam-style 3.2 ▪ 1 mark

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

Solution 3.2

Worked steps

(a) Same pH (same ratio and pK_a) B1. (b) Buffer P has the greater capacity — more moles of both components, so it can absorb more added acid or base M1 A1.

Exam-style 3.3 ▪ 2 marks

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

Solution 3.3

Method: Best capacity near 1:1

Worked steps

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 M1 A1.