

Exercise walk-through

8.10

Buffer Capacity

AP Chemistry

Buffers and Henderson-Hasselbalch

A **buffer** holds pH steady with **both** a weak acid and its conjugate base:

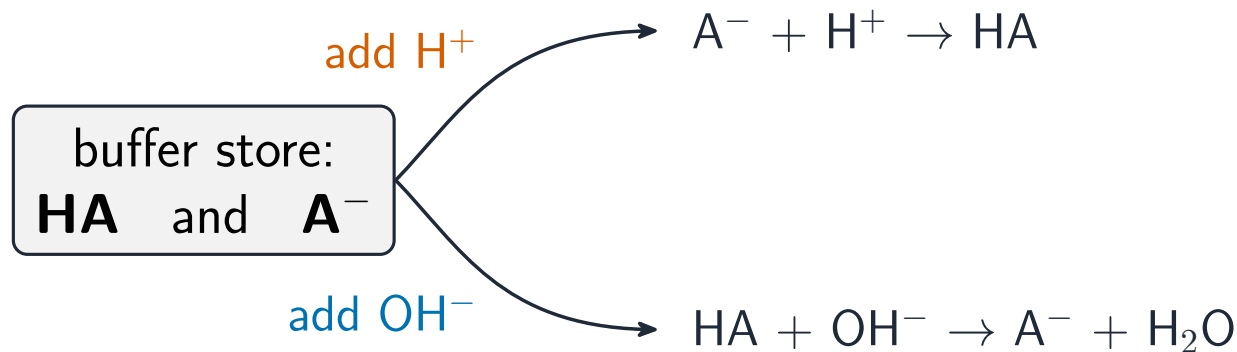
- added acid $\Rightarrow$ conjugate base soaks up H^+
- added base $\Rightarrow$ weak acid soaks up OH^-

Henderson-Hasselbalch

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$$

Equal amounts $\Rightarrow \text{pH} = \text{p}K_a$.
Capacity grows with total concentration.

Properties of Buffers

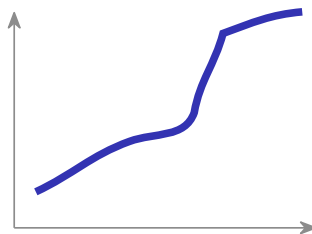


either way, the pH barely changes

A buffer resists pH change by mopping up added acid or base

Check yourself

- 1 What is the pH of 0.001 M HCl?
- 2 In Bronsted-Lowry terms, what does a base do?
- 3 A buffer needs which two species present?
- 4 At the half-equivalence point, pH equals what?



Answers 1. 3 2. accepts a proton 3. a weak acid and its conjugate base 4. pK_a

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

2.1 What does buffer capacity measure?

[1]

2.1

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

2.2 Which sets the pH: the ratio or the amounts?

[1]

2.2

- The ratio sets the pH

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

[1]

2.3

- The more concentrated one

Exercise 3.1

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

Exercise 3.1

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

3.1 B

- the amounts (moles) of the components

Exercise 3.2 (a)

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]

Exercise 3.2 (a)

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]

(a)

- Same pH (same ratio and pK_a)

Exercise 3.2 (b)

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).

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

[2]

Exercise 3.2 (b)

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).

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

[2]

(b)

- Buffer P has the greater capacity – more moles of both components, so it can absorb more added acid or base

Exercise 3.3

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

[2]

Exercise 3.3

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

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