

Exercise walk-through

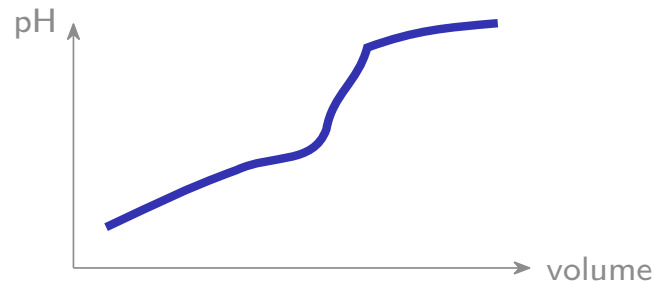
8.7

pH and pKa

AP Chemistry

What we will cover

- 1 Bronsted-Lowry and pH
- 2 Strong acids and bases
- 3 Weak acid and base equilibria
- 4 Buffers and Henderson-Hasselbalch
- 5 Acid-base titrations
- 6 Structure and pKa



Choosing a buffer, and what limits it

the best ratio

a buffer works best when the weak acid and its conjugate base are at **similar** concentration – pH near pK_a

choosing one

pick a weak acid whose pK_a is **close to the pH you want**, ideally within one unit

buffer capacity

how much acid or base it can absorb before the pH changes sharply

what raises it

higher total concentration of both components, and a ratio near 1:1

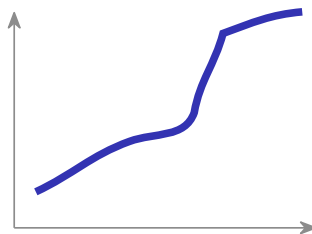
when it fails

once one component is consumed, the pH moves rapidly – the buffer is exhausted

Capacity and pH are separate choices: the **ratio** sets the pH, the **total concentration** sets how much abuse it will take.

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 Find $\text{p}K_a$ for $K_a = 1 \times 10^{-4}$. [1]

2.2 Acid A has $\text{p}K_a = 2$, acid B has $\text{p}K_a = 6$. Which is stronger? [1]

2.3 At what pH is a weak acid half-ionized? [1]

Exercises 2.1·2.3

2.1 Find $\text{p}K_a$ for $K_a = 1 \times 10^{-4}$. [1]

2.1

- $\text{p}K_a = 4$
-

2.2 Acid A has $\text{p}K_a = 2$, acid B has $\text{p}K_a = 6$. Which is stronger? [1]

2.2

- Acid A ($\text{p}K_a = 2$)
-

2.3 At what pH is a weak acid half-ionized? [1]

2.3

- $\text{pH} = \text{p}K_a$

Exercise 3.1

3.1 A stronger acid has a

[1]

☐

A larger pK_a

B smaller pK_a

C pK_a of exactly 7

D negative K_a

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3.1 B

- a smaller $\text{p}K_a$

Exercise 3.2 (a)

3.2 Three acids have K_a values 1×10^{-3} , 1×10^{-5} , and 1×10^{-9} .

(a) Find each $\text{p}K_a$.

[2]

Exercise 3.2 (a)

3.2 Three acids have K_a values 1×10^{-3} , 1×10^{-5} , and 1×10^{-9} .

(a) Find each $\text{p}K_a$.

[2]

(a)

- 3, 5, 9

Exercise 3.2 (b)

3.2 Three acids have K_a values 1×10^{-3} , 1×10^{-5} , and 1×10^{-9} .

(b) Rank the acids from strongest to weakest.

[2]

Exercise 3.2 (b)

3.2 Three acids have K_a values 1×10^{-3} , 1×10^{-5} , and 1×10^{-9} .

(b) Rank the acids from strongest to weakest.

[2]

(b)

- strongest to weakest: $K_a = 10^{-3}$, then 10^{-5} , then 10^{-9} (smallest pK_a first)

Exercise 3.3

3.3 An acid has $\text{p}K_a = 4.2$. Below pH 4.2, which form (acid or conjugate base) dominates? Explain. [2]

Exercise 3.3

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3.3

- The acid form (HA) dominates – below $pH = pK_a$ there is more H^+ , which keeps the acid protonated