

Exercise walk-through

8.3

Weak Acid and Base Equilibria

AP Chemistry

Weak acid and base equilibria

A **weak acid** only **partly** ionizes:

Ionization constant

$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]}$$

Larger K_a = stronger. For a conjugate pair,
 $K_a K_b = K_w$.

Worked example

0.10 M, $K_a = 10^{-5}$:

$$K_a \approx \frac{x^2}{0.10} \Rightarrow x = 10^{-3}$$

$$\text{pH} = 3$$

A strong acid at 0.10 M would give pH 1.

Exercises 2.1-2.3

2.1 Write the K_a expression for $\text{HF} \rightleftharpoons \text{H}^+ + \text{F}^-$. [1]

2.2 Does a small K_a mean a strong or weak acid? [1]

2.3 For 0.10 M acid with $K_a = 4 \times 10^{-7}$, use $x = \sqrt{K_a C}$ to find $[\text{H}^+]$. [2]

Exercises 2.1-2.3

2.1 Write the K_a expression for $\text{HF} \rightleftharpoons \text{H}^+ + \text{F}^-$. [1]

2.1

- $$K_a = \frac{[\text{H}^+][\text{F}^-]}{[\text{HF}]}$$

2.2 Does a small K_a mean a strong or weak acid? [1]

2.2

- Weak

2.3 For 0.10 M acid with $K_a = 4 \times 10^{-7}$, use $x = \sqrt{K_a C}$ to find $[\text{H}^+]$. [2]

2.3

- $$x = \sqrt{(4 \times 10^{-7})(0.10)} = \sqrt{4 \times 10^{-8}} = 2 \times 10^{-4} \text{ M}$$

Exercise 3.1

3.1 For a weak acid, $[\text{H}^+] \approx$

[1]

☐

A K_a

B $\sqrt{K_a C}$

C C

D $K_a C$

Exercise 3.1

3.1 For a weak acid, $[\text{H}^+] \approx$

[1]

☐

A K_a

B $\sqrt{K_a C}$

C C

D $K_a C$

3.1 B

- $[\text{H}^+] \approx \sqrt{K_a C}$

Exercise 3.2 (a)

3.2 A 0.20 M solution of a weak acid has $K_a = 1.0 \times 10^{-5}$.

(a) Find $[\text{H}^+]$ using the approximation.

[2]

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(a)

- $$[\text{H}^+] = \sqrt{(1.0 \times 10^{-5})(0.20)} = \sqrt{2.0 \times 10^{-6}} = 1.41 \times 10^{-3} \text{ M}$$

Exercise 3.2 (b)

3.2 A 0.20 M solution of a weak acid has $K_a = 1.0 \times 10^{-5}$.

(b) Find the pH.

[2]

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[2]

(b)

- $\text{pH} = -\log(1.41 \times 10^{-3}) = 2.85$

Exercise 3.3

3.3 Explain why the small- x approximation is valid for a weak acid but not for a strong acid. [2]

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3.3

- A weak acid ionizes only slightly, so x is tiny compared to C and $C - x \approx C$; a strong acid ionizes fully, so $x \approx C$ and the approximation fails