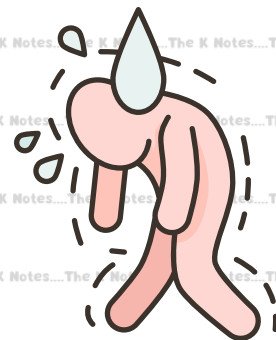
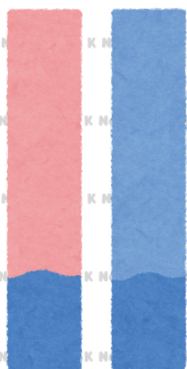
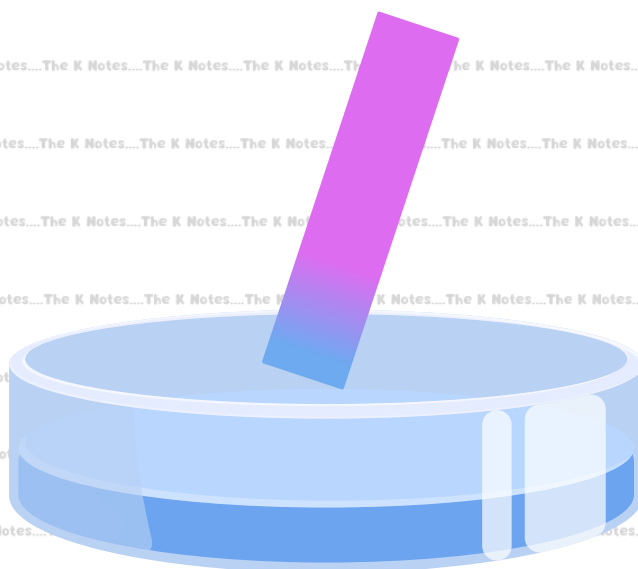
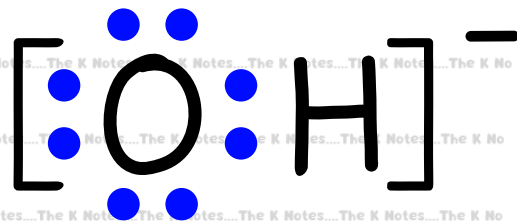


# EXAMPREPNOTES

## Ionization of a Weak Base



**UNLOCK THE MYSTERIES OF CHEMISTRY WITH OUR COMPREHENSIVE AND ENGAGING STUDY GUIDES.**

# Ionization of a Weak Base

## What Is a Weak Base?

A weak base is a substance that doesn't fully accept hydrogen ions ( $H^+$ ) when it's in water. Instead, only a small number of base molecules react with water, while most of them stay the same.

## Examples of Weak Bases:

- Ammonia ( $NH_3$ ): Found in cleaning products.
- Methylamine ( $CH_3NH_2$ ): Used in making medicines.



## The Key Reaction

### What's Happening?

When a weak base is added to water, it partially reacts to produce:

- $OH^-$  (hydroxide ions): This makes the solution basic.
- $BH^+$  (conjugate acid): This is what's left after the base grabs a hydrogen ion.

The general reaction looks like this:



**Base**

**Acid**

**C.Acid**

**C.Base**

**02**

# Ionization of a Weak Base

## What's Happening?

- Think of weak bases as lazy students who don't fully participate.
- Some molecules of the base (B) grab hydrogen ions from water and form  $\text{BH}^+$  and  $\text{OH}^-$ .
- Most base molecules stay as B, unreacted.



**Base**

**Acid**

**C. Acid**

**C. Base**

## How to Picture This ?

- Imagine a group of students:
- Most are still sitting at their desks (unreacted base, B).
- A few are standing by the board doing work (reacted base,  $\text{BH}^+$  and  $\text{OH}^-$ ).
- The lazy ones (B) dominate the classroom!

# Ionization of a Weak Base

## Base Dissociation Constant (K<sub>b</sub>)

- Just like weak acids have a K<sub>a</sub> value, weak bases have a K<sub>b</sub> value to measure their strength.
- The formula for :  $B(aq) + H_2O(l) \rightleftharpoons BH^+(aq) + OH^-(aq)$

$$K_b = \frac{[BH^+][OH^-]}{[B]}$$



## Here's what it means:

- **[BH<sup>+</sup>]**: Concentration of the base that has reacted.
- **[OH<sup>-</sup>]**: Concentration of hydroxide ions.
- **[B]**: Concentration of the base that hasn't reacted.

# Ionization of a Weak Base

## What Does $K_b$ Tell Us?



- **Small  $K_b$  Value = Weak Base Behavior:**  
Most of the base molecules don't react—they stay as B.

- **Large  $K_b$  Value = Stronger Base:**
- **More base molecules react with water to produce  $BH^+$  and  $OH^-$**

### Quick Question

If 90 out of 100 base molecules split, would  $K_b$  be large or small?

**Answer: Large—because most of the molecules split, it's a stronger base!**

# Ionization of a Weak Base

## Why Do We Use pKb?

Since  $K_b$  values are often very small, it's easier to use  $pK_b$ , which simplifies things:

$$pK_b = -\log(K_b)$$

Reverse Relationship:

- Smaller  $pK_b$  = Stronger base.
- Larger  $pK_b$  = Weaker base.

## Example: Ammonia ( $NH_3$ )

- When ammonia reacts with water, it forms ammonium ( $NH_4^+$ ) and hydroxide ions ( $OH^-$ ):
- $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$
- The equilibrium expression is:

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$



# Ionization of a Weak Base

## Fast Quiz

1 Define a weak base.

(Hint: Does it ionize completely or partially in water?)



2 Write the general ionization equation for a weak acid (B).

(Hint: Think of  $B(aq) + H_2O(l) \rightleftharpoons \dots(aq) + \dots(aq)$ .)

3 What does it mean when we say the equilibrium "lies to the left" for a weak base?

4 Match the following acids to their behavior:

a) Strong base

b) Weak base

i) Fully ionizes in water.

ii) Partially ionizes in water.

5 Explain the meaning of  $K_b$  in simple terms.

(Hint: It's a measure of how much the base splits.)

6 If the  $K_b$  of an base is  $1.0 \times 10^{-5}$ , calculate the  $pK_b$ .

(Hint: Use the formula  $pK_b = -\log(K_b)$ .)

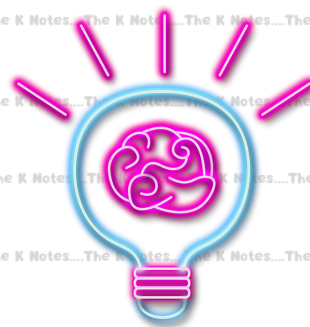
7 Why do we use  $pK_b$  instead of  $K_b$  to compare bases strengths?

# Ionization of a Weak Base

## Continue Fast Quiz

8 A weak acid has a  $pK_a$  of 4.8.

Is it stronger or weaker than an acid with a  $pK_a$  of 6.2? Explain.



9 The  $pK_b$  of ethanoic acid is 4.76. Calculate the concentration of  $H^+$  ions in a 0.10 M solution.

(Hint: Use the formula for  $K_a$  and assume small ionization.)

10 Challenge Problem:

A 0.050 M solution of a weak base has a pH of 8.

Calculate the  $K_b$  for the acid.





# More Study Guides at

**K - Chemistry .com**