






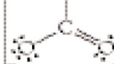
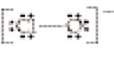


# Calculating pH of Weak Acids-Bases

**TABLE 14.2** Values of  $K_a$  for Some Common Monoprotic Acids

Formula	Name	Value of $K_a^*$
$\text{HSO}_4^-$	Hydrogen sulfate ion	$1.2 \times 10^{-2}$
$\text{HClO}_2$	Chlorous acid	$1.2 \times 10^{-2}$
$\text{HC}_2\text{H}_2\text{ClO}_2$	Monochloroacetic acid	$1.35 \times 10^{-3}$
$\text{HF}$	Hydrofluoric acid	$7.2 \times 10^{-4}$
$\text{HNO}_2$	Nitrous acid	$4.0 \times 10^{-4}$
$\text{HC}_2\text{H}_3\text{O}_2$	Acetic acid	$1.8 \times 10^{-5}$
$[\text{Al}(\text{H}_2\text{O})_6]^{3+}$	Hydrated aluminum(III) ion	$1.4 \times 10^{-5}$
$\text{HOCl}$	Hypochlorous acid	$3.5 \times 10^{-8}$
$\text{HCN}$	Hydrocyanic acid	$6.2 \times 10^{-10}$
$\text{NH}_4^+$	Ammonium ion	$5.6 \times 10^{-10}$
$\text{HOC}_6\text{H}_5$	Phenol	$1.6 \times 10^{-10}$

↑  
Increasing acid strength

Base	Lewis Structure	Conjugate Acid	Equilibrium Reaction	$K_b$
Ammonia ( $\text{NH}_3$ )		$\text{NH}_4^+$	$\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$	$1.8 \times 10^{-5}$
Pyridine ( $\text{C}_5\text{H}_5\text{N}$ )		$\text{C}_5\text{H}_5\text{NH}^+$	$\text{C}_5\text{H}_5\text{N} + \text{H}_2\text{O} \rightleftharpoons \text{C}_5\text{H}_5\text{NH}^+ + \text{OH}^-$	$1.7 \times 10^{-9}$
Hydroxylamine ( $\text{H}_2\text{NOH}$ )		$\text{H}_3\text{NOH}^+$	$\text{H}_2\text{NOH} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{NOH}^+ + \text{OH}^-$	$1.1 \times 10^{-8}$
Methylamine ( $\text{NH}_2\text{CH}_3$ )		$\text{NH}_3\text{CH}_3^+$	$\text{NH}_2\text{CH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3\text{CH}_3^+ + \text{OH}^-$	$4.4 \times 10^{-4}$
Hydrosulfide ion ( $\text{HS}^-$ )		$\text{H}_2\text{S}$	$\text{HS}^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{S} + \text{OH}^-$	$1.8 \times 10^{-7}$
Carbonate ion ( $\text{CO}_3^{2-}$ )		$\text{HCO}_3^-$	$\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^-$	$1.8 \times 10^{-4}$
Hypochlorite ion ( $\text{ClO}^-$ )		$\text{HClO}$	$\text{ClO}^- + \text{H}_2\text{O} \rightleftharpoons \text{HClO} + \text{OH}^-$	$3.3 \times 10^{-7}$

## Sample Problems

a. What is the pH of 25.0 mL of a 0.250-M solution of acetic acid?

b. What the percent dissociation of a 0.325-M solution of formic acid?

c. Calculate the pH of a solution that contains 1.00 M HCN and 5.00 M  $\text{HNO}_2$ . Also calculate the concentration of  $\text{CN}^-$  ion in this solution at equilibrium.

d. What is the pH of a solution where 25.0-mL of 0.25 M  $\text{HNO}_3$  is mixed with 25.0-mL of 0.25-M  $\text{HNO}_2$

e. What is the pH of a 0.25-M solution of  $\text{NH}_3$ ?

f. What is the pH of a mixture of 25.0 mL of 0.25M  $\text{KOH}$  and 25.0 mL of 0.25 M  $\text{CH}_3\text{NH}_2$

## Calculating $K_a$ from percent dissociation

### *Sample 1:*

Lactic Acid ( $\text{HC}_3\text{H}_5\text{O}_3$ ) is a waste product that accumulates in muscle during exertion, leading to pain and a feeling of fatigue. In a 0.100 M aqueous solution, lactic acid is 3.7% dissociated. Calculate the value of  $K_a$  for this reaction.