# pH of Weak Acids

What is the pH and % ionization of a 0.0084 M solution of HClO? ($pK_a = 7.46$)

# pH of Weak Acids

What is the pH and % ionization of a 0.0084 M solution of HClO? ($pK_a = 7.46$)

Solution: Write down the reaction

$$HClO \leftrightarrow H^+ + ClO^-$$

Step 1: Solve for $K_a$

$$K_a = 10^{-pKa} = 10^{-7.46} = 3.47x10^{-8}$$

Step 2: The pKa is quite close to 7.0. Will the approximate method work? We will check.

Make a reaction table

| Molecule | HClO | $ClO^-$ | $H^+$ |
|---|---|---|---|
| Initial | 0.0084 | 0 | 0 |
| Change | -x | x | x |
| Equilibrium | 0.0084-x | x | x |

# pH of Weak Acids

HClO problem (contd) ($pK_a = 7.46$)

Step 3: Solve for x

$$x = \frac{K_a \pm \sqrt{K_a{}^2 + 4(0.0084)K_a}}{-2}$$

$$x = \frac{3.47x10^{-8} \pm \sqrt{(3.47x10^{-8})^2 + 0.0336(3.4710^{-8})}}{-2}$$

$$x = 1.7x10^{-5}$$

Now, we compare this value directly with the approximate method

$$x = \sqrt{[HClO]_0 K_a} = \sqrt{(0.0085)(3.48\,x\,10^{-8})}$$

$$x = 1.7x10^{-5}$$

Even for HClO the approximate method works well.

# pH of Weak Acids

HClO problem (contd)  pH and % ionization

Step 4: Solve for pH

$$pH = -log_{10}(1.7x10^{-5}) = 4.77$$

Step 5: Calculate percent ionization

$$\%\ ionization = \frac{x}{[initial]}100\%$$

$$\%\ ionization = \frac{1.7x10^{-5}}{0.0084}100\% = 0.2\%$$