Which of the following is a stronger acid?

a) HIO_3 or CH_3COOH

b) H_2O_2 or HSO_3^-

c) $H_2PO_4^-$ or HCN

Equilibrium Constant for the Ionization of Water

- a solution can be classified as acidic, basic or neutral based on the relative concentrations of H_3O^+ and OH^-

acidic	$[H_3O^+] > [OH^-]$
neutral	$[H_3O^+] = [OH^-]$
basic	$[H_3O^+] < [OH^-]$

- even in the absence of acids or bases, pure water contains a very small amount of H_3O^+ and OH^- as a result of collisions between water molecules
- self-ionization can be represented as:

$$59\text{kJ} + 2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$

- an equilibrium constant for this reaction can be written as:

$$Keq = Kw = \frac{[H_3O^+][OH^-]}{1} = [H_3O^+][OH^-]$$

Kw = dissociation constant for water

In pure water, at 25°C,

$[H_3O^+] = 1.00 \times 10^{-7}$ M

$[OH^-] = 1.00 \times 10^{-7}$ M

$$Kw = [1.00 \times 10^{-7}\text{ M}][1.00 \times 10^{-7}\text{ M}] = 1.00 \times 10^{-14}$$

- the value of Kw only varies with temperature
- when Kw or the temperature is not stated, it can be assumed that $Kw = 1.00 \times 10^{-14}$

ex.
What is $[OH^-]$ in 0.025 M HCl?

$HCl \rightarrow H^+ + Cl^-$

0.025M (H_3O^+) 0.025M

$K_W = [OH^-][H_3O^+]$

$[OH^-] = \frac{K_W}{[H_3O^+]} = \frac{1.00 \times 10^{-14}}{0.025}$

$= 4.0 \times 10^{-13} M$

Find $[H_3O^+]$ in 0.300 M NaOH

$NaOH \rightarrow Na^+ + OH^-$

0.300M 0.300M

$K_W = [H_3O^+][OH^-]$

$[H_3O^+] = \frac{K_W}{[OH^-]} = \frac{1.00 \times 10^{-14}}{.300} = 3.33 \times 10^{-14} M$

Find $[H_3O^+]$ in 0.020 M $Ba(OH)_2$

$K_W = [H_3O^+][OH^-]$

$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

0.020M 0.040M

$[H_3O^+] = \frac{K_W}{[OH^-]} = \frac{1.00 \times 10^{-14}}{0.04} = 2.5 \times 10^{-13} M$

$$BaO \rightarrow Ba^{2+} + O^{2-}$$

$$O^{2-} \xrightarrow{H_2O} 2OH^-$$