4.7 Kw

Kw = Equilibrium constant for the self ionization of water

$H_2O(l) \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

$Kw = [H^+][OH^-]$

Remember (l) (pure liquids) not included in Keq expressions

also written as:

$2\,H_2O(l) \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$

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

Neutral soln $H_3O^+ = OH^-$
Acidic H_3O^+ greater than OH^-
Basic H_3O^+ less than OH^-

$Kw = 1.00 \times 10^{-14}$ @ 25°C

Example 1: In a neutral soln, $[H_3O^+] = [OH^-]$. Find [ ] of each ion.

Example 2: An acid solution dissolved in water contains $[H_3O^+] = 0.01M$. Calculate $[OH^-]$

Self Ionization of Water is Endothermic:

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

- increase temp equilibrium shifts...

- decrease temp equilibrium shifts...

Unless told otherwise assume temp = 25°C ∴ Kw = 1.00×10^{-14} !!

Quick Check:

a) When water is heated, what happens to $[H_3O^+]$?

b) Is hot water acidic, basic or neutral? Explain

c) What happens to the value of Kw when water is heated?

Kw Calculations

1. What is $[H_3O^+]$ & $[OH^-]$ in 0.001 M (aq), HCl ? (at 25°C)

Some explaination 1st → HCl is a strong acid so 100% dissociates

so $HCl \rightleftharpoons H^+ + Cl^-$

→ and (aq) = in H_2O so $H^+ + H_2O \rightarrow H_3O^+$

$[H_3O^+] = [HCl^-] =$

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

2. In 0.025 M NaOH (aq) what is $[H_3O^+]$?
Is sol'n acidic, basic or neutral?
support with calc's (use #'s to show NaOH is basic)