4.7 Kw

Kw = Equilibrium constant for the self ionization of water

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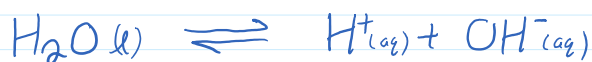
$$Kw = [H^+][OH^-]$$

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

also written as :

$$2H_2O(l) \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$$
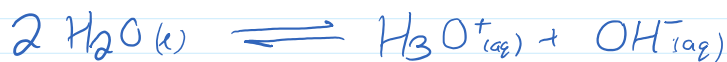
$$Kw = [H_3O^+][OH^-]$$

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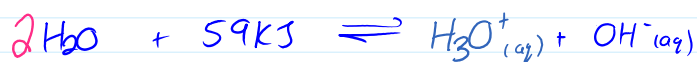Basic H_3O^+ less than OH^-

$$\boxed{Kw = 1.00 \times 10^{-14} \text{ @ } 25°C}$$

Example 1: In a neutral sol^n; $[H_3O^+] = [OH^-]$. 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 :
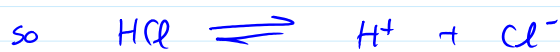
a) When water is heated, what happens to $[H_3O^+]$?

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

c) What happens to the value of K_w 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)