IONIC PRODUCT OF WATER

WATER

$H_2O \rightleftharpoons H^+ + OH^-$

$$K_c = \frac{[H^+][OH^-]}{[H_2O]}$$

$$K_c [H_2O] = [H^+][OH^-]$$

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

K_w = ionic product of water

= 10^{-14} mol^2 dm^{-6} at 298K

$H_2O \rightleftharpoons H^+ + OH^-$

H_2O	H^+	OH^-
1,000,000		
999,999	1	1
999,990	10	10

EFFECT OF TEMPERATURE

endothermic →

$$H_2O \rightleftharpoons H^+ + OH^-$$

← exothermic

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

What happens to K_w, pH and neutrality as temperature increases?

Temperature ↑

- Equilibrium moves right in endothermic direction to oppose T increase
- K_w increases
- $[H^+]$ increases so pH decreases
- Still neutral as $[H^+] = [OH^-]$

CALCULATING pH OF WATER

$$K_w = [H^+]\,[OH^-]$$

Calculate the pH of water at 40°C when K_w = 2.09 x 10^{-14} mol^2 dm^{-6}

In pure water, $[H^+] = [OH^-]$, ∴ $K_w = [H^+]^2$

$[H^+] = \sqrt{K_w}$

$= \sqrt{2.09 \, x \, 10^{-14}}$

$= 1.45 \times 10^{-7}$

pH = –log $[H^+]$ = –log 1.45 x 10^{-7} = **6.84**

