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# IONIC PRODUCT OF WATER

# WATER



$$K_c = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$

$$K_c [\text{H}_2\text{O}] = [\text{H}^+][\text{OH}^-]$$

$K_w$  = ionic product of water  
=  $10^{-14} \text{ mol}^2 \text{ dm}^{-6}$  at 298K

$$K_w = [\text{H}^+][\text{OH}^-]$$



1,000,000

999,999

1

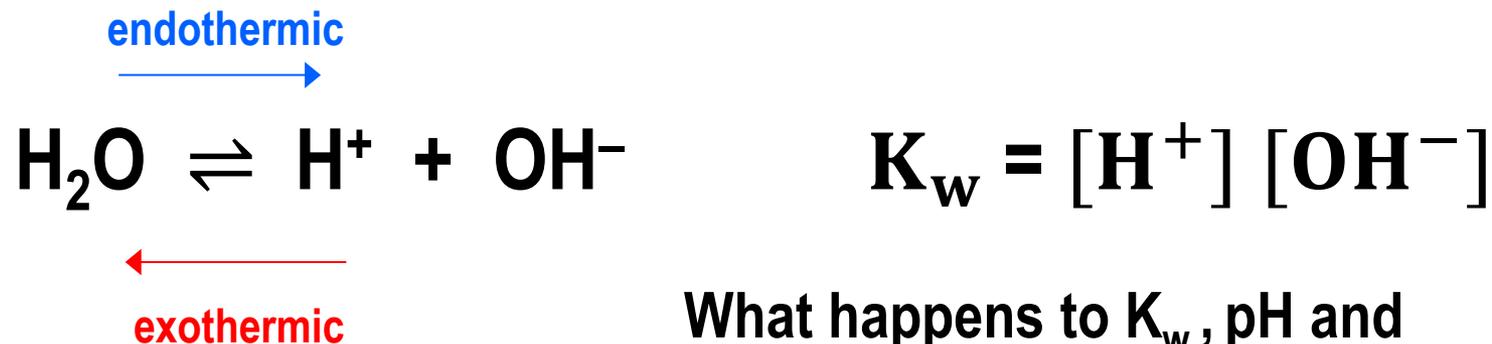
1

999,990

10

10

# EFFECT OF TEMPERATURE



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
- $[\text{H}^+]$  increases so pH decreases
- Still neutral as  $[\text{H}^+] = [\text{OH}^-]$

# CALCULATING pH OF WATER

$$K_w = [\text{H}^+] [\text{OH}^-]$$

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

In pure water,  $[\text{H}^+] = [\text{OH}^-]$ ,  $\therefore K_w = [\text{H}^+]^2$

$$\begin{aligned}[\text{H}^+] &= \sqrt{K_w} \\ &= \sqrt{2.09 \times 10^{-14}} \\ &= 1.45 \times 10^{-7}\end{aligned}$$

$$\text{pH} = -\log [\text{H}^+] = -\log 1.45 \times 10^{-7} = \mathbf{6.84}$$