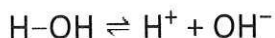


The Temperature Dependence of K_w

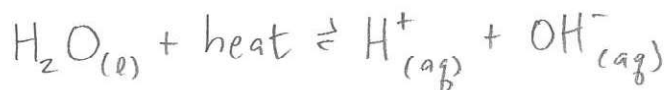
Consider the simple dissociation of water:



1. Is the dissociation of water an endothermic or exothermic process? Why? (Hint: is a bond breaking or forming?)

Breaking (or ENDing) a bond is always endothermic!
(need to input energy to break the attraction)

2. Rewrite the dissociation of water as a thermochemical equation:



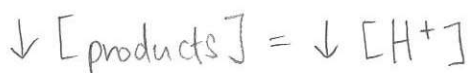
3. If you **cool** a solution of pure water,
a. which direction should the reaction shift and why?

$\downarrow T = \downarrow \text{reactant} \Rightarrow$ shift left to produce more heat + re-establish equilibrium

- b. would you expect K_w to increase, decrease, or stay the same? Why?

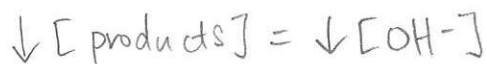


- c. would you expect $[\text{H}^+]$ to increase, decrease, or stay the same? Why?



- d. would you expect pH to increase, decrease, or stay the same? increase! ($\downarrow [\text{H}^+] = \uparrow \text{pH}$)

- e. would you expect $[\text{OH}^-]$ to increase, decrease, or stay the same? Why?



- f. would you expect pOH to increase, decrease, or stay the same? increase! ($\downarrow [\text{OH}^-] = \uparrow \text{pOH}$)

- g. does the equation $\text{pH} + \text{pOH} = 14$ still hold true? Why or why not? Why?

Nope! Both pH and pOH increased, so $\text{pH} + \text{pOH} > 14$ when pure H_2O gets colder than 25°C .

4. If you **heat** a solution of pure water,

- a. Would you expect pH to increase, decrease, or stay the same? decrease! (shift right = $\uparrow [\text{H}^+]$)

- b. Does this mean your solution of water is now more acidic, more basic, or still neutral? Explain.

Still neutral! Although $[\text{H}^+] \uparrow$, $[\text{OH}^-] \uparrow$ too $\Rightarrow [\text{H}^+] = [\text{OH}^-]$

Soooooo important to know: The dissociation of water is endo thermic!