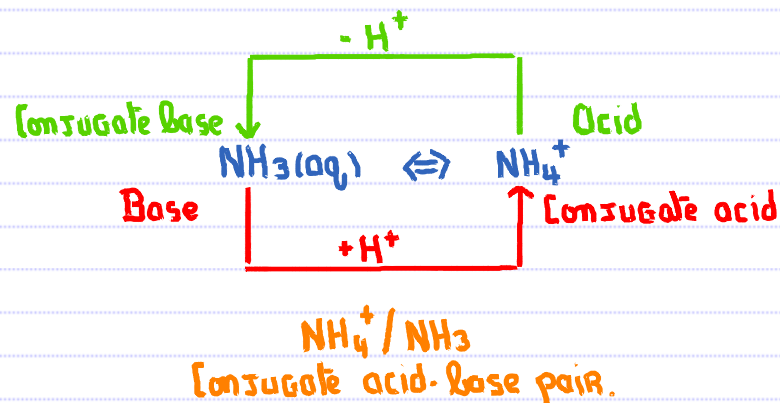
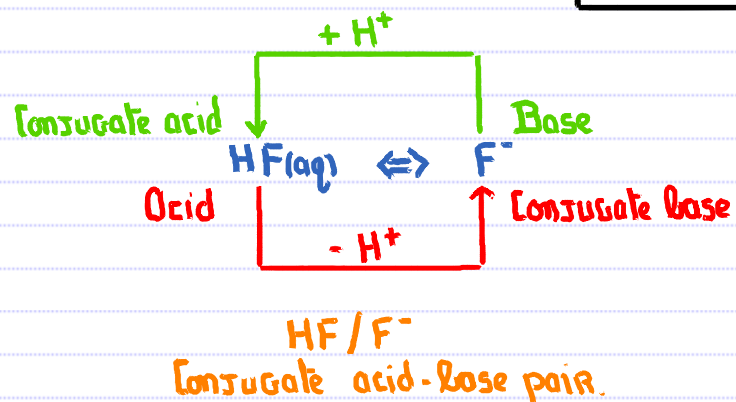
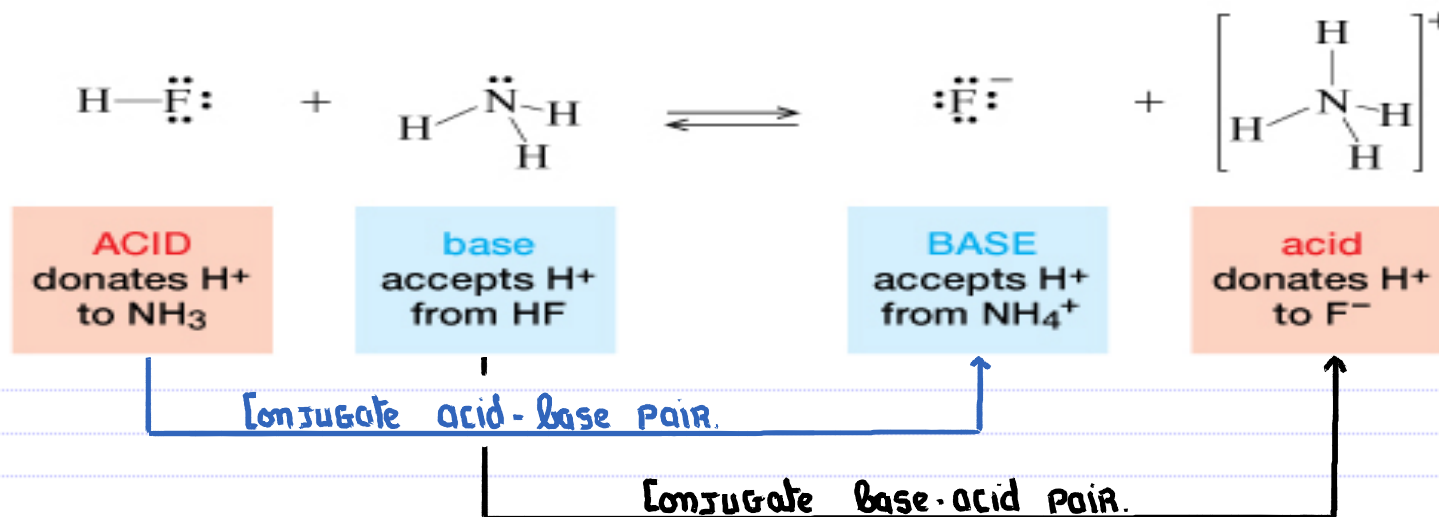


16.1 Introduction to Acids and Bases

Conjugate Acid-Base pairs

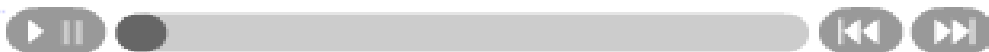


16.2 Water and the pH Scale

Autoionization of Water

Chemistry Interactive: Autoionization of Water

See Class Web Site



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$\text{@ } 25^\circ\text{C}, K_w = 1 \times 10^{-14}$$

$$\text{@ } 25^\circ\text{C}, K_w = 1 \times 10^{-14}$$

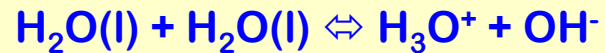
$$[\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$$
$$[\text{H}_3\text{O}^+] = [\text{OH}^-] = \sqrt{1 \times 10^{-14}}$$

$$[\text{H}_3\text{O}^+] = 1 \times 10^{-7}$$
$$[\text{OH}^-] = 1 \times 10^{-7}$$

16.2 Water and the pH Scale

Autoionization of Water

The autoionization of water is an **endothermic** process.



Thus as the temperature increases then – the $[\text{H}_3\text{O}^+]$ should –



a) Decrease

b) Increase ✓


c) Remain the same



Heat the reaction = addition of a reactant.
Results in a shift towards more products ... $[\text{H}_3\text{O}^+] \uparrow$

16.2 Water and the pH Scale

Autoionization of Water

With the $[H_3O^+]$ increasing with increasing temperature this must mean that as the temperature of water increases **the water** – 

a) becomes acidic

b) becomes basic

c) remain neutral ✓



Yes the $[H_3O^+] \uparrow$
But so does the $[OH^-]$
Thus $[H_3O^+]$ still equals $[OH^-]$

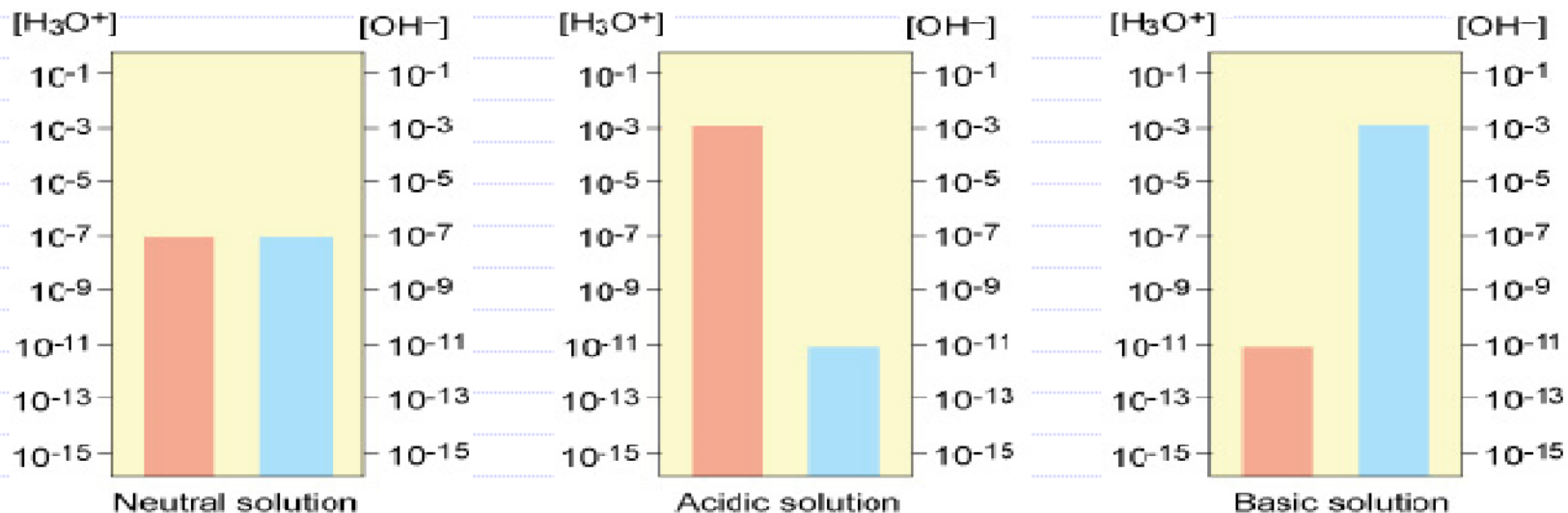
SOME K_w VALUES

0°C	:	1.4×10^{-15}
25°C	:	1.0×10^{-14}
90°C	:	5.57×10^{-13}

16.2 Water and the pH Scale

Autoionization of Water – Neutral/Acidic/Basic Solutions

at 25°C : $K_w = 1 \times 10^{-14}$



$$[H_3O^+] = [OH^-]$$
$$[H_3O^+] = 1 \times 10^{-7}$$
$$[OH^-] = 1 \times 10^{-7}$$

$$[H_3O^+] > [OH^-]$$
$$[H_3O^+] = 1 \times 10^{-3}$$
$$[OH^-] = 1 \times 10^{-11}$$

$$[H_3O^+] < [OH^-]$$
$$[H_3O^+] = 1 \times 10^{-11}$$
$$[OH^-] = 1 \times 10^{-3}$$

16.2 Water and the pH Scale

pH and pOH Calculations

in general : $pX = -\log_{10} X$

$$pH = -\log_{10} [H_3O^+]$$

$$pOH = -\log_{10} [OH^-]$$

@ 25°C : $[H_3O^+][OH^-] = 1 \times 10^{-14}$

$$\log_{10} ([H_3O^+][OH^-]) = \log_{10} (1 \times 10^{-14})$$

$$\log_{10} [H_3O^+] + \log_{10} [OH^-] = -14$$

$$\underbrace{-\log_{10} [H_3O^+]}_{pH} - \underbrace{\log_{10} [OH^-]}_{pOH} = 14$$

$$pH + pOH = 14 @ 25^\circ C$$

