

## Acid Base Equilibrium

### Acid Base

1. What does the prefix hydro- tell us about an acid?
2. What does the suffix -ate tell us about an acid?
3. What does the suffix -ous tell us about an acid?
4. Define an Arrhenius acid and base.
5. Define a Brønsted – Lowry acid and base.
6. What is a conjugate pair?
7. Define a Lewis acid and base.
8. What happens in the autoionization of water?
9. Mathematically show the  $[H^+]$  in water at 25°C.
10. What determines the strength of an acid or base?

### Problems:

1. What are the conjugate bases of these acids? If the chemical also has a conjugate acid, write that too.  
 $HNO_3$ ,  $H_2O$ ,  $H_3O^+$ ,  $H_2SO_4$ ,  $HBr$ ,  $HCO_3^-$ .
2. What are the conjugate acids of these bases? If the chemical also has a conjugate base, write that too.  
 $OH^-$ ,  $H_2O$ ,  $HCO_3^-$ ,  $SO_4^{2-}$ ,  $ClO_4^-$
3. Find the  $[H^+]$  and pH of water at 50°C if the  $K_w = 5.476 \times 10^{-14}$ .
4. Find the  $[OH^-]$  and pH of water at 0°C if the  $K_w = 1.14 \times 10^{-13}$ .

### Acid Base Vodcast 2

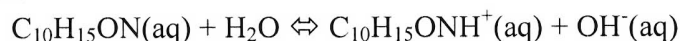
1. What must always be produced in order to write a  $K_a$  expression?
2. What must always be produced in order to write a  $K_b$  expression?

### Problems:

1. Calculate the pH of each of the following strong acid solutions: (a)  $8.5 \times 10^{-3}$  M HBr, (b) 1.52 g of  $HNO_3$  in 575 mL of solution, (c) 5.00 mL of 0.250 M  $HClO_4$  diluted to 50.0 mL, (d) a solution formed by mixing 10.0 mL of 0.100 M HBr with 20.0 mL of 0.200 M HCl.
2. A 0.085 M solution of  $C_6H_5CH_2COOH$  has a pH of 2.68. Calculate the  $K_a$  value for this acid.

Lactic acid ( $CH_3CH(OH)COOH$ ) has one acidic hydrogen. A 0.10 M solution of lactic acid has a pH of 2.44. Calculate  $K_a$ .

3. A 0.100 M solution of chloroacetic acid ( $ClCH_2COOH$ ) is 11.0% ionized. Using this information, calculate  $[ClCH_2COO^-]$ ,  $[H^+]$ ,  $[ClCH_2COOH]$ , and  $K_a$  for chloroacetic acid
4. A particular sample of vinegar has a pH of 2.90. If acetic acid is the only acid that vinegar contains ( $K_a = 1.8 \times 10^{-5}$ ), calculate the concentration of acetic acid in the vinegar.
5. Calculate the pH of each of the following solutions ( $K_a$  and  $K_b$  values are given in Appendix D): (a) 0.095 M propionic acid ( $C_2H_5COOH$ ), (b) 0.100 M hydrogen chromate ion ( $HCrO_4^-$ ), (c) 0.120 M pyridine ( $C_5H_5N$ ).
6. Calculate the percent ionization of hydrazoic acid ( $HN_3$ ) in solutions of each of the following concentrations ( $K_a$  is given in Appendix D): (a) 0.400 M, (b) 0.100 M, (c) 0.0400 M.
7. Calculate the molar concentration of  $OH^-$  ions in a 0.075 M solution of ethylamine ( $C_2H_5NH_2$ ;  $K_b = 6.4 \times 10^{-4}$ ). Calculate the pH of this solution.
8. Calculate the molar concentration of  $OH^-$  ions in a 0.550 M solution of hypobromite ion ( $BrO^-$ ;  $K_b = 4.0 \times 10^{-6}$ ). What is the pH of this solution?
9. Ephedrine, a central nervous system stimulant, is used in nasal sprays as a decongestant. This compound is a weak organic base:



A 0.035 M solution of ephedrine has a pH of 11.33. (a) What are the equilibrium concentrations of  $C_{10}H_{15}ON$ ,  $C_{10}H_{15}ONH^+$ , and  $OH^-$ ? (b) Calculate  $K_b$  for ephedrine.