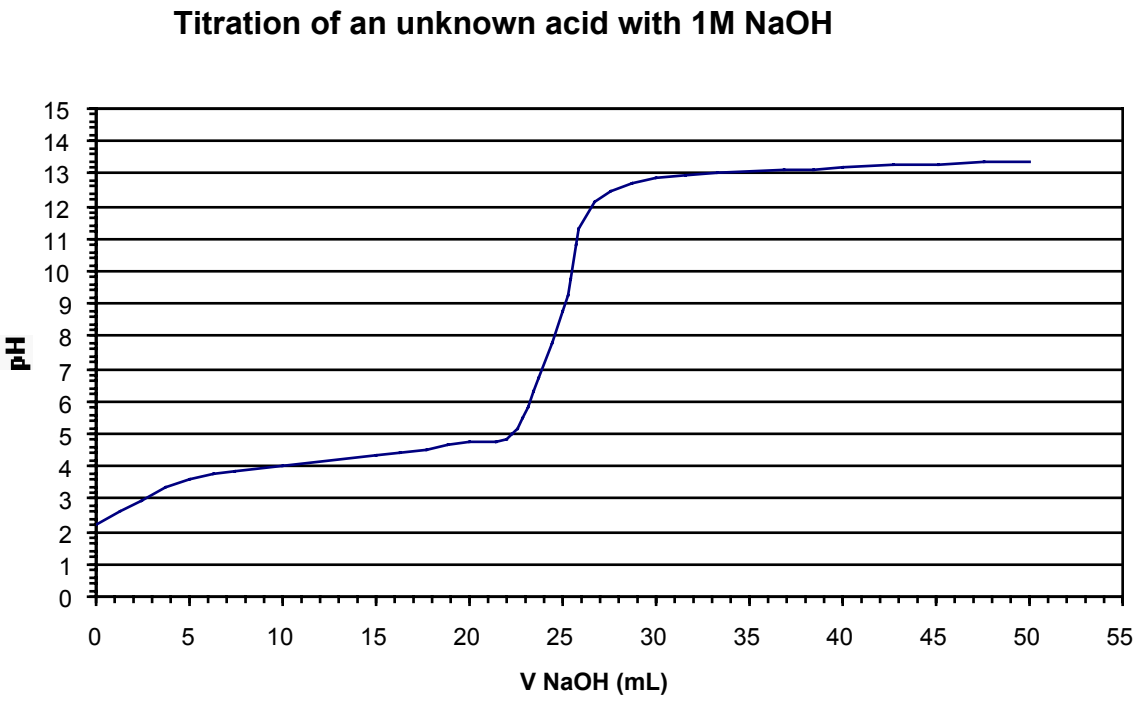
Lecture Notes T: Acid-Base Chemistry VII

1) Using titrations to determine the properties of unknown solutions



Consider the following titration curve:
Label the equivalence point, V_{eq}, and the buffer point.
How many moles of acid did I start with?

a) 0.25 mol b) 0.025 mol c) 0.0125 mol

What is the pK_a for this acid?

a) 8.8 b) 4.2 c) 2.2

What is the pH range of buffers I can make with this acid and its conjugate base?

If I mixed this acid with Sodium Acetate (pK_a = 4.75), would the acid give up its proton?

What reaction would you use to calculate the pH at the start of the reaction?

a) $HA + H_2O \leftrightarrows A^- + H_3O^+$
b) $HA + OH^- \leftrightarrows A^- + H_2O$

When 20 mL of NaOH has been added, what is the dominant species in solution?

a) HA
b) A^-
c) OH^-
d) H_3O^+

2) Weak Bases

What is the pH of a 0.10 M solution of NH_3 in water?
From Table 10.2: $NH_4^+ + H_2O \leftrightarrows NH_3 + H_3O^+$ $pK_a = 9.25$ $K_a = 10^{-9.25} = 5.6 \times 10^{-10}$

How would you make a pH = 10 buffer from 0.10M NH_3 and 0.10M NH_4Cl?

3) Polyprotic Acids

Phosphoric Acid:

$H_3PO_4 + H_2O \leftrightarrows H_3O^+ + H_2PO_4^-$ $pK_{a1} = 2.12$ $K_{a1} = 7.52 \times 10^{-3}$

$H_2PO_4^- + H_2O \leftrightarrows H_3O^+ + HPO_4^{2-}$ $pK_{a1} = 7.21$ $K_{a2} = 6.23 \times 10^{-8}$

$HPO_4^{2-} + H_2O \leftrightarrows H_3O^+ + PO_4^{3-}$ $pK_{a1} = 12.67$ $K_{a3} = 2.2 \times 10^{-13}$

Sulfurous Acid:

$H_2SO_3 + H_2O \leftrightarrows H_3O^+ + HSO_3^-$ $pK_{a1} = 1.81$ $K_{a1} = 1.54 \times 10^{-2}$

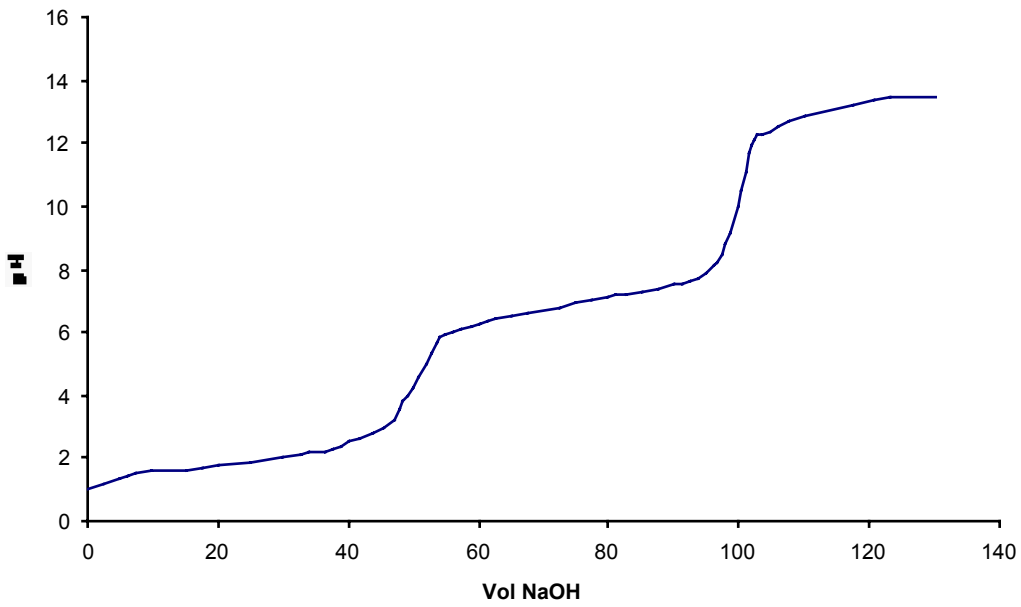
$HSO_3^- + H_2O \leftrightarrows H_3O^+ + SO_3^{2-}$ $pK_{a2} = 6.91$ $K_{a2} = 1.02 \times 10^{-7}$

Using the Sulfurous acid system, make a buffer with a pH = 7.

In the above system, what is the concentration of H_2SO_3?

I want to make a pH = 12 buffer, and all I have is Na_3PO_4 and HCl. How do I go about doing this?

4) Titration of a polyprotic acid



5) Carbon Dioxide

$CO_2\,(g) \leftrightarrows CO_2\,(aq)$ K = 0.034

$CO_2\,(aq) + 2\,H_2O \leftrightarrows H_3O^+ + HCO_3^-$ $pK_{a1} = 6.37$ $K_{a1} = 4.3 \times 10^{-7}$

$HCO_3^- + H_2O \leftrightarrows H_3O^+ + HCO_3^-$ $pK_{a2} = 10.32$ $K_{a2} = 4.8 \times 10^{-11}$

The partial pressure of CO_2 in the atmosphere is 3.55×10^{-4} atm. What is the pH of water in equilibrium with air?

Suppose a can of soda contains a gas mixture for which the partial pressure of CO_2 is 1 atm. What is the pH of the soda?