Answer on Question #79535, Chemistry/ General Chemistry

Find the pH at 25^{0}C when 60.0 mL of 0.100 M HNO_3(aq) is added to 50.0 mL of 0.100 M NH_3(aq). Kb for NH_3 at 25^{0}C is 1.8×10^{-5}.

Solution

HNO_3 (aq) + NH_3(aq) $\rightarrow$ NH_4NO_3(aq)

To find pH we should determine what reactant is in exsess.

Find amount of substances of HNO_3 and NH_3:

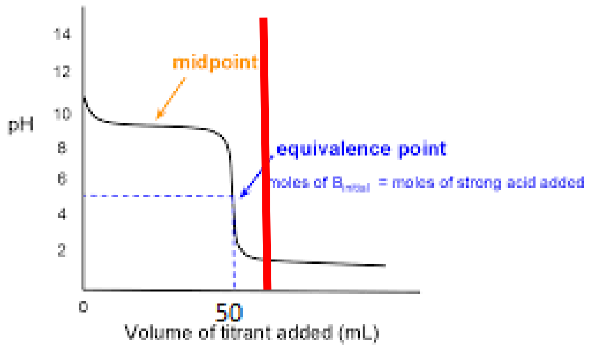
n(HNO_3) = 0.060 L $\times$0.100 M=0.006 mol

n(NH_3) = 0.050 L$\times$0.100 M = 0.005 mol.

According to equation mole ratio of HNO_3 and NH_3 is 1:1, then HNO_3 is excess. The amount of HNO_3 is greater than the moles of NH_3. The 0.006 moles of HNO_3 neutralizes the 0.005 moles of NH_3. Amount of H^+ in excess is:

n(H^+) = 0.006 – 0.005 = 0.001 (mol)

On the titration curve this point is after equivalence point (red line):



After the equivalence point, the pH is controlled by the excess of HNO_3 and the hydrolysis of the NH_4^+.

$NH_4^+ + H_2O \leftrightarrow NH_3 + H_3O^+$

Ka = Kw/Kb

Ka = $1\times10^{-14}/1.8\times10^{-5} = 5.56\times10^{-10}$.

As Ka is very small we can ignore amount of H^+ formed by hydrolysis process. We should find concentration of H^+ formed when HNO_3 was added.

$[H^+] = n(H^+)/V_{total}$ = 0.001 mol /(0.060 L +0.050 L) = 0.0091 M

pH = -log[H^+]

pH= - log (0.0091) = 2.04

Answer: 2.04