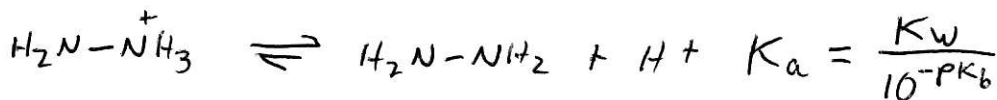


2. a. 6.80 g $\text{H}_2\text{N}-\text{NH}_3^+\text{Cl}^-$ (molar mass 68.51 g/mol)

$$= 0.09926 \text{ mol in } 0.5000 \text{ L}$$

$$[\text{H}_2\text{N}-\text{NH}_3^+]_0 = \frac{0.09926 \text{ mol}}{0.5000 \text{ L}} = 0.1985 \text{ M}$$



$$K_a = \frac{1.0 \times 10^{-14}}{10^{-5.88}} = 7.59 \times 10^{-9}$$

$$\frac{[\text{H}^+][\text{H}_2\text{N}-\text{NH}_2]}{[\text{H}_2\text{N}-\text{NH}_3^+]} = 7.59 \times 10^{-9} = \frac{x^2}{0.1985 - x} \approx \frac{x^2}{0.1985}$$

$$x = 3.88 \times 10^{-5} \quad \text{approx is ok } \checkmark$$

$$= [\text{H}^+]$$

$$\text{pH} = 4.41$$

b. 75.0 mL 0.1985 M $\text{H}_2\text{N}-\text{NH}_3^+$ + 75.0 mL 0.200 M $\text{H}_2\text{N}-\text{NH}_2$

14.89 mmol $\text{H}_2\text{N}-\text{NH}_3^+$

15.0 mmol $\text{H}_2\text{N}-\text{NH}_2$

$$\text{pH} = \text{p}K_a + \log \frac{[\text{H}_2\text{N}-\text{NH}_2]}{[\text{H}_2\text{N}-\text{NH}_3^+]} = \text{p}K_a + \log \left(\frac{n_{\text{H}_2\text{N}-\text{NH}_2}}{n_{\text{H}_2\text{N}-\text{NH}_3^+}} \right)$$

$$= 8.12 + \log \frac{15.0 \text{ mmol}}{14.89 \text{ mmol}}$$

$$\text{pH} = 8.12 + 0.003 = 8.123$$

$$\text{pH} = 8.12$$

c. 15.0 mL 0.0750 M HCl \rightarrow 1.125 mmol HCl

50 mL soln #2 - get $n_{\text{H}_2\text{N}-\text{NH}_2}$ and $n_{\text{H}_2\text{N}-\text{NH}_3^+}$ in this sample

these were mixed up!

$$50.0 \text{ mL} \times \frac{14.89 \text{ mmol } \text{H}_2\text{N}-\text{NH}_2}{150.0 \text{ mL soln}} = 4.963 \text{ mmol } \text{H}_2\text{N}-\text{NH}_2$$

$$50.0 \text{ mL} \times \frac{15.0 \text{ mmol } \text{H}_2\text{N}-\text{NH}_3^+}{150.0 \text{ mL soln}} = 5.00 \text{ mmol } \text{H}_2\text{N}-\text{NH}_3^+$$

The 1.125 mmol HCl converts 1.125 mmol $\text{H}_2\text{N}-\text{NH}_2$ into $\text{H}_2\text{N}-\text{NH}_3^+$, so we end up with 3.838 mmol $\text{H}_2\text{N}-\text{NH}_2$ and 6.125 mmol $\text{H}_2\text{N}-\text{NH}_3^+$ in the resulting solution.

$$\text{pH} = \text{p}K_a + \log \left(\frac{n_{\text{H}_2\text{N}-\text{NH}_2}}{n_{\text{H}_2\text{N}-\text{NH}_3^+}} \right) = 8.12 + \log \left(\frac{3.838}{6.125} \right) = 7.92$$