\[ [\text{OH}^-] = \sqrt{K_b \times c_B} \]

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

The results are in cell F10 and pH = 10.36.

**26.00 mL**

no. mmol HClO\textsubscript{4} added = 26.00 \times 0.200 = 5.2000

initial no. mmol NaOH = 50.00 \times 0.100 = 5.0000

no. mmol H\textsubscript{2}NNH\textsubscript{3}\textsuperscript{+} formed = 0.2000

initial no. mmol H\textsubscript{2}NNH\textsubscript{2} = 50.00 \times 0.0800 = 4.000

no. mmol H\textsubscript{2}NNH\textsubscript{2} present = 4.000 - 0.2000 = 3.800

\[ c_{\text{H}_2\text{NNH}^+} = \frac{0.2000}{76.00} = 2.63 \times 10^{-3} = [\text{H}_2\text{NNH}^+] \]

\[ c_{\text{H}_2\text{NNH}_2} = \frac{3.800}{76.00} = 5.00 \times 10^{-2} = [\text{H}_2\text{NNH}_2] \]

\[ [\text{H}_3\text{O}^+] = K_a \times \frac{c_{\text{H}_2\text{NNH}_2}}{c_{\text{H}_2\text{NNH}_2}} \]

The results are in cell F11 and pH = 9.26.

**35.00 and 44.00 mL**

Proceeding in the same way, we obtain the results in cells F12 and F13 with pH = 7.98 and 6.70 respectively.

**45.00 mL**

\[ [\text{H}_3\text{G}^+] = \sqrt{K_a c_{\text{BH}^+}} \quad (\text{cell F14}) \quad \text{pH} = 4.68 \]

**46.00 and 50.00 mL**

\[ [\text{H}_3\text{O}^+] = c_{\text{HClO}_4} \quad (\text{cells F15 and F16}) \]

This is obtained from the excess HClO\textsubscript{4} added and assumes that dissociation of BH\textsuperscript{+} is negligible.