Ion Concentrations and Adding Solutions

Problem 5-17

If one assumes the volumes are additive, what is the [Cl-] in a solution obtained by mixing 225 mL of 0.625 M KCl and 615 mL of 0.385 M $MgCl_2$?

Solution:

For the molar concentration of Cl^-, we need the total amount, in moles, of Cl^- in the solution.

$$n_{Cl^- \text{ from KCl}} = 0.225 \text{ L} \times 0.625 \tfrac{mol}{L} = 0.1406 \text{ mol Cl}^-$$

$$n_{Cl^- \text{ from MgCl}_2} = 0.615 \text{ L} \times 0.385 \tfrac{mol}{L} \times \frac{2 \text{ mol Cl}^-}{1 \text{ mol MgCl}_2} = 0.4736 \text{ mol Cl}^-$$

$$n_{Cl^- \text{ total}} = 0.1406 \text{ mol Cl}^- + 0.4736 \text{ mol Cl}^- = 0.6142 \text{ mol Cl}^-$$

The volumes are additive, so the total volume is
$$V_{total} = 0.225 \text{ L} + 0.615 \text{ L} = 0.840 \text{ L}$$

...and the concentration of Cl^- is
$$C_{Cl^-} = \frac{0.6142 \text{ mol Cl}^-}{0.840 \text{ L}} = 0.731 \text{ M Cl}^-$$