

The influence of ionic strength on the solubility of barium iodate

Author: Dr David J McGarvey, School of Chemistry & Physics, Keele University

Practical:

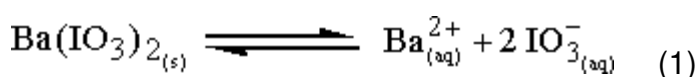
Abstract

Introduction

In this experiment, the influence of ionic strength (I) on the solubility of barium iodate, $\text{Ba}(\text{IO}_3)_2$, is examined. The results of the experiment are used to obtain the solubility product

$$K_s^\circ$$

and mean activity coefficients (γ_{\pm}) for $\text{Ba}(\text{IO}_3)_2$ at different ionic strengths. The mean activity coefficient data is used to test the validity of the Debye-Hückel limiting law (DHLL).



The solubility product

$$K_s^\circ$$

of $\text{Ba}(\text{IO}_3)_2$ is given by equation 2.

$$K_s^\circ = a_{\text{Ba}^{2+}} a_{\text{IO}_3^-}^2 = [\text{Ba}^{2+}] [\text{IO}_3^-]^2 \gamma_{\pm}^3 \quad (2)$$

The solubility (s) is the number of moles of $\text{Ba}(\text{IO}_3)_2$ that dissolve per dm^3 of solution. Therefore, equation 2 may be re-written in terms of s .

$$K_s^\circ = 4s^3 \gamma_{\pm}^3 \quad (3)$$

Using the DHLL (equation 4), re-arrangement of equation 3 yields equation 5.

$$\log_{10} \gamma_{\pm} = -A|z_+z_-| \sqrt{I} \quad (4)$$

$$\log_{10} s = \frac{1}{3} \log_{10} \left(\frac{K_s^\circ}{4} \right) + A|z_+z_-| \sqrt{I} \quad (5)$$

Thus, providing that the DHLL is valid, a plot of $\log_{10}s$ versus \sqrt{I} should yield

a straight line, from which



is determined from the value of the intercept. Equation 5 may be written in an alternative manner (equation 6) that yields an explicit expression for $\log_{10} \gamma_{\pm}$.

$$\log_{10} \gamma_{\pm} = \frac{1}{3} \log_{10} \left(\frac{K_s^\circ}{4} \right) - \log_{10} s \quad (6)$$

Intended academic level

Second Year University Level

Duration

3 hours

Outcomes

- Determine the solubility product K_s° for $\text{Ba}(\text{IO}_3)_2 \cdot \text{H}_2\text{O}$.
- Determine mean activity coefficients (γ_{\pm}) for Ba^{2+} and IO_3^- over a range of ionic strengths.
- Test the validity of the Debye-Hückel limiting law (DHLL).

Materials

Digital colourimeter, 1 cm cuvettes, stoppered bottles, 25°C constant temperature water bath, volumetric glassware, solid $\text{Ba}(\text{IO}_3)_2$, solid KCl, I_2 solution (0.05 mol dm^{-3} in 0.1 mol dm^{-3} KI solution), KI solution (0.1 mol dm^{-3}), HCl solution (2 mol dm^{-3}), de-ionised water.

Costs

Unknown

Further comments

The following skills are introduced or enhanced in this laboratory exercise:

- Working in a team
- Planning your work
- COSHH risk assessment
- Recording and analysing experimental data

- Plotting and extracting information from graphs using Excel
- Extracting information from literature sources.

Contact Details

Dr David J McGarvey
School of Chemistry & Physics
Keele University