Chemistry 254
Experiment 3
Mean activity coefficient of an electrolyte

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Last editted on 11th August 2022

Abstract

In this practical the effect of electrolyte concentration of th mean activity coefficient was investigated through Debye-Hückel theory.

Contents

1 Introduction

In this practical the effect of electrolyte concentration of th mean activity coefficient was investigated through Debye-Hückel theory.

by virtue of the fact that $log(s) = log(s_0) + Kz_+z_-\sqrt{I}$, we know that when $\sqrt{I} = 0$, $log(s) = log(s_0)$. Thus we can find s_0 by extrapolating from our solubility data using a linear regression, where the intercept will equal $log(s_0)$. Furthemore we able to extract the Debye-Hückel constant, K, from the slope of the linear regression.

Using these values we are able to identify the values for $\gamma_\pm$ at different solubilities, and the K_{sp}.

2 Results

Table 1 shows the solubilities of all samples, along with the calculated values for ionic strength, used in figure 1, and the mean activity coefficient.

All constants are shown in table 2, including room temperature.

Table 1: Ionic strength and mean activity coefficient for different solubilities

s (M)	I (M)	$\gamma_\pm$
0.04958	1.025	0.01622
0.03053	0.7653	0.02634
0.01823	0.5091	0.04412
0.007633	0.2538	0.1054
0.002969	0.1265	0.2709

Table 2: Constants

s_0 (M)	K	K_{sp}	RT
-7.125	4.172	6.470e-7	16 °C

A static export of the notebook containing all analysis and figures is availible at `https://adammenne.github.io/chemistry_254/practical_2/plots.html`. With full source code availble at `https://github.com/AdamMenne/chemistry_`

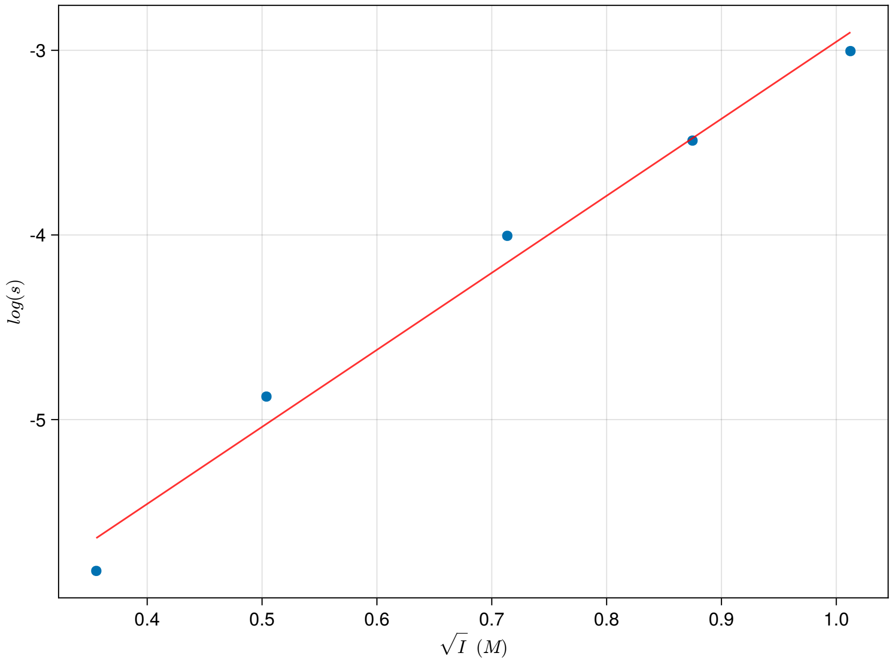

Figure 1: $log(s)$ as a function of $\sqrt{I}$

`254/tree/master/practical_2`

3 Discussion

The fit on the linear regression has a percent error of 0.2307 and 0.3152 for the intercept and slope respectively. This indicates, atleast approximately, a linear relationship, as is expected from $log(s) = log(s_0) + Kz_+z_-\sqrt{I}$. See figure 1

Beyond this it is difficult to assess the accuracy of our data, without comparing to known values.

Appendix A Additional tasks

1. 0.002
2. 0.006

Appendix B Flow Diagram

1. Pipette 5 cm^3 of one of five solutions of different concentration into a Erlenmeyer flask.
2. Add $\pm 10cm^3$ of $1M$ HCl and $\pm 10cm^3$ of 10% KI into the flask.
3. Wait for three minutes, and titrate using thiosulphate solution, adding starch indicator towards the endpoint.
4. Repeat twice.
5. Repeat 1 through 4 for the other four solutions

Appendix C MSDS

Potassium nitrate

- Oxidising, harmful

- may cause eye damage and respiratory irritation
- keep away from ignition sources and combustable material
- keep away from skin and eyes

Silver bromate

- Oxidising, harmful

- may cause skin burns, eye damage and respiratory inflammation
- keep away from ignition sources and combustable material
- if in contact with skin or eyes wash for several minutes

Hydrochloric acid

- Harmful, corrisive

- may cause skin burns, eye damage and respiratory irritation, do not inhale

- if in contact with skin or eyes wash for several minutes

Potassium iodide

- Harmful

- may cause skin and eye irritation

- if in contact with skin or eyes wash for several minutes