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Lab Report

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Abstract:

In this experiment the solubility of KNO3, and its temperature precipitation been measured. The KNO3 was dissolved it in water and used a Probe to determine its ksp as a function of temperature. The ∆H was -3.41X 104 with195.479% error, and the ∆S was 135.0194 with 17.6% error.

Introduction:

The purpose of this experiment is to measure the solubility of KNO3 as a function of temperature and determine the ksp of KNO3 , ∆H, and ∆S. Ksp is an equilibrium expression, which means that it is between solid and its solute. To measure the temperature of the solution we use a temperature probe once it starts to precipitate. We measure the volume of the solution after the KNO3 dissolve too to be able to do the calculation of this experiment. We measured the ksp, of KNO3 , the enthalpy, entropy, and the free energy of the dissolution.

The enthalpy is the thermodynamic potential of the system (∆H).

The entropy is the dissorderness of the system (∆S).

The free energy is a thermodynamic quantity that measures the work that can be done in a system (∆G).

The formula for Ksp is Ksp=[K+][NO₃-]

The concentration can be calculated by using the formula: M₁V₁ = M₂V₂

The ∆H and the ∆S can be calculated by using the linear slope in the lnKsp and the reciprocal of the temperature (in Kalvin), which is found in the experiment using the temperature probe. lnKsp = -(∆H/R)(1/T)+(∆S/R).

The ∆G formula is ∆G= -RTlnKsp

Data:

Table 1: experiment numbers.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | T1 | T2 | T3 | T4 | T5 |
| Volume (L) | 3X10-3 | 3.5X10-3 | 4.0X10-3 | 4.5X10-3 | 5.5X10-3 |
| Crystalization Temp (K) | 323.35 | 323.65 | 316.15 | 306.45 | 299.65 |

Results:

Intital mass was 1.976 g

Number of moles was 1.95X10-2

Table 1: Molarities (M)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| T1 | T2 | T3 | T4 | T5 |
| 6.52 | 5.58 | 4.89 | 4.34 | 3.55 |

Table 2: results calculated

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | T1 | T2 | T3 | T4 | T5 |
| Ksp | 42.45 | 31.18 | 23.88 | 18.86 | 12.63 |
| ∆G | -1.01X104 | -9.26X103 | -8.34X103 | -7.48X103 | -6.32X103 |
| 1/T | 3.09X10-3 | 3.09X10-3 | 3.16X10-3 | 3.26X10-3 | 3.34X10-3 |
| ln(ksp) | 3.75 | 3.44 | 3.17 | 2.94 | 2.54 |

∆H= -3.41X104

∆S= 135.0194

Discussion:

The purpose of this experiment is to measure the solubility of KNO3 as a function of temperature and determine the ksp of KNO3 , ∆H, and ∆S. The experiment was done by dissolving KNO₃ in water. And by recording the volume of the solution and temperature of the precipitation once the solid dissolved. The ksp and ∆G were found above for each trial. The ∆H was -3.41X104. The ∆S was 135.0194. The Actual ∆H is 35610 J, and the actual ∆S was 114.8 J.  The percent error for the ∆H was 195.479%, and for the ∆S it was 17.6%.

Possible sources of error might be the reported temperature. It supposed to be reported once the precipitate happens when the first flake of crystals was formed. The group might reported it seconds after it formed which would affect all the calculations at the end. Another source of error was the volume of water that was added in the last trail. We added more water than we should have.

Questions:

A) Yes, based on the data the dissolving process was spontaneous.

B) Endothermic. Yes the data calculated confirmed that since the ∆H came out negative.

C) I expected to increase. ∆S is positive which confirmed that.