Solubility of Potassium Nitrate

Purpose

A key factor affecting the solubility of a substance – how much solute can be dissolved in a solvent – is temperature. For most substances increasing temperature will increase solubility - more solute will be able to dissolve in the same volume of solvent.

A solubility curve illustrates how the solubility of a substance varies with temperature. By determining the mass of solute that can be dissolved in a volume of solvent under a variety of temperatures we can easily construct a solubility curve.

In this lab exercise you will create a solubility curve for an ionic compound, potassium nitrate, KNO3.

Safety

Use caution when using the hot water bath to avoid hot water and steam burns.

Always wear safety goggles and remove any loose clothing.

Materials

electronic scale

10 mL test tube

hot water bath – 600 mL beaker

bunsen burner

ring stand

wire gauze

thermometer

10 mL graduated cylinder

Spatula

Weigh boat

Glass stirring rod

test tube clamp

solid potassium nitrate

distilled water

Procedure

1. Prepare a water bath by filling a large beaker approximately 2/3 full with water. Place the beaker on top of the wire gauze on a ring stand. Place the Bunsen burner under the beaker and begin heating the water to just below boiling. While this is heating continue with Step 2.
2. Accurately measure out 2 grams of solid potassium nitrate and add to the test tube. It is not necessary that you measure out *exactly* the masses given below, but you must record the *precise* masses you actually use.
3. Add exactly 5.0 mL of water into the test tube.
4. Place the tube into the water bath in order to dissolve the solid KNO3. You will need to use a stirring rod to carefully stir the solution to help the dissolving process, particularly for trials 3 and 4.
5. Remove the test tube from the hot water bath once the KNO3 has fully dissolved and place a thermometer in the tube. Watch the solution carefully. Record the temperature as soon as you see crystals forming within the test tube (you may need to wait awhile for crystals to form in the test tube). It may help to place the test tube in a cool water bath to allow it to cool quicker.
6. Add an additional 2 grams of KNO₃ into the test tube for the next trial, and return the tube to the water bath. Repeat Step 5 once the KNO3 dissolves.
7. Repeat steps 5 and 6 for trials 3 and 4.

Be prepared to act quickly for trial 4 – crystallization may occur very soon after you remove the test tube from the hot water bath. It may be necessary to return the test tube to the water bath to re-dissolve the salt and allow it to recrystallize again.

1. When finished with the four trials, pour the potassium nitrate solution into the discard container. Clean and dry all equipment and your lab station.

Data

1. Record at least three unique observations collected during the experiment.
2. Copy the following table into your lab report and fill it in with your own set of mass and volume data.

Convert the mass/volume ratio you used for each test tube into mass/100 mL ratio.

For example, in trial 1 you had 2.0 g KNO3 dissolved in 5.0 mL. This is equivalent to what mass of KNO3 per 100 mL of water?

1. Also record the temperature at which recrystallization occurred. This is the solubility of the substance at that temperature - the maximum amount of solute that can be dissolved in 100.0 mL of water at that temperature.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial | Mass KNO3 (g) used | Volume Water (mL) | Convert to g/100 mL | Saturation Temp (°C) |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |

1. Use graph paper to construct a solubility curve for KNO3 based on your data. Add the four values from your solubility table for potassium nitrate to increase your data points.
2. Title your graph and label each axis with the appropriate units and scale.

Analysis

A well thought out evaluation of the data collected. Refer back to your procedure and the data collected during the experiment. Did you achieve the results expected? Is there anything that surprised you? Reflect upon the experiment and identify at least two possible errors that affected your results, and provide suggestions for improvement in the future. Do your data points from the four trials of your experiment align with the data points from your solubility table? Explain. How could you use your solubility curve to predict if a solution is saturated or unsaturated? What additional information would be needed to distinguish between a saturated and supersaturated solution?

Analysis needs to be in essay format using complete sentences with appropriate grammar and punctuation. Do not repeat the steps from your procedure.