SOLUBILITY OF A SALT

Reminder – Goggles must be worn at all times in the lab!

PRE-LAB DISCUSSION:

The solubility of a pure substance in a particular solvent is the quantity of that substance that will dissolve in a given amount of the solvent. Solubility varies with the temperature of the solvent. Thus, solubility must be expressed as the quantity of solute per quantity of solvent at a specific temperature. For most ionic solids, especially salts in water, solubility varies directly with temperature. That is, the higher the temperature of the solvent, water, the more solute (salt) that will dissolve in it.

In this experiment, you will study the solubility of potassium nitrate (KNO_3) in water. You will dissolve different quantities of this salt in a given amount of water at temperatures nearing the water's boiling point. Each solution will be observed as it cools, and the temperature at which recrystallization of the salt occurs will be noted and recorded. The start of crystallization indicates that the solution has become saturated. At this temperature, the solution contains the maximum quantity of solute that can be dissolved in that amount of solvent.

> *Saturated* means as much solute as possible is dissolved in a given amount of solvent at a given temperature.
> *Unsaturated* means that less than the maximum amount of solute is dissolved in a given amount of solvent at a given temperature.
> *Supersaturated* means that more than the maximum amount of solute that could normally be dissolved in a given amount of solvent at a given temperature present.

After solubility data for several different quantities of solute have been collected, the data will be plotted on a graph. A solubility curve for KNO_3 will be constructed by connecting the plotted points.

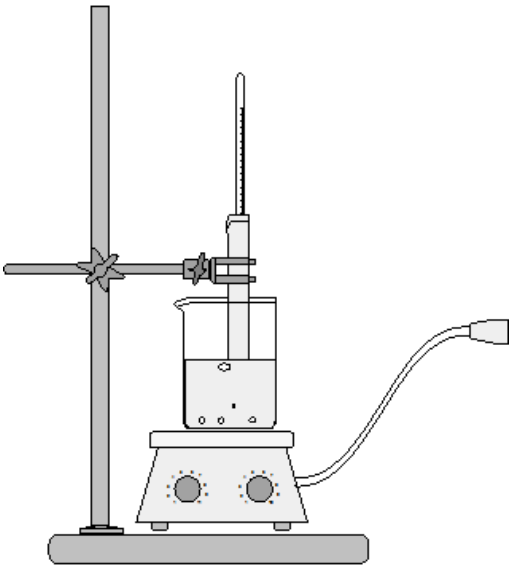
PURPOSE:

Collect the experimental data necessary to construct a solubility curve for potassium nitrate (KNO_3) in water.

PROCEDURE:

While one lab partner carries out steps 1 through 5, the other partner should go on to step 6.

1. Clean carefully four test tubes and rinse them with distilled water.
2. Line these tubes up in your test tube rack and place a paper towel under the rack. Label on the towel "1" in front of the first test tube, "2" in front of the second, etc. It is important that you do not mix up the four test tubes.
3. On the balance, measure out exactly 0.400 grams of potassium nitrate (KNO_3). Use weighing paper from the side counter. Never pour a compound directly onto the balance. Remember to consider the mass of the weighing paper. Pour the salt into the test tube labeled "1".
4. Repeat Step 3 for the following masses of KNO_3, adding each quantity to the tube indicated:
   0.600 grams to test tube #2
   0.800 grams to test tube #3
   1. 00 grams to test tube #4
5. Add exactly 1.00 ml of distilled water to each test tube.
6. Fill a 400 or 600 ml beaker about three-fourths full of tap water. This will be used as a water bath. Using the water bath and test tube #1, prepare the setup shown to the right. Heat the water to about 75 °C and adjust the hotplate to maintain the water at about this temperature.



7. Stir the KNO_3/water mixture with a glass stirring rod until the KNO_3 is completely dissolved. Remove the stirrer and rinse it off. Loosen the clamp and, using a test tube holder, remove tube.
8. While one lab partner repeats Step 7 for test tube #2, the other partner should place a warm thermometer (dipped into the hot water bath) into the solution in test tube #1. Hold the test tube to the light and watch for the first sign of crystallization in the solution. At the *instant* crystallization starts, observe and record the temperature. Should crystallization start too quickly (due to a cold thermometer), re-dissolve the solute and repeat this step.

9. Procedural steps 7 and 8 should be followed for all four test tubes. One lab partner should stir the KNO_3 until it dissolves, and the other partner should record the temperatures of crystallization. Record all temperatures in your Data table.
10. If any doubtful results are obtained, the procedure can be repeated by re-dissolving the salt in the hot water bath and allowing it to re-crystallize.
11. When you are done with the lab, clean the tubes and return them to your drawer. Take the ring stand apart, and put it away, but only after the metal and water beaker are cool enough to handle.

RESULTS

Observations and Data:

Test tube #	Grams KNO_3/1.0 ml H_2O	crystallization temperature (°C)
1	0.400 grams/1.00 ml	_____
2	0.600 grams/1.00 ml	_____
3	0.800 grams/1.00 ml	_____
4	1.000 grams/1.00 ml	_____

Graphs:

1. Plot your experimental data on graph paper. Plot “mass of solute per 1.00 ml of water” on the y-axis and “temperature in °C on the x-axis. Draw your BEST FITTING CURVE through your data points.