# Solubility Curves

When we looked at the solubility rules, we classified salts as either soluble or insoluble in water. In reality there is no salt that is 100% insoluble. Instead, there are a range of solubilities. In this lab we will examine how much of a particular solute ($KClO_3$) will dissolve in a given amount of water at various temperatures.

## Objectives

- To determine the solubility of potassium chlorate at a specific temperature.
- To use the combined class results to produce a solubility curve.
- To use solubility curves to make predictions about solutions of $KClO_3$ and other salts.

## Procedure (read each step completely before following the instructions for that step)

1. Gather together: a test tube, a thermometer, a 10 mL graduated cylinder, a 400 mL beaker, and a 100mL beaker. Half-fill the 400 mL beaker with hot water from the kettle, then place it on a hot plate.
2. You will be assigned a mass of $KClO_3$ between 1 - 4 grams. Assigned mass: _____ g
3. Stand the test tube in the 100 mL beaker. Place these on the scale together. Press the tare button.
4. Use the funnel provided to add the desired mass of $KClO_3$ into the tube (do not allow the funnel to touch the tube or otherwise affect the mass). If you spill any chemical, on the scale or in the beaker, brush it away before you take your final measurement. Your mass should be exact (within ± 0.02 g).
5. Measure exactly 10 mL of distilled water in a graduated cylinder (adjust the volume using an eyedropper); add this to the tube. Ensure any solid clinging to the side of the tube is washed down to the bottom.
6. Place the tube and contents in a hot water bath (i.e. the 400 mL beaker). Stir carefully with the thermometer until all the $KClO_3$ has dissolved. Do not heat the tube beyond the point where all the solid is dissolved.
7. Lift the test tube out of the water bath (use paper towel to hold the tube if it is too hot). Allow the solution to cool slowly, stirring occasionally with the thermometer. If several minutes have passed and you do not see any precipitate form, run cool tap water on the outside of the tube to cool it down faster. Note the temperature at which the first crystals of $KClO_3$ come out of solution: _____°C.
8. Repeat step 7 (reheat, and then re-crystallize, the $KClO_3$) at least once more to confirm your temperature value. Subsequent readings will be more accurate because you will know what to look for.
9. Wash the $KClO_3$ down the sink and clean out the test tube. Rinse and return all equipment.
10. Give your temperature value (along with the mass of $KClO_3$ used) to your teacher.

## Data and Questions

| Class data | |
|---|---|
| $KClO_3$ (g /100 g $H_2O$) | Temperature (°C) |
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1. Graph the class data. In this lab, temperature is the dependent variable and g $KClO_3$ is the independent variable. Normally, the independent variable is plotted on the x-axis. However, for this graph, you will plot temperature (in °C) on the x-axis. Connect the points with a curved "line-of-best-fit".
2. Read 7.1 (pg. 314). Label the regions of your graph that correspond to "saturated" and "unsaturated".
3. Use the solubility curves on pg. 316 (fig. 2) to answer the following:
   a. To make a saturated solution of $KClO_3$, how much $KClO_3$ is dissolved in 100 g of water at (i) 20°C (ii) 40°C (iii) 60°C
   b. What minimum temperature is needed to dissolve these masses of $KNO_3$ (not $KClO_3$) in 100 g $H_2O$: (i) 46 g (ii) 15 g (iii) 80 g
4. What type of solution (saturated or unsaturated) forms when ___ g of $KClO_3$ are dissolved in 100 g of $H_2O$ at ___°C:
   (a) 43 g, 85°C, (b) 32 g, 85°C, (c) 10 g, 60°C.
5. 100 g $H_2O$ is saturated with $KClO_3$ at 100°C. How much $KClO_3$ will come out of solution if the temperature is lowered to 48°C?. How much would precipitate under the same circumstances if 350 g water were used?
6. A saturated solution of potassium nitrate is cooled from 50°C to 10°C. How many grams of $KNO_3$ will precipitate out of 150 g of water?