

## STUDY GUIDE-SOLUBILITY GRAPH

When using a solubility graph it's important to understand how it is created first. To start with, the solubility of a substance for a given temperature must be determined. This is done by finding out what mass of solute is needed to make a saturated solution in  $100\text{ cm}^3$  of water for that temperature (referred to as the solubility). This is repeated for each of the temperatures from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ . The data is then plotted on a temperature/solubility graph, and the points are connected. These connected points are called a solubility curve. To see the actual graph mentioned click on [Solubility Graph](#).

A solubility graph can be used to solve a variety of questions. The first type is simply to identify a substance when you are given the solubility in  $\text{g}/100\text{ cm}^3$  of water and the temperature. All you do is see which solubility curve the solubility and temperature intersect at. For example, what substance has a solubility of  $90\text{ g}/100\text{ cm}^3$  of water at a temperature of  $25^\circ\text{C}$ ? The only substance whose solubility curve is located at the intersection of  $90\text{ g}/100\text{ cm}^3$  and  $25^\circ\text{C}$  is sodium nitrate.

Sometimes you're given the substance name and either the temperature or the solubility. Then you have to find out what the solubility or temperature is. Locate the solubility curve needed and see for a given temperature, which solubility it lines up with and visa versa. For example, what is the solubility of potassium nitrate at  $80^\circ\text{C}$ ? Locate where  $80^\circ\text{C}$  is on the solubility curve for potassium nitrate. Extend a line over to the solubility axis that is level with this point. If you did it correctly, the solubility should be 170 grams. If you need to find what temperature a substance has for a given solubility, locate where the solubility intersects the curve for the substance, and drop a vertical line down from that point to the temperature below. Example: at what temperature will sodium nitrate have a solubility of  $95\text{ g}/100\text{ cm}^3$ ? You'll need to more carefully estimate where 94 g will be, but if you drop a vertical line down from this intersection point, it should be about  $30^\circ\text{C}$ .

You can also use a solubility graph to determine if a solution is saturated, unsaturated, or supersaturated. If the solubility for a given substance places it anywhere on it's solubility curve it is saturated. If it lies above the solubility curve, then it's supersaturated, and if it lies below the solubility curve it's an unsaturated solution.

Sometimes you'll need to determine how much additional solute needs to be added to a unsaturated solution to make it saturated. For example, 30 grams of potassium nitrate has been added to  $100\text{ cm}^3$  of water at a temperature of  $50^\circ\text{C}$ . How many additional grams of solute must be added to make it saturated? From the graph you can see that the solubility for potassium nitrate at  $50^\circ\text{C}$  is 84 grams. If there are already 30 grams of solute in the solution, all you need to get to 84 grams is 54 more grams (  $84\text{ g} - 30\text{ g}$  ).

Lastly you can use a solubility graph to determine at what temperature a precipitate(crystals) will begin forming when an unsaturated solution cools down. Suppose you have a sodium nitrate solution at  $100^\circ\text{C}$  containing 120 g of dissolved solute. Locate where 120 g intersects the curve for sodium nitrate, and the temperature at this point is when crystals can start forming. In this example the temperature will be about  $56^\circ\text{C}$ .