### Solubility Curves

* The solubility of a substance in a solvent is the maximum amount of that substance (solute) which will dissolve in a fixed quantity of the given solvent at a specified temperature.
* The relationship between temperature and the solubility can be illustrated using a graph of solubility curves.

Solubility Curve of

Magnesium Chloride

MgCl2 (aq)

**Supersaturated region**: (above curve)

More solute dissolved than can actually be dissolved

Solubility

(g/kg of H2O)

**Saturated region**: (line of the graph)

maximum amount of solute dissolved than can actually be dissolved

50.0

**Unsaturated region**: (below curve)

Less solute dissolved than can actually be dissolved

25

Temperature (ºC)

* The graph states that at 25oC , for magnesium chloride to be a:
  + Saturated solution;here is ONLY 50.0 g of solute per 1000.0 g of water
  + Supersaterated solution;there is MORE THAN 50.0 g of solute per 1000.0 g of water
  + Unsaturated solution;there is LESS THAN 50.0 g of solute per 1000.0 g of Water
* If the temperature of a saturated solution at 25oC (50.0 g of MgCl2) is changed, then the type of solution will change accordingly as indicated by the graph.
  + Increase in temperature, the solution becomes unsaturated.
  + Decrease in temperature, the solution becomes supersaturated.

**Reading a Solubility Chart**

1. The curve shows the # of grams of solute in a saturated solution containing 100 mL or 100 g of water at a certain temperature.
2. Any amount of solute below the line indicates the solution is unsaturated at a certain temperature
3. Any amount of solute above the line in which all of the solute has dissolved shows the solution is supersaturated.
4. If the amount of solute is above the line but has not all dissolved, the solution is saturated and the # grams of solute settled on the bottom of the container = total # g in solution – # g of a saturated solution at that temperature. (according to the curve)
5. Solutes whose curves move upward w/ increased temperature are typically solids b/c the solubility of solids increases w/ increased temperature.
6. Solutes whose curves move downward w/ increased temperature are typically gases b/c the solubility of gases decreases with

increased temperature.

**Solubility Problems to solve**

At 10oC, 80 g of NaNO3 will dissolve in

100 mL (a saturated solution)

2. To find the # grams needed to saturate a solution when the volume is NOT 100 mL use the following

strategy to find answer:

Start w/ known vol. x Solubility/100mL at set temp. = amount of Solute needed to saturate

Ex. 60 mL H2O x 80 g NaNO3 = 48 g NaNO3 needed to saturate solution

100 mL H2O

or if the chart is in units of 100 g of H2O use the density of water conversion 1mL H2O= 1 g H2O

Ex. 60 mL H2O x 1 g H2O x 80 g NaNO3 = 48 g NaNO3

1 mL H2O 100 g H2O

# WS - Reading the Solubility Chart Problems

1. Which of the salts shown on the graph is the least soluble in water at 10oC?
2. Which of the salts shown on the graph has the greatest increase in solubility as the temperature increases from 30 degrees to 60 degrees?
3. Which of the salts has its solubility affected the least by a change in temperature?
4. At 20oC, a saturated solution of sodium nitrate contains 100 grams of solute in 100 ml of water. How many grams of sodium chlorate must be added to saturate the solution at 50oC?
5. At what temperature do saturated solutions of potassium nitrate and sodium nitrate contain the same weight of solute per 100 mL of water?
6. What two salts have the same degree of solubility at approximately 19oC?
7. How many grams of potassium chlorate must be added to 1 liter of water to produce a saturated solution at 50oC?
8. A saturated solution of potassium nitrate is prepared at 60oC using 100.mL of water. How many grams of solute will precipitate out of solution if the temperature is suddenly cooled to 30oC?
9. What is the average rate of increase for the solubility of KNO3 in grams per 100 mL per degree Celsius in the temperature range of 60oC to 70oC?
10. If 50. mL of water that is saturated with KClO3 at 25oC is slowly evaporated to dryness, how many grams of the dry salt would be recovered?
11. Thirty grams of KCl are dissolved in 100 mL of water at 45oC. How many additional grams of KCl are needed to make the solution saturated at 80oC?
12. What is the smallest volume of water, in mL, required to completely dissolve 39 grams of KNO3 at 10oC?
13. What is the lowest temperature at which 30. grams of KCl can be dissolved in 100 mL of water?
14. Are the following solutions saturated, unsaturated or supersaturated (assume that all three could form supersaturated solutions)
15. 40. g of KCl in 100 mL of water at 80oC
16. 120. g of KNO3 in 100 mL of water at 60oC
17. 80. g of NaNO3 in 100 mL of water at 10oC
18. Assume that a solubility curve for a gas such as ammonia, at one atmosphere of pressure, was plotted on the solubility curve graph. Reading from left to right, would this curve would \_\_\_\_\_

a. slope upward b. slope downward c. go straight across