READING SOLUBILITY GRAPHS
What is solubility

- Solubility is the ability of one substance (solute) to dissolve into another (solvent).

- Solubility is usually expressed as a rate: amount of solute per amount of solvent
  For example: 36.0 g NaCl/100g of H₂O at 20°C
FACTORS AFFECTING SOLUBILITY

◦ **TEMPERATURE**

**FOR SOLID SOLUTES, AS TEMPERATURE INCREASES, SOLUBILITY INCREASES**

as the kinetic energy (temperature) increases, particles move faster and spread out more so there are more spaces between molecules for solute particles to occupy.

**FOR GAS SOLUTES, AS TEMPERATURE INCREASES, SOLUBILITY DECREASES**

as the particles have more kinetic energy, particles move faster and spread out more. When a gas spreads it can move up and out of the solution, exiting beaker and essentially floating away.

◦ **PRESSURE**

Pressures changes have little affect on solid or liquid solutes. And increase in environmental pressure will cause the particles of a gas to be more soluble (there is more of a push on particles to dissolve). A decrease in environmental pressure will cause a gas to be less solubility (gas particles spread out).
vocabulary

3 terms are used when analyzing solubility curves

1. SATURATED SOLUTION
2. UNSATURATED SOLUTION
3. SUPERSATURATED SOLUTION
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**ASSOCIATED VOCABULARY**

**SATURATED SOLUTION** – a saturated solution contains the maximum amount of solute

A saturated solution cannot dissolve any more solute particles. There is no more spaces for the particles to fit, or be mixed among the solvent particles. The solute particles won’t dissolve, so they fall to the bottom of the beaker. You have probably seen this when you add too much lemonade mix.

These particles are dissolved, so cannot be seen by the naked eye

Can you see the sugar molecules dissolved in kool aid?  NO

Collection of solid solute particles that cannot dissolve. Particles sink to bottom of beaker. These particles can be seen with the naked eye.
**UNSATURATED SOLUTION** – contains the minimum amount of solute dissolved.

The image on the left has room for more solute particles to be added.
SUPERSATURATED SOLUTION – contains more solute than the saturation point.

Heating a solution will cause particles to spread out, allowing more solute to fit in spaces between solvent particles. The extra heat creates kind of an artificial scenario in which more solute can dissolve. When the solution cools, the solute will crystallize (solidify) out of solution. This is the process used to make rock candy.
The curve of a solubility graph represents the saturation point for the solute at increasing temperatures.

Above the line, any dissolved solute is a supersaturated solution.

Below the line, any dissolved solute is an unsaturated solution.

SAMPLE QUESTION: Which term describes a solution containing 30 g KNO₃ dissolved at 40° C?

ANSWER: unsaturated
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Observe patterns

Which substances are more soluble as temperature increases? Which are less soluble as temperature increases?

To answer this question analyze the trend line, looking for changes in x & y axis.

if the slope is positive/line curves up: as temperature increases, more solute mass dissolves aka more soluble

If the slope is negative/line curves down: As temperature increases, less mass of solute dissolves aka less soluble
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INTERPRETING X & Y VARIABLES

What Y variable corresponds to a specific X variable.

To answer this question:
read where the X & Y coordinate intersect.

SAMPLE QUESTION 1:
What mass of NaNO\(_3\) will dissolve at 60° C?
ANSWER: 125 grams

SAMPLE QUESTION 2:
What temperature is required to dissolve 59 grams of NH\(_4\)Cl?
ANSWER: 70 °C
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CALCULATING SOLUBILITY

Use the graph’s mass and temperature to set up a proportion to estimate the solubility of a second mass or temperature.

SAMPLE QUESTION 1: When making a saturated solution of KI, what mass of KI will dissolve in 150 grams H₂O at 15 °C?

ANSWER: Use graph to determine mass of solute that dissolves in 100 g of solvent at specified temperature. (It the mass value where the KI line intersects the 15 °C coordinate.) Set up a proportion for 150 g of solvent and solve.

\[
\frac{141 \text{ g KI}}{100 \text{ g H}_2\text{O}} = \frac{X}{150 \text{ g H}_2\text{O}}
\]

\[X = (141 \text{ g})(150 \text{ g}) ÷ 100 \text{ g} = 211.5 \text{ g KI}\]
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CALCULATING SOLUTE MASS THAT CAN BE ADDED

How much more solute can dissolve

To answer this question:
read where the X & Y coordinate intersect to determine
maximum amount that will dissolve, use subtraction to compare
to amount given in question

SAMPLE QUESTION 1:
How much more KClO$_3$ can be added to a solution that
contains 20 grams dissolved at 75 °C?

ANSWER: at 75 °C, 36 g KClO$_3$ dissolves
36 g – 20 g = 16 g KClO$_3$ can be added