




# Solutions

Chapter 18

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- Why do you stir your tea or coffee after you add sugar?
  - Why do you add salt to the ice when you make ice cream?



# Solutions

- What is a solution-  
a homogeneous mixture that can be solid, liquid, or gas that contains a solute dissolved in a solvent.

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- What is the one factor that determines whether a substance will dissolve in another substance:

**Nature of the solute and the solvent.**



- Solute-

The substance that is dissolved

Solvent-

Causes the solute to dissolve by surrounding it.

# Factors that determine how fast a substance dissolves:

- stirring (agitation)
- Temperature
- surface area of the solute (cube vs. granulated)



# Stirring

- If you drop sugar into your drink and don't stir, what happens?
- Why will the sugar eventually dissolve but very slowly?
- Why does stirring speed up this process?- more solvent comes in contact with the solute.



# Temperature

- more the particles to move more quickly so solute and solvent bump into each other more often.



# Particle Size

- The greater surface area of the solute allows the solvent to touch more of it.



# Solubility


- how much solute can be dissolved in a certain amount of solvent at a certain temperature.

What happens if you add too much sugar to your drink?

# Solubility

- is measured in mass of solute / volume of solution or mass of solute / mass of solvent.

Examples: 10 g of NaCl / ml of solution

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- Once we get a certain amount of solute dissolved it has reached its solubility point or equilibrium. The same amount is being dissolved as is reforming so no extra can be dissolved. This is called a saturated solute.




# Saturated solution

- Contains as much solute as the solution can hold at that temperature. The solution is full of solute and no more will dissolve.




# Unsaturated Solution

- contains less solute than a saturated solution

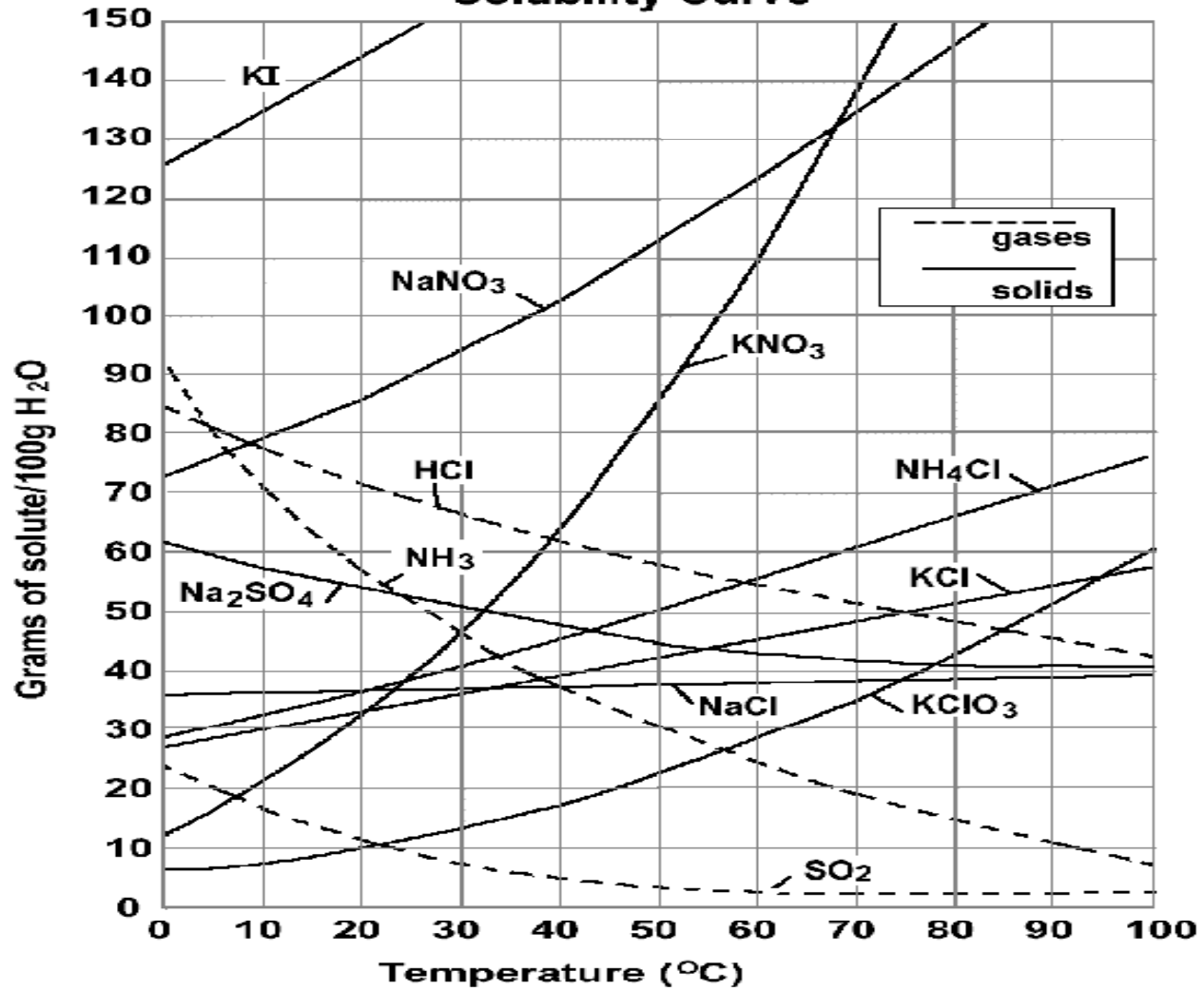
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- Two liquids that dissolve in each other are said to be miscible.
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  - If they won't dissolve they are said to be immiscible.

# Factors affecting solubility:

- The nature of the solute and solvent are the biggest determinants of the solubility but temperature can also affect the solubility of some solutes.

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- For most solutes solubility increases as temperature increases
  - Gases are opposite. As temperature increases solubility decreases.
  - Pressure also affects gas solubility (soda)

### Solubility Curve





# Supersaturated solution:

- A solution that contains more solute at a given temperature than it normally would hold.

This is a very unstable substance as soon as you add one more crystal called the seed crystal the extra dissolved solute will precipitate to form a saturated solution with extra crystals sitting at the bottom.

[Movie 1](#)


[Movie 2](#)

[Movie 3](#)



# Concentration


- the measure of the amount of solute that is dissolved in a given quantity of solvent.
- What is the difference between concentration and solubility? Solubility is how much solute the solution can dissolve at a given temperature.
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- Concentration is how much solute is dissolved in the solution at any given time.

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- If a solution has a lot of solute in it, it is considered to be concentrated.
  - If a solution contains low concentrations of solute the solution is said to be dilute.

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- Molarity is used to express concentration.


Molarity=moles of solute/liter of solution


$$M=m/v(\text{in liters})$$

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- You can make a solution less concentrated by diluting it
  - How is this done?
  - By adding more solvent.

Total moles of solute don't change just the amount of solvent. By adding more water to orange juice concentrate the solution becomes more dilute.

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- We can figure out how to make a new solution from an existing one by diluting it.
  - $M_1V_1=M_2V_2$

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- % solutions
  - Sometimes if both solute and solvent are liquids we use % by volume to talk about concentration.
  - % by volume =  $(\text{volume of solute} / \text{solution volume}) \times 100$
  - If one the solute is a solid and the solvent is a liquid we might use % by mass.
  - % by mass =  $(\text{mass of solute g} / \text{solution volume ml}) \times 100$

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- The properties of a solution differ from those of the solvent.
  - Sometimes these differences are due to the presence of solute molecules and not what the solute is.
  - The properties of the solution that are different from those of the solvent depend only on the number of particles dissolved in the solvent- colligative properties

# Colligative properties

- vapor pressure lowering
- boiling point elevation
- freezing point depression

EX: Solute particles change freezing point by getting in the way so it is harder for the solution to form crystals and freezes. The more solute particles the harder it is for the solution to freeze.

# Which will change the properties more?

- **1 mole of NaCl or 0.5 mole of NaCl?**
  - **1 mole of NaCl will affect the solution more than .5 mole of NaCl**

Why?


- 1 mole of NaCl breaks into 1 mole of  $\text{Na}^+$  and 1 mole of  $\text{Cl}^-$  for a total of 2 moles of particles.
- .5 mole of NaCl breaks into .5 mole of  $\text{Na}^+$  and .5 mole of  $\text{Cl}^-$  for a total of 1 mole of particles.

# Which will affect the properties more?


- 1 mole of NaCl or 1 mole of CaCl<sub>2</sub>?
- **1 mole of NaCl will affect less than 1 mole of CaCl<sub>2</sub>**
- 1 mole of NaCl will break into 1 mole of Na<sup>+</sup> and 1 mole of Cl<sup>-</sup> for a total of 2 mole of particles.
- 1 mole of CaCl<sub>2</sub> will break into 1 mole of Ca<sup>+</sup> and 2 mole of Cl<sup>-</sup> for a total of 3 moles of particles.

# Which will affect properties more?

- 1 mole of NaCl will affect more than 1 mole  $C_6H_{12}O_6$
- 1 mole of NaCl or 1 mole  $C_6H_{12}O_6$ ?
- 1 mole of NaCl will break into 1 mole of  $Na^+$  and 1 mole of  $Cl^-$  for a total of 2 moles of particles.
- 1 mole of  $C_6H_{12}O_6$  will not break up into ions so will produce a total of 1 mole of particles.

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- The solute particles get in the way of the solvent and make it harder to escape from the solution in boiling or evaporation. Or it gets in the way of crystals forming in freezing point.

In other words the solution will not freeze until it reaches a lower temperature or it melts at a lower temperature than it would normally. (lowering the freezing point)

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- water with salt in it will freeze at a temperature lower than 0 degrees C. That also means that ice with salt on it will melt at a temperature lower than 0 degrees.
  - How does this affect our ice cream making? Since the ice melts easier or faster with the salt in it at room temperature it absorbs more heat from the surrounding area. Thus taking heat from the cream mixture and causing it to freeze.