

Solutions

Chapter 15

How Solutions Form

- Two parts to a solution
- Solute - the solid part that is dissolved
- Solvent – the part that does the dissolving
Water is the universal solvent

The dissolving process

- Polar solvent dissolves polar solute by breaking them down into their individual molecules
- Polar solvent dissolves ionic compounds by breaking them up into their individual ions

Solubility

◆ Solubility

- ⌘ maximum grams of solute that will dissolve in 100 g of solvent at a given temperature
- ⌘ varies with temp
- ⌘ based on a saturated solution

Solubility Table

➤ shows the dependence of solubility on temperature

Solubility vs. Temperature for Solids

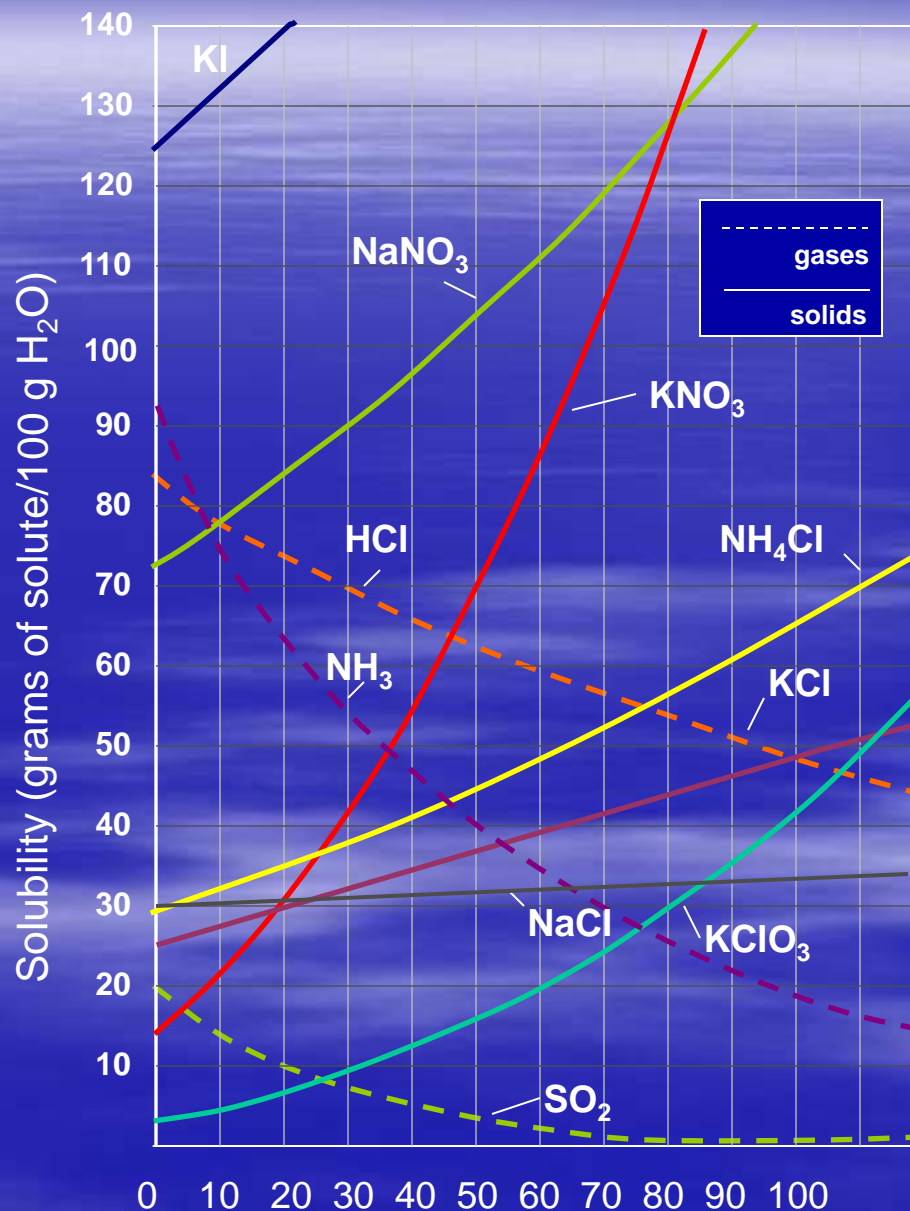
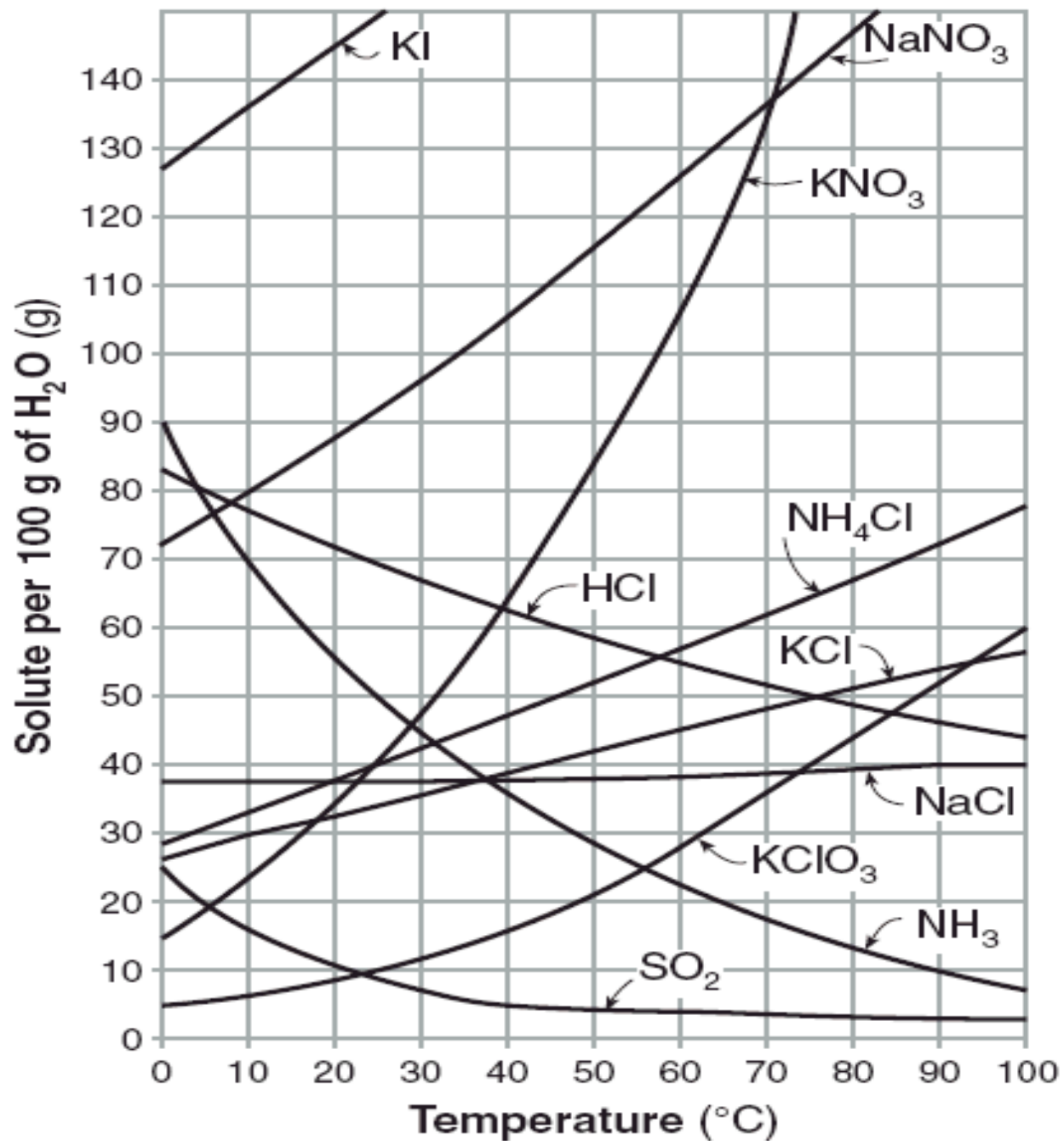


Table G Solubility Curves

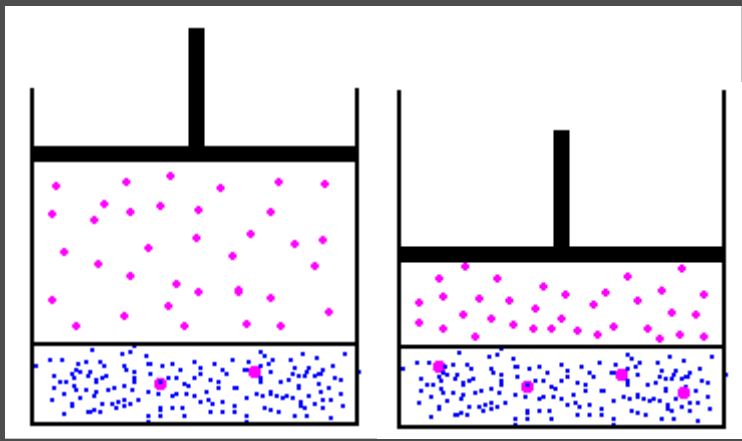


Solubility

- **Solids are more soluble at...**
 - high temperatures.

- **Gases are more soluble at...**

- low temperatures &
- high pressures (Henry's Law).
- EX: nitrogen narcosis, the "bends," soda



Rate of dissolving in solid/ liquid solutions

- Add energy
 - Stir
 - Heat
- Increase area by crushing
- Rate of dissolving in a gas/liquid solution
 - decrease energy
 - increase pressure

Organic Solvents

- Organic dissolves organic (nonpolar dissolves nonpolar)

Solubility and Concentration

- Solubility – How many grams of solute can dissolve in a certain amount of solvent
- Usually expressed in the grams that can be dissolved in 100 g of H₂O

Concentration

- How much solute is dissolved in the solvent
- Concentrated- is a lot of solute in the solvent
- Dilute - is little solute in the solvent
- Terms that refer to concentration
 - Saturated
 - The solvent has all the solute that it can hold at that temperature
 - Unsaturated
 - The solvent can hold more solute at the given temperature
 - Supersaturated
 - The solvent has more solute than it can normally hold
 - This is a very unstable solution

Solubility

UNSATURATED SOLUTION

more solute dissolves



SATURATED SOLUTION

no more solute dissolves



SUPERSATURATED SOLUTION

becomes unstable, crystals form

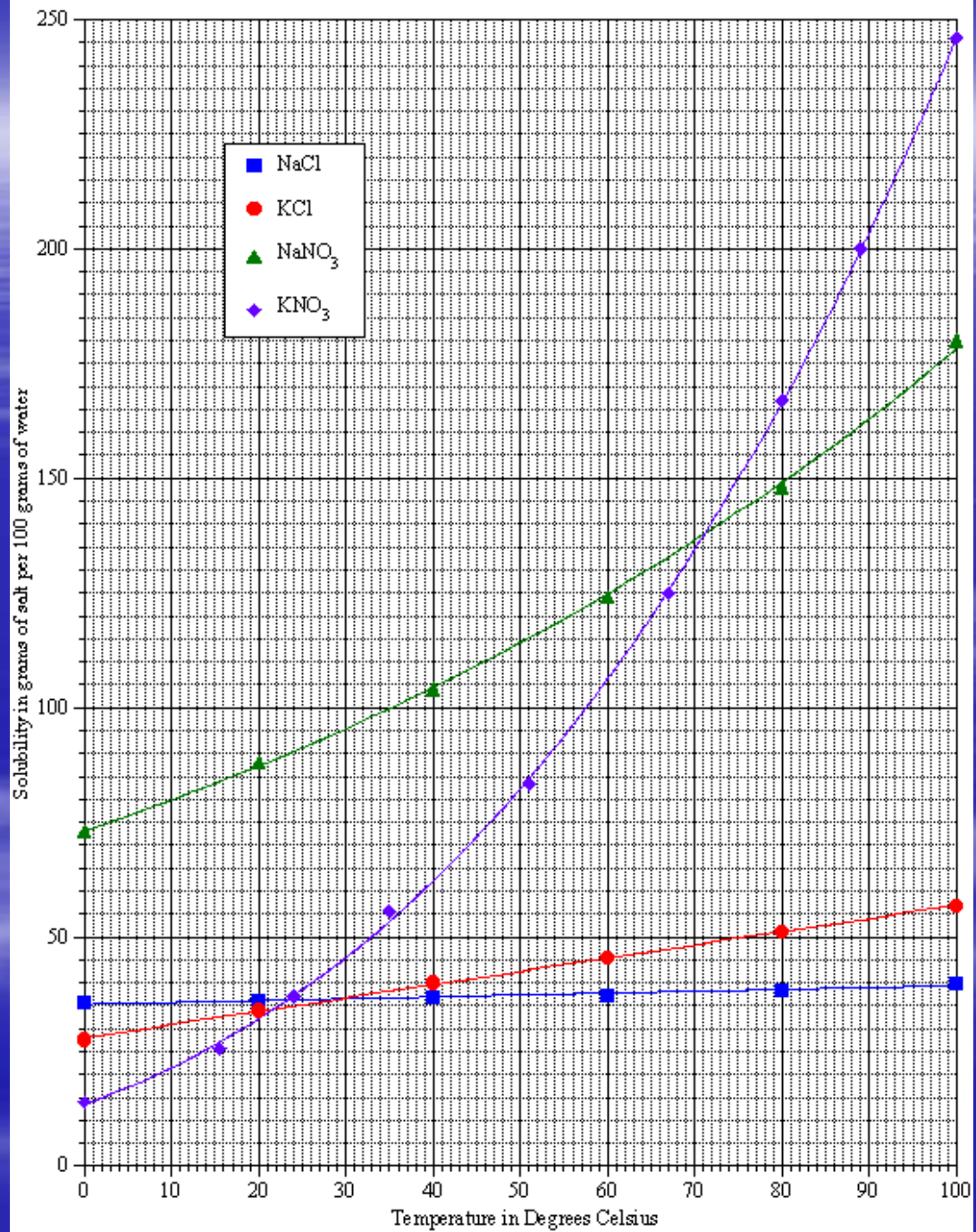


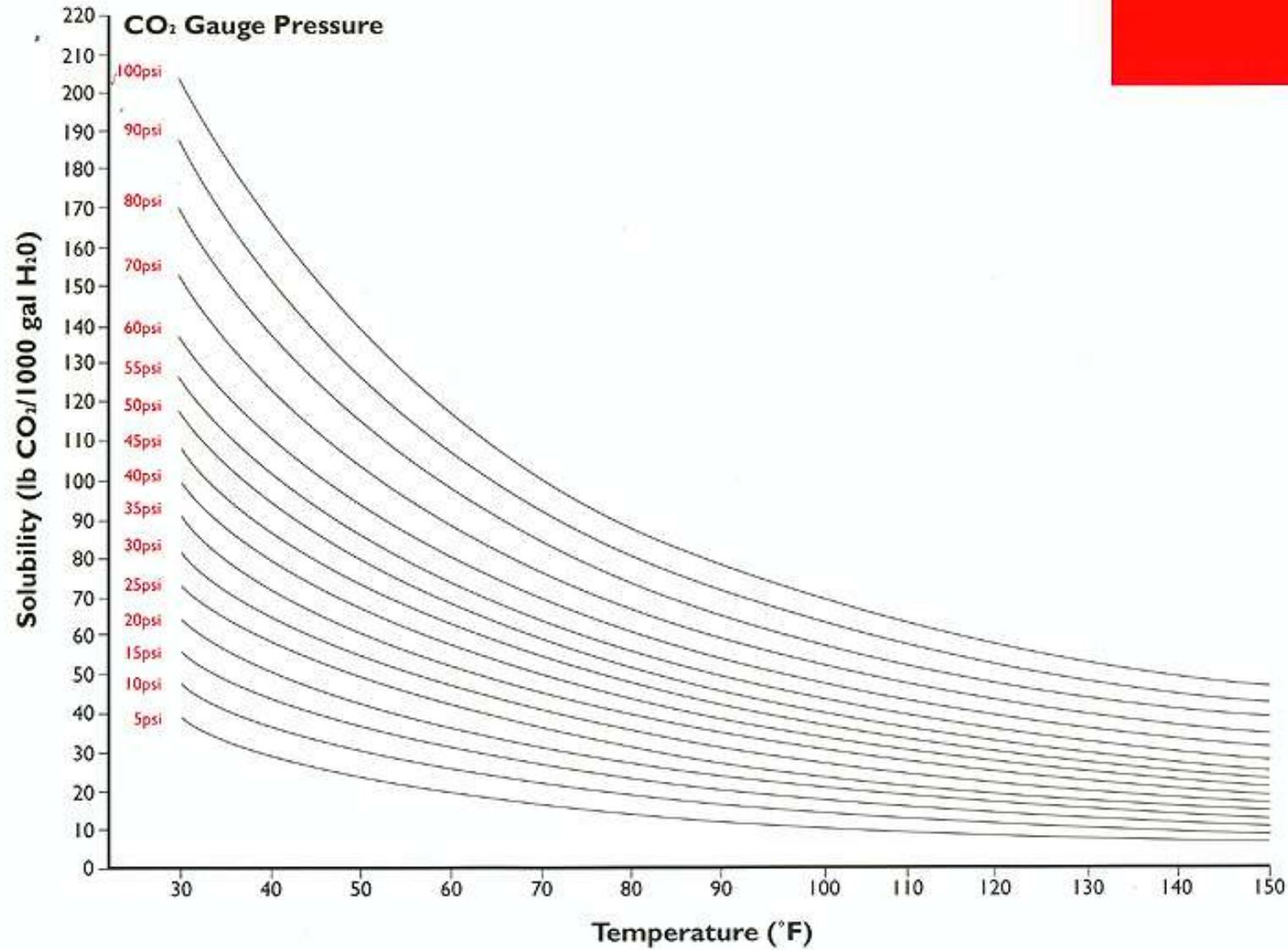
increasing concentration

Temperature and Soluability

- A solvent can hold more solid and liquid solute at higher temperatures
- A solvent holds more gas solute at a lower temperature
- Particles in a solution
 - What dissolves what
 - Polar dissolves polar
 - Nonpolar dissolves nonpolar (organic dissolves organic)

Solubility of Various Salts at Different Temperatures

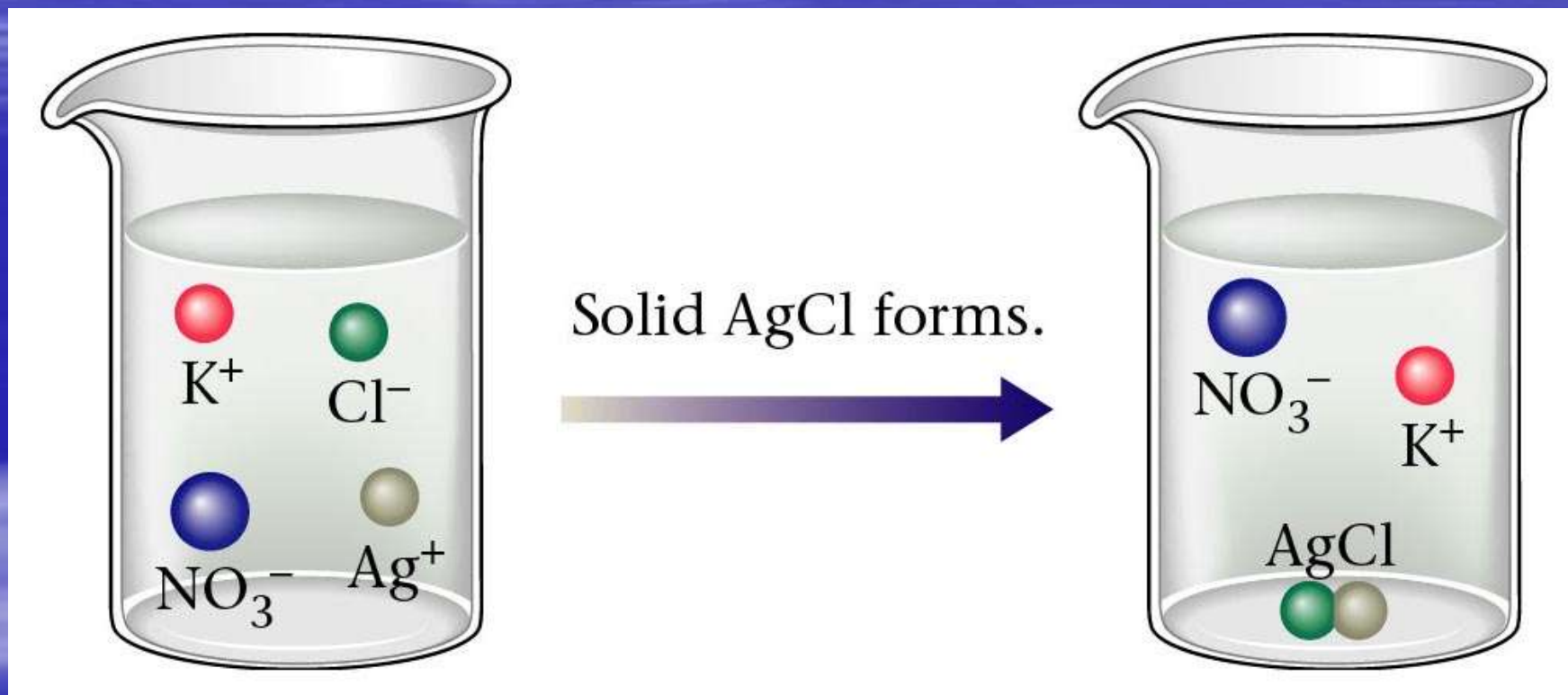




Particles in a solution

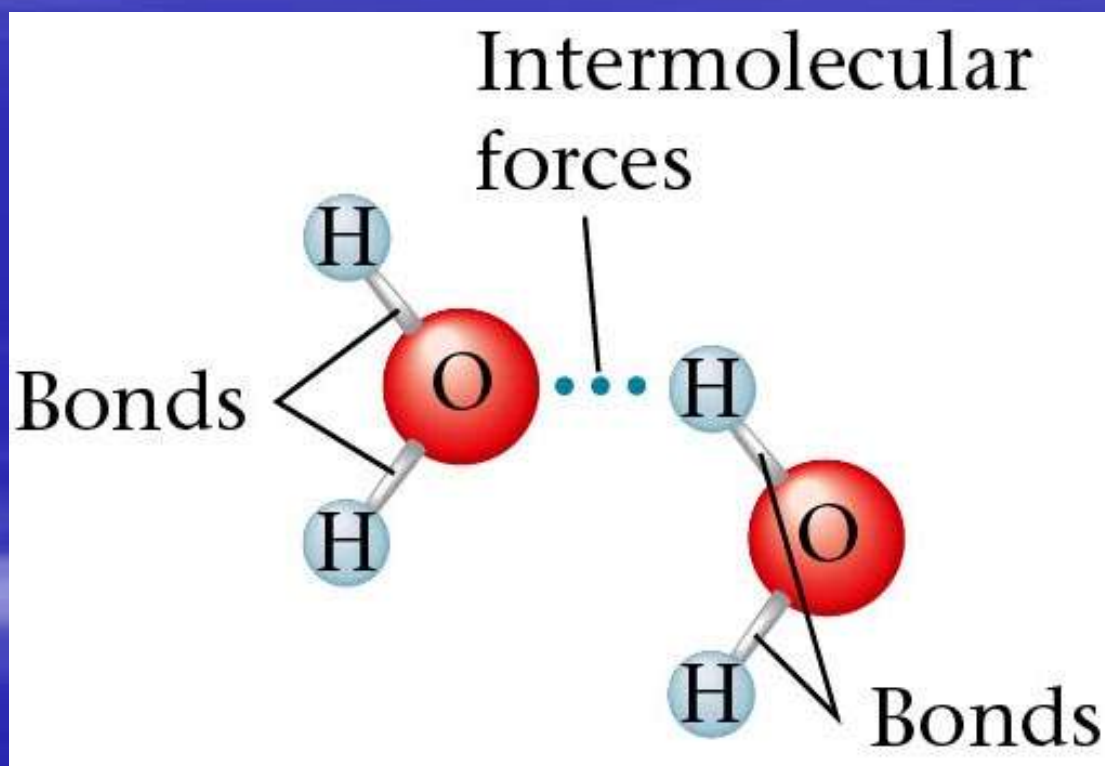
- Dissociation - when ionic compounds break into their individual ions
 - Like NaCl breaks up into its Na^+ ions and its Cl^- ions
- Ionization - when a highly polar molecular solid breaks into ions
 - Like HCl breaks up into H^+ ions and Cl^-

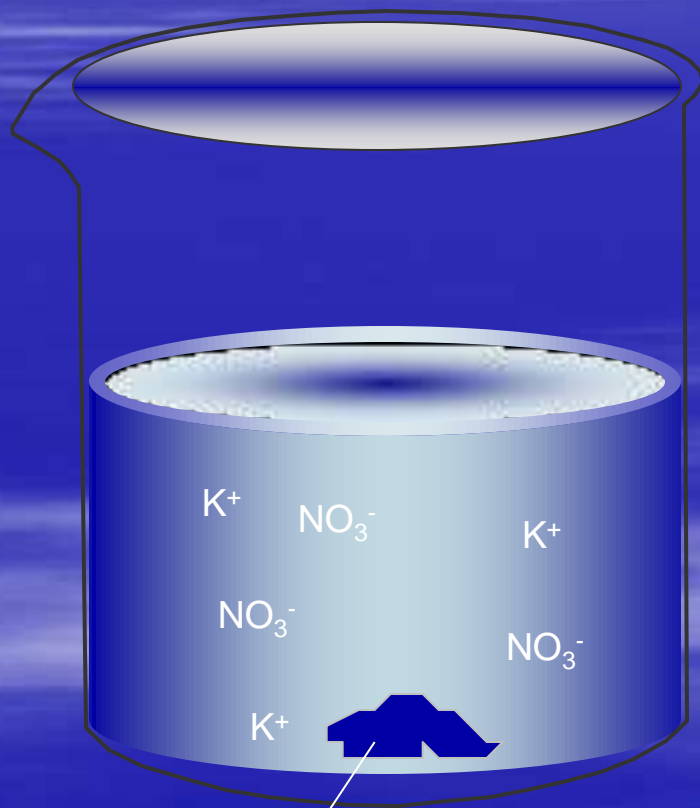
Dissociate in Water



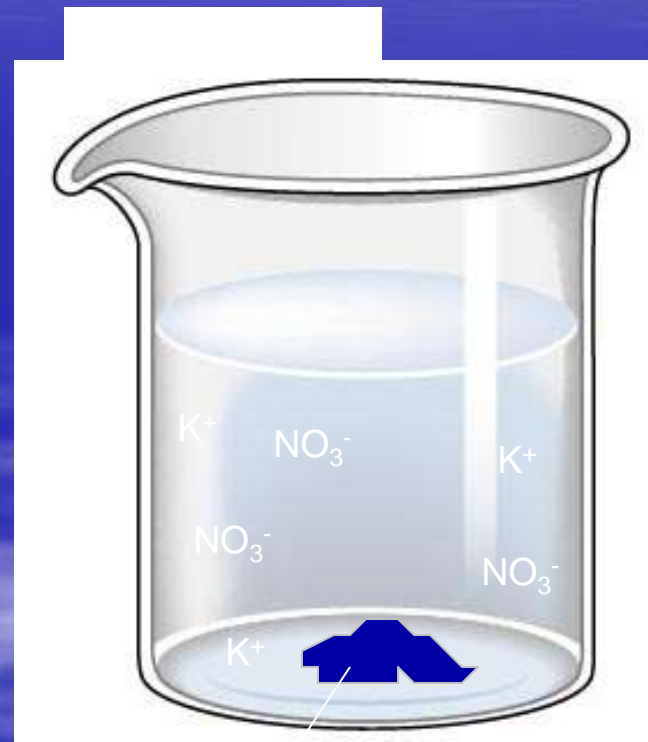
Hydrogen Bonding

- Intermolecular forces of attraction *between* molecules
- Bonds exist *within* molecules



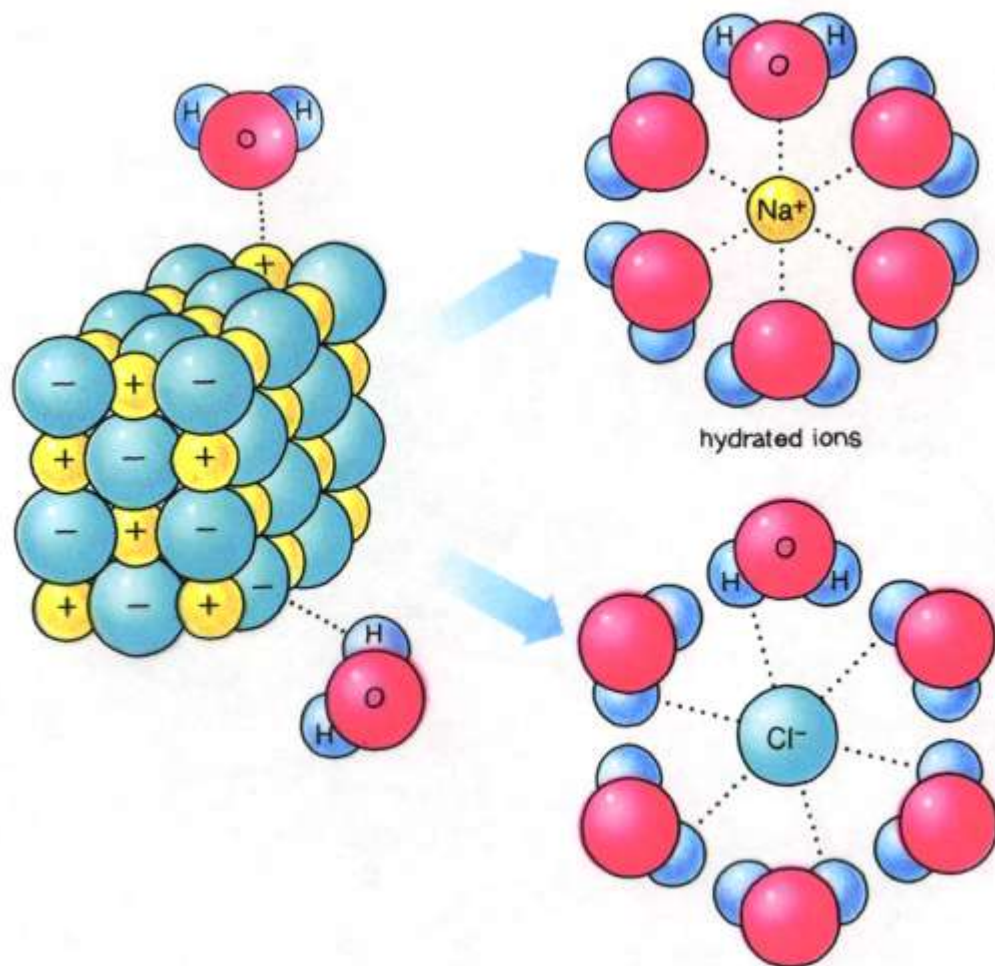


AgCl precipitate



AgCl precipitate

Dissolving of NaCl



Describe each situation below.

(A) Per 100 g H₂O, 100 g NaNO₃ @ 50°C.



Unsaturated; all solute dissolves; clear solution.

(B) Cool solution (A) very slowly to 10°C.



Supersaturated; extra solute remains in solution; still clear.

(C) Quench solution (A) in an ice bath to 10°C.



Saturated; extra solute (20 g) can't remain in solution, becomes visible.



Hotpack / Coldpack



Electrolyte

- Is a liquid that conducts electricity
- Water is a nonelectrolyte
 - It is the ions in the water that makes it conduct electricity

The effects of solute

- Particles Increase the boiling point of the solvent
- Decrease the freezing point
- Examples: of this is antifreeze that is put in automobile engines, also salt and water (salt on the road in the winter time)

Quiz

1. Explain why heating usually increases the solubility of a solid.
2. Why does stirring a sugar-water solution help the sugar dissolve faster?
3. A solid solutions composed of metals is a _____.
4. In a solution of sugar and water, the water is the _____.
5. A solution that contains more solute than a saturated one is _____.
6. What is the mass of one milliliter of water?
7. A solution that can hold more salute at a given temperature is _____.
8. A solution that has dissolved all the solute it can hold at a given temperature is _____.
9. What happens to the freezing point and boiling point of water when a solute is added?
10. What is an electrolyte?
11. What kind of conditions increase the solubility of a gas in a liquid?
12. What type of solute will a polar solvent dissolve?
13. What is the difference between dissociation and ionization?