Chp 13. SOLUTIONS

13.1 SOLUTIONS

What are solutions?

SOLUTIONS

Solutions are homogeneous mixtures of two or more substances

SOLUTIONS

Each substance retains it's own identity.

SOLUTIONS

Solutions are made of gas, liquid or solid substances or a combination of each.

SOLUTIONS

- gas/gas
- liquid/liquid
- solid/solid
- gas/liquid
- gas/solid
- solid/liquid
- gas/liquid/solid

SOLUTION "TERMS"

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- **solute / solvent**

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- **solute / solvent**
  - *solute - the minor substance or component*

SOLUTION "TERMS"

- **solute / solvent**
  - *solute - the minor substance or component*
  - *solvent - the major substance or component*

13.2 SOLUTION "TERMS"

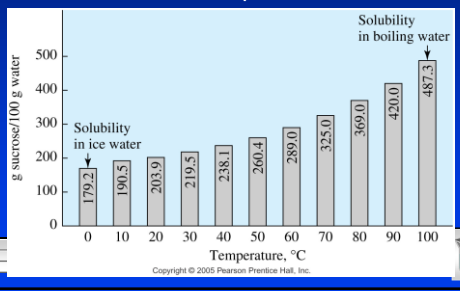
- **Solubility**
- **Unsaturated**
- **Saturated**
- **Supersaturated** (demo)

Solubility

- Maximum amount of solute that will dissolve in a given solvent.
- Units: g solute/100 g solvent.

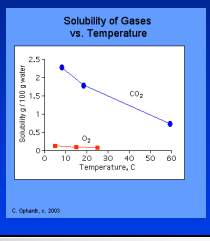
Effect on solubility

1. Solids are more soluble in water with an increase in temp.



Effect on solubility

2. Gases are less soluble in water with an increase in temp.



Effect on solubility

2. Pressure does not affect solubility of solids or liquids, but affects the solubility of gases. As pressure increases solubility increases.

Qualitative description of solubility

- < 0.1 g/100g - insoluble.
- 0.1-1 g/ 100 g - slightly soluble.
- 1-10 g/ 100 g - soluble.
- >10 g/ 100 g - very soluble.

Unsaturated solution

A solution that contains less solute than maximum amount that can be dissolved.

Saturated solution

A solution that contains maximum amount of solute that can be dissolved.

Supersaturated solution

A solution that contains more dissolved solute than that needed for a saturated solution.

- Dilute solution: contains small amount of solute relative to the amount that could dissolve.
- Concentrated solution: contains large amount of solute relative to the amount that could dissolve.
- Aqueous solution: solution in which water is a solvent.
- Nonaqueous solution: A substance other than water is a solvent.

Summary Solvents and Solutes

- **Solvent** - the dissolving medium
- **Solute** -the dissolved particles
- Aqueous solution- a solution with ***water*** as the solvent.

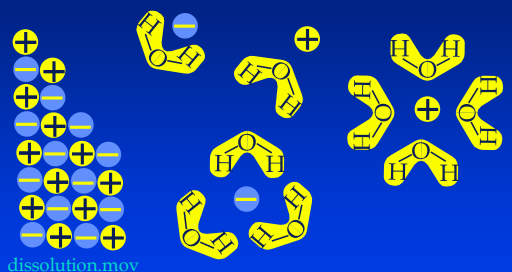
13.3 Solution Formation

Solution - a homogenous mixture, that is mixed molecule by molecule

dissolution.mov

NaCl dissolving

13.3 How Ionic solids dissolve



dissolution.mov

NaCl dissolving

How Ionic solids dissolve

- Water breaks the + and - charged pieces apart and surrounds them.
- Called solvation.
- In some ionic compounds, the attraction between ions is greater than the attraction exerted by water
  - *Barium sulfate* and *calcium carbonate*

- Solids will dissolve if the attractive force of the water molecules is stronger than the attractive force of the solid.
- Hydrogen bonding is a strong attractive force.

Sugar and water

- Water doesn't dissolve nonpolar molecules because the water molecules can't hold onto them.
- The water molecules hold onto each other and remain separate from the nonpolar molecules.
- Oil and water

Solution Formation

- Factors affecting rate of solution formation:
- size of the particles- smaller the size , larger the surface area.
- Stirring- increases interactions.
- Temperature (increase)- increases interactions.

13.4 Solubility Rules

"like dissolves like"

- Intermolecular attractions
  - Solvent:solvent
  - Solvent:solute
  - Solute:solute

When the IMF are similar, a solution will form

Solubility Rules:

- "Like dissolves like"
- Ionic/polar solutes dissolve in polar solvents (Practice Ex: 13.1.).
- Nonpolar solutes dissolve in nonpolar solvents
- Nonpolar solutes do not dissolve in polar solvents (Ex.: oil/water)

Aqueous Solutions

- Water dissolves ionic compounds and polar covalent molecules best.
- Electrolyte solutions - dissolved ionic substances
- Non-electrolyte solutions – dissolved polar covalent substances.

Electrolytes and Nonelectrolytes

- Electrolytes- compounds that conduct an electric current in aqueous solution, or in the molten state
  - –all ionic compounds are electrolytes (they are also salts)
- barium sulfate- will conduct when molten, but is *insoluble* in water!

Electrolytes and Nonelectrolytes

- Not all electrolytes conduct to the same degree
  - –there are *strong* electrolytes and *weak* electrolytes
  - –depends on: degree of ionization
- Nonelectrolytes do not conduct.
  - –Many molecular materials, because they *do not have ions*

Electrolyte Summary

- Substances that conduct electricity when dissolved in water, or molten.
- Must have charged particles that can move.
- Ionic compounds break into charged ions:

  NaCl $\rightarrow$ **Na^{1+}** and **Cl^{1-}** *in water*
- These ions can conduct electricity.

- Strong electrolytes ionize completely.
- Weak electrolytes don't fall completely apart into ions.
- Nonelectrolytes do not conduct electricity when dissolved in water or molten
- Polar covalent molecules such as methanol (CH_3OH) don't fall apart into ions when they dissolve.

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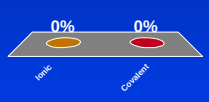
Is NH_4Cl ionic or covalent?

1. Ionic
2. Covalent



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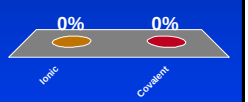

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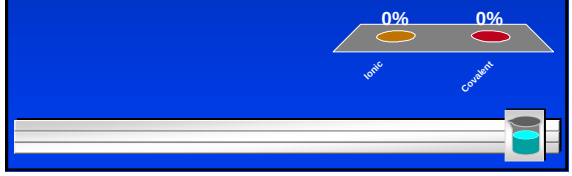

Is K_2O ionic or covalent?

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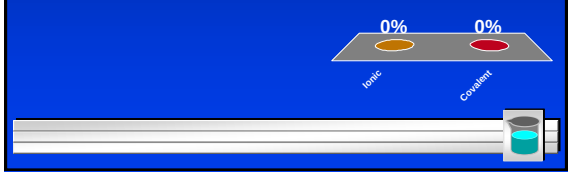
2. Covalent



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Is PO_3 ionic or covalent?

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2. Covalent

Is $Mg_2C_2O_4$ ionic or covalent?

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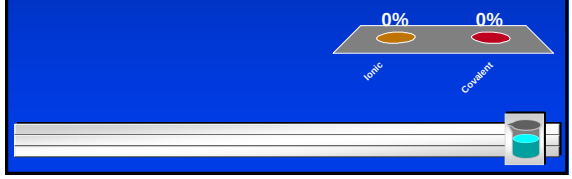
2. Covalent



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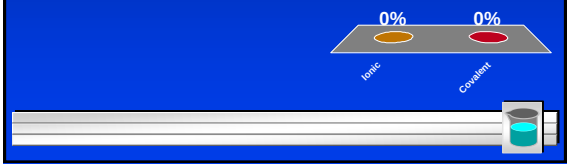

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