Factors that Affect the Rate of Dissolving and Solubility

Dissolving

One very important property of a solution is the rate of dissolving, or how quickly a solute dissolves in a solvent. When dissolving occurs, there is NO CHEMICAL REACTION involved. Therefore, the solute and solvent can be separated using physical properties such as boiling points or filtration.

The rate at which a solute dissolves depends on a number of factors:

i) **Temperature**

Yo! Know this stuff ☺

Increasing temperature increases the kinetic energy (energy of motion) of the molecules, which increases the frequencies of collisions and the rate of dissolving.

ii) **Agitation**

Stirring/shaking brings fresh solvent into contact with undissolved solute, increasing collisions and the rate of dissolving.

iii) **Particle Size**

Crushing solute into smaller pieces increases the surface area that is in contact with solvent, thus increasing the rate of dissolving.

The Dissolving Process

Whether or not a solute dissolves and to what extent depends on the forces of attraction between:

- Solute particles
- Solvent particles
- Solute and solvent particles

When ions are present in an **aqueous** solution, each ion is **hydrated**. This means that water molecules surround the ion. Hydrated ions can conduct electricity and are referred to as **electrolytes**.

Solubility

Solubility describes the **amount** of **solute** that can be dissolved in a given **amount** of **solvent** under given **conditions**.

A solute is described as **soluble** in a particular solvent if its solubility is **greater** than **1 g per 100 mL**.

A solute is described as **insoluble** in a particular solvent if its solubility is **less** than **0.1 g per 100 mL**.

Substances with solubility between these limits are called **slightly soluble**.

Factors affecting solubility include:

i) **Molecular Size**

Small molecules tend to be more soluble than large ones.

ii) **Temperature**

Affects the solubility of gases and solids in liquids.
For gases in liquids: as temp ↑ solubility ↓
For solids in liquids: as temp ↑ solubility ↑

A solubility curve (graph) describes how much solute can be dissolved in a given solvent at a certain temperature.

iii) **Pressure**

Affects the solubility of gases in liquids.
As pressure ↑ solubility ↑

When the forces of attraction between **different** particles in a mixture are **stronger** than the forces of attraction between **like** particles in the mixture, a solution forms. The strength of each attraction influences the solubility, or the amount of solute that dissolves in a solvent.

The dissolving process can be broken down into three key steps:

1. The forces holding the solute together must be broken (requires energy)

   Ionic compounds - the forces holding the ions together must be broken

   "intermolecular forces"
   Covalent molecules - the forces holding molecules together must be broken

2. The intermolecular forces (between particles) holding the solvent together must be broken (requires energy)

3. Solute and solvent attract (release energy) and the molecules of solute fill in the spaces between solvent molecules.

TEST
Note: *Dissolving is more likely to occur if the energy required (steps 1 and 2) is less than the energy released (step 3).*

Polar and Non-Polar Substances

In general, we can follow the rule of "like dissolves like" when trying to predict the solubility of different particles. Ionic solutes and polar covalent solutes dissolve in polar solvents and non-polar solutes dissolve in non-polar solvents.

Remember, you can use the difference in electronegativities (ΔEN) to predict if a compound is ionic, polar or non-polar. 3.3 ionic 1.7 polar covalent 0.5 non-polar 0 PURE

There are a few possible forces that act between particles, which helps to explain the "like dissolves like" trend:

Dipole-Dipole Attractions - the attraction between the opposite partial charges on two different polar molecules.
"Polar" molecules
$\delta^+ H-Cl^{\delta-} \cdots \delta^+ H-Br^{\delta-}$

Ion-Dipole Attractions - the attractive forces between an ion and a polar molecule. Ions posses a full charge and are therefore attracted to the partial charge on the polar molecules.

$Na^+ \cdots \delta^- O - H\delta^+$