Chemistry 6A F2007

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Wednesday

11/7/07

Announcement:

This weeks experiment (Atomic Spectra/Flame Test) is due next week, even though there is no lab scheduled for the next two weeks.

Monday's Lab must turn in the lab by Tuesday (11/13)
Tuesday's Lab must turn in the lab by Tuesday (11/13)
Thursday's Lab must turn in the lab by Thursday (11/15)

Late labs will have points deducted.

INCREASING THE RATE OF DISSOLVING

Crush or grind the solute:

Smaller particles provide for more surface area for solvent interaction, thus increasing the rate of solubility.

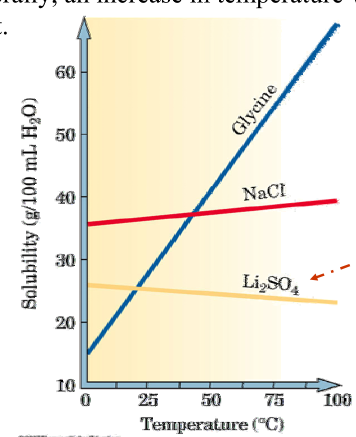
Heat the solvent:

When the solvent molecules move faster, there are more frequent collisions with solute thus increasing the rate of solution.

Stir or agitate the solution:

Stirring removes locally saturated solution from the vicinity of the solute thus allowing unsaturated solvent to take its place.

Generally, an increase in temperature will increase the solubility of a salt.



But this is not always the case!

Temperature effects:

Heat and Solution Formation:

When some solutes dissolve, heat is evolved:

solute + solvent → solution + heat
(energy)

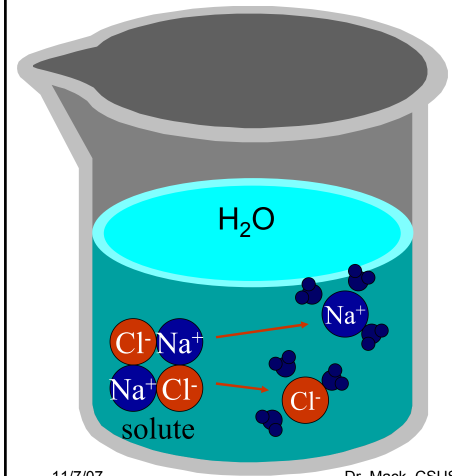
Exothermic process
The solution heats up $\Delta T > 0$

When some solutes dissolve, heat is absorbed:

heat + solute + solvent → solution
(energy)

Endothermic process
The solution cools $\Delta T < 0$

The Solution Process

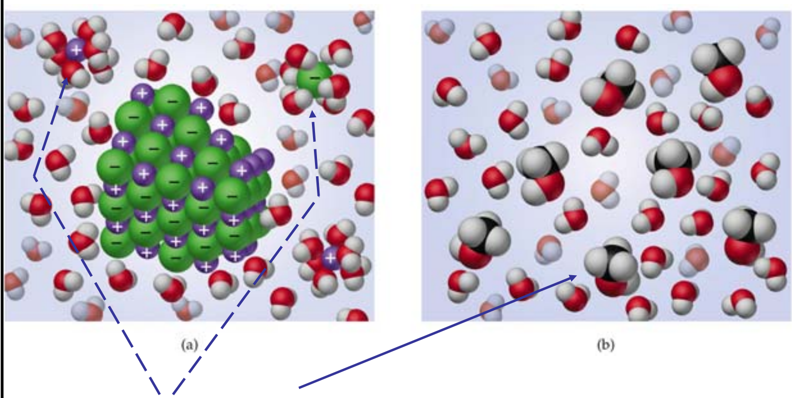


The solute is added to the solvent.

The solute dissolves and solute molecules surround.

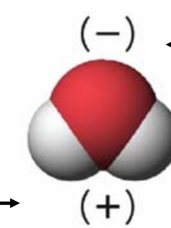
The solution process continues until all of the solute dissolves or the solution is saturated.

The Solution Process:



Ions or molecules are "***solvated***" by water

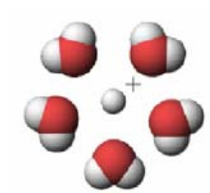
Water (H_2O) is a polar molecule:



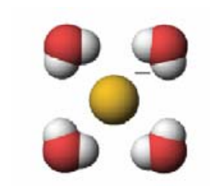
one end is "*negative like*"

one end is "*positive like*"

The negative ends surround the *cations*



The positive ends surround the *anions*



A solute will not dissolve in a solvent if:

(1) the forces between solute particles are too strong to be overcome by interactions with solvent particles.

(2) the solvent particles have a different form of polarity than the solute particles.

A good rule of thumb for solubility is ***"like dissolves like."***

Polar solvents dissolve *polar* or ionic solutes.

Non-polar solvents dissolve *non-polar* or nonionic solutes.

Solubility of Inorganic Compounds:

Rule 1: Compounds containing one of the following cations are likely soluble:

Group 1A cations (Li^+, Na^+, K^+, Rb^+, Cs^{+}) Ammonium ion (NH_4^+)

Rule 2: Compounds containing one of the following anions are likely soluble:

Nitrate (NO_3^-), perchlorate (ClO_4^-), acetate ($CH_3CO_2^-$)

Between these two rules, one can identify 90–95% of all soluble salts.

Predict the solubility of:

(a) $CdCO_3$ ***insoluble*** — carbonates are generally insoluble except for ***Rule 1*** cations…

(b) MgO ***insoluble*** — oxides are generally insoluble except for ***Rule 1*** cations…

(c) Na_2S ***soluble*** — ***Rule 1*** cation…

(d) $Pb(NO_3)_2$ ***soluble*** — ***Rule 2*** anion…

(e) AgCl ***insoluble*** — chlorides are generally soluble w/ exception of: Ag^+, Pb^{2+} & Hg_2^{2+}

GENERAL SOLUBILITIES OF IONIC COMPOUNDS IN WATER

TABLE 7.4 General solubilities of ionic compounds in water

Compounds	Solubility	Exceptions
Group IA (Na^+, K^+, etc.) and NH_4^+	Soluble	
Nitrates (NO_3^-)	Soluble	
Acetates ($C_2H_3O_2^-$)	Soluble	
Chlorides (Cl^-)	Soluble	Chlorides of Ag^+, Pb^{2+}, Hg^+ (Hg_2^{2+})
Sulfates (SO_4^{2-})	Soluble	Sulfates of Ba^{2+}, Sr^{2+}, Pb^{2+}, Hg^+ (Hg_2^{2+})
Carbonates (CO_3^{2-})	Insoluble[a]	Carbonates of group IA and NH_4^+
Phosphates (PO_4^{3-})	Insoluble[a]	Phosphates of group IA and NH_4^+

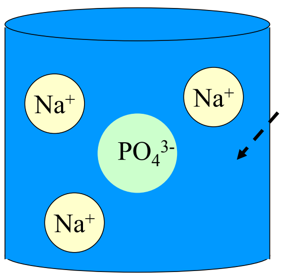
[a]Many hydrogen carbonates (HCO_3^-) and phosphates (HPO_4^{2-}, $H_2PO_4^-$) are soluble.

Na_2CO_3	$(NH_4)_2SO_4$	magnesium oxide	$V(C_2H_3O_2)_2$
Soluble	*Soluble*	*Insoluble*	*Soluble*

It's time to play…

What's in the beaker !!!

In da beaker… $Na_3PO_4(aq)$



sodium salt, soluble

$3Na^+(aq) + PO_4^{3-}(aq)$

ions only in solution!

The relative amounts of ***solute*** in the solution is expressed by a ***concentration***.

Mass Percent (a.k.a. ***Weight Percent***)

$$\text{mass percent: } \frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \times 100$$

What is the mass percent of a solution that is made by adding 2.45 g of potassium chloride to 75.4mL of water?

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

$$\text{\% KCl} = \frac{2.45\text{g KCl}}{2.45\text{g KCl} + 75.4 \text{ mL } H_2O \times \frac{1.00\text{g } H_2O}{1.00\text{mL } H_2O}} \times 100$$

= 3.15 %

What is the mass % of chloride ion in this solution:

$$3.15\% \text{ KCl} = \frac{3.15\text{g KCl}}{100\text{g solution}}$$

For every one mol of KCl there is one mol of Cl^-

$$\frac{3.15\text{g KCl}}{100\text{g solution}} \times \frac{1 \text{ mol KCl}}{74.55\text{g KCl}} \times \frac{1 \text{ mol } Cl^-}{1 \text{ mol KCl}} \times \frac{35.45\text{g } Cl^-}{1 \text{ mol } Cl^-}$$

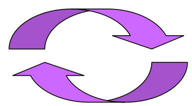
$$\frac{0.154 \text{ g } Cl^-}{100\text{g solution}} = 0.154\% \ Cl^-$$

How many grams of a 4.83% solution of dextrose would it take to obtain 128g of dextrose.

$$\%\ \text{mass} = \frac{\text{g solute}}{100.0\ \text{g solution}}$$

flip-see-doo!

$$4.83\ \%\ \text{dextrose} = \frac{4.83\text{g dextrose}}{100.0\ \text{g solution}}$$



Conversion Factor!!!

$$\frac{100.0\ \text{g solution}}{4.83\text{g dextrose}}$$

Lecture Problem: p.85 How many grams of a 4.83% solution of dextrose would it take to obtain 128g of dextrose.

$$128\text{g}\ \cancel{\text{dextrose}} \times \frac{100\text{g solution}}{4.83\text{g}\ \cancel{\text{dextrose}}} = 2650\text{g of solution}$$

contain 128g of dextrose