



Dissolving ionic compounds

Dissolution of an ionic compound in water

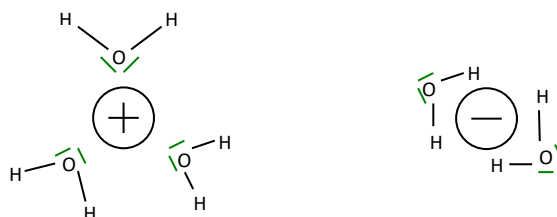
1. Dissociation of an ionic compound by water

When an ionic solid is introduced into water, the solvent molecules weaken the electrostatic bonds between the ions through Coulombic interaction. As a large number of water molecules are present around the ionic solid, this interaction is important. It enables the separation of ions from the solid when the solid and solvent molecules collide.



2. Ion solvation

The ions formed are then surrounded by several water molecules. This prevents the solid from reforming.



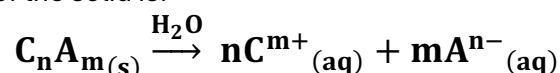
Ions have become solvated (or hydrated)

3. Dispersion of the solvated ions

Thermal agitation causes solvated ions to disperse among the water molecules.

Equation of dissolution

Dissolved in water, a ionic solid $C_nA_m(s)$ separates in aqueous cations, C^{m+}_{aq} , and aqueous anions, A^{n-}_{aq} . The equation of dissolution of the solid is:



Note: The dissolution of an ionic solid is NOT a chemical reaction. There is no change in structure of chemicals, as the cations and anions are both ALREADY present in the solid.

Molar concentrations

1. « Solute concentration »

The solute concentration is the ratio of ionic solid per unit volume of the solution.

$$\underbrace{C(C_nA_m)}_{(\text{mol} \cdot \text{L}^{-1})} = \frac{\overbrace{n(C_nA_m)}^{\text{quantity of solid (mol)}}}{\underbrace{V}_{\text{volume of the solution(L)}}$$

Note: **The solute concentration is fictitious !!!**

The ionic solid C_nA_m doesn't exist in the solution, it has been dissolved and therefore dissociated in individual ions.



The ionic model

2. Concentration of the ions, after dissolution

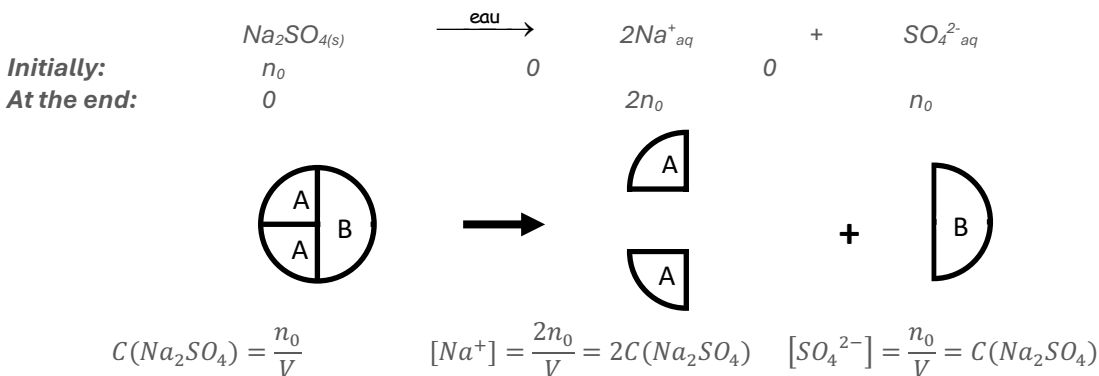
Ion X_{aq} in the solution:

$$\underbrace{[X]}_{\text{molar concentration of } X \text{ in the solution (mol.L}^{-1}\text{)}} = \frac{\text{quantity of ion } X_{aq} \text{ in the solution (mol)}}{\underbrace{V}_{\text{volume of the solution (L)}}}$$

Note :

- notations $C(C_rA_m)$ et $[X]$: different conventions for the solute and the ions.
- Molar concentration of solute and molar concentrations of the ions are related through the equation of dissolution

Ex : Dissolution of n_0 moles of Na_2SO_4 , sodium sulfate, in a volume V of water.



Properties of an ionic solution

1. The solution is electrically neutral

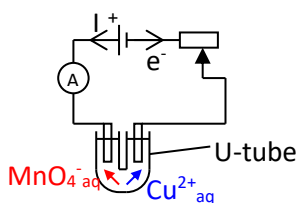
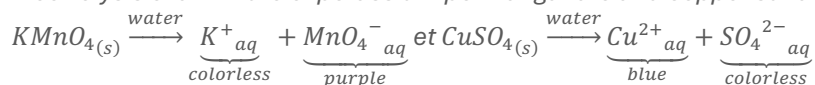
An ionic solution is made of ions coming from an electrically neutral ionic solid. Therefore, it is neutral.

2. The solution is conducting electricity

If an ionic solution is overall neutral, it is made of mobile ions, moving freely in the solution. An electric current is created by moving electrical charges, which is the case of ions. Therefore, an ionic solution can conduct electricity.



Ex : Electrolysis of a mixture of potassium permanganate and copper sulfate.



Observations :

On a quatre types d'ions en solution.

The ammeter shows that a current is travelling through the circuit.

The separation of colors shows that the copper ions are travelling in the same direction than the current, and permanganate ions are travelling in the opposite direction.

Notes:

- An ionic solution is also called electrolytic solution.
- In an ionic solid, ions, and therefore electrical charges, are stationnary. Therefore, an ionic soli dis an insulator.