Answer on Question #62806 - Chemistry - General Chemistry

Question:

You have a solution of table salt (NaCl) in water. Describe the chemical species that you would see if you could see individual particles in the water. What would happen to the concentration of the sodium chloride as you boiled the solution?

Solution:

Salt being dissolved in water undergoes electrolytic dissociation:
$Na^+Cl^- \leftrightarrow Na^+ + Cl^-$
This process goes completely and we actually do not have molecules $NaCl$ in solution.
Also water undergoes dissociation:
$H_2O \leftrightarrow H^+ + OH^-$
but in very low extent.
So theoretically we would see a lot of ions $Na^+$ and $Cl^-$, few ions $H^+$ and $OH^-$ and a lot of molecules $H_2O$.
But in reality ions in water solution do not exist as individual particles, they are surrounded by water molecules forming hydrated ions: $Na^+*nH_2O$, $Cl^-*nH_2O$, $H^+*nH_2O$, $OH^-*nH_2O$
We have to notice that $H^+$ ion is so strongly bonded to the water molecule that forms new particle called hydroxonium ion: $H_3O^+$. So actually instead of hydrated protons we would have hydrated hydroxonium ions: $H_3O^+*nH_2O$.
And again – the degree of dissociation of water is very low, so concentration of hydrated $H_3O^+$ and $OH^-$ ions is very low.
**So finally we see:**
**Very many hydrated ions $Na^+*nH_2O$ and $Cl^-*nH_2O$; very few hydrated ions $H_3O^+*nH_2O$ and $OH^-*nH_2O$; and also certain amount of individual molecules of water $H_2O$, depending on the salt concentration.**

During boiling the solution we would observe different behavior depending on initial concentration.
If initial solution is unsaturated than its concentration increases as water vaporizes. After the concentration reaches saturation point it stops changing, and as water continues vaporizing the excessive salt starts to crystallize.
If initial solution is already saturated than its concentration remains unchanged as excessive salt crystallizes during water vaporization.
As the final point in both cases we get saturated salt solution with some crystalline salt.