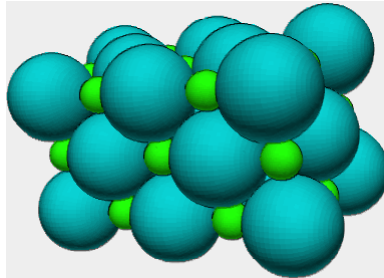


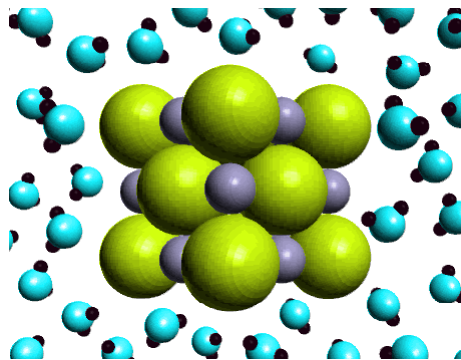
Precipitation Reactions

- When we dissolve an ionic compound in water the substance dissociates into aqueous positive and negative ions
- The positive ions are attracted to the negative oxygen side of the water molecule and the negative ions are attracted to the positive hydrogen side
- The ions become surrounded by water molecules, or hydrated
- The substance no longer exists as a compound, but as freely moving ions, moving throughout the solution

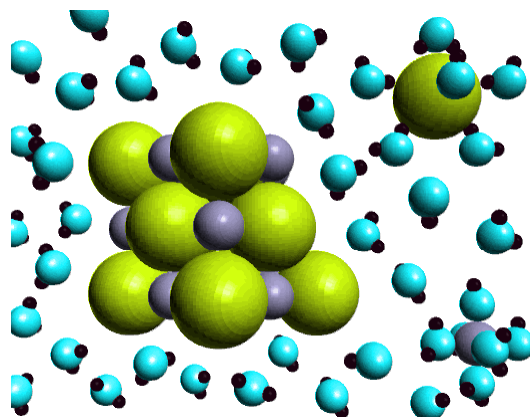
Solid NaCl



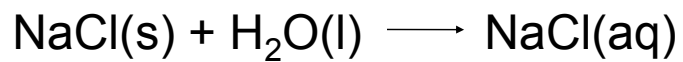
NaCl added to water



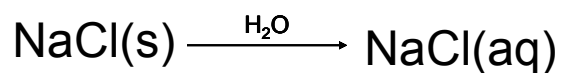
The NaCl ionizes and the ions are hydrated



Molecular Representation of the
Dissolving of NaCl



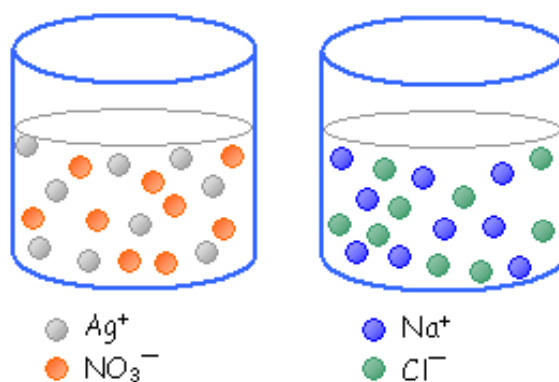
Symbolic Representation



Precipitates

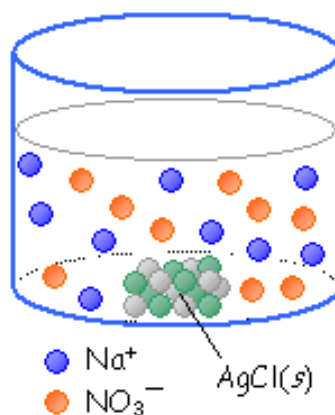
- Some ionic solids are not very soluble in water because the attraction between the ions is greater than the attraction between water and the individual ions
- When these substances form in a solution a solid settles to the bottom
- These are called **precipitation reactions**
 - When a solution of aqueous silver nitrate and aqueous sodium chloride are mixed, the two clear colourless solutions form a cloudy mixture. The cloudy mixture clears as a white solid settles to the bottom of the container.

- A solution of aqueous silver nitrate, $\text{AgNO}_3(\text{aq})$, and aqueous sodium chloride, $\text{NaCl}(\text{aq})$.



- When we mix the two solutions, the force of attraction between the silver and chloride ions is stronger than the force keeping them in solution
- When the two ions come into contact, they form the compound silver chloride
- Eventually, the number of ions joining together becomes so large that the water cannot suspend them and they settle to the bottom as a solid

- The process in which ions leave a solution and form an ionic solid is called **precipitation** or a **precipitate**



- The sodium and nitrate ions remain in solution
- Since the ions separate in solution, they are allowed to react separately
- The sodium ions and nitrate ions do not participate in the reaction
- They are called **spectator ions**

Solubility Rules

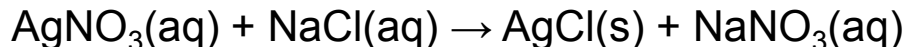
- Several ionic substances have a low solubility in water because the force of attraction between the ions is greater than the force water molecules use to dissociate the ions
- These compounds do not dissociate in water, rather they will usually form suspensions and settle to the bottom
- Chemists have done many experiments to determine the solubility of substances
- These experiments have resulted in some general rules that can be used to determine if a substance is soluble in water

Predicting Solubility

- Are the following compounds soluble?
 - sodium sulfate (Na_2SO_4)
 - yes
 - silver nitrate (AgNO_3)
 - yes
 - aluminum hydroxide ($\text{Al}(\text{OH})_3$)
 - low
 - lead(II) chloride (PbCl_2)
 - low

Precipitation Reactions

- A precipitation reaction is a chemical reaction between ions in solution that results in the formation of a precipitate
- The equation of the reaction between aqueous silver nitrate and aqueous sodium chloride is



- However, this equation is not an accurate representation of what is occurring
- It gives an indication of the contents of each solution, but we know that the ions are dissociated in the solution
- A more accurate representation is the ionic equation

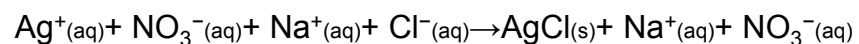
- The equation for the dissociation of silver nitrate in water is



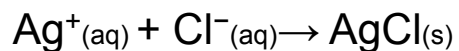
- The equation for the dissociation of sodium chloride in water is



- The overall ionic equation for the reaction between aqueous silver nitrate and aqueous sodium chloride is



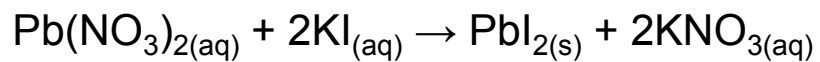
- The ionic equation shows the spectator ions
- The net ionic equation does not show the spectator ions



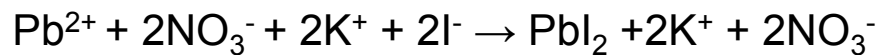
Example

- Write the complete set of equations (molecular, ionic and net ionic) for the reaction between aqueous lead(II) nitrate and aqueous potassium iodide.

- Molecular



- Ionic



- Net Ionic

