# 23.1 Reactions in Aqueous Solutions

Chemistry

**Summarize main points from each video.**

**Video Title / topic** _____

**Video Title / topic** _____

**Video Title / topic** _____

# Topic Introduction

**Summarize your understanding of each paragraph.**

An aqueous solution is a solution in which the solvent is water. It is usually shown in chemical equations by appending (aq) to the relevant chemical formula. For example, a solution of table salt, or sodium chloride (NaCl), in water would be represented as Na+(aq) + Cl−(aq).

The word aqueous means pertaining to, related to, similar to, or dissolved in water. As water is an excellent solvent and is also naturally abundant, it is a ubiquitous solvent in chemistry.

Substances that are hydrophobic ('water-fearing') often do not dissolve well in water, whereas those that are hydrophilic ('water-friendly') do. An example of a hydrophilic substance is sodium chloride.

Reactions in aqueous solutions are usually metathesis reactions. Metathesis reactions are another term for double-displacement; that is, when a cation displaces to form an ionic bond with the other anion.

https://en.wikipedia.org/wiki/Aqueous_solution.

# Read/Summarize Text

1. **Read the passage.**
2. **Underline key expressions in each sentence.**
3. **Re-write each word (or expression) you underlined.**
4. **Summarize the passage.**

*Solubility*

1

2

Solubility is the property of a solid, liquid, or gaseous chemical substance called solute to dissolve in a solid, liquid, or gaseous solvent. The solubility of a substance fundamentally depends on the physical and chemical properties of the solute and solvent as well as on temperature, pressure and the pH of the solution. The extent of the solubility of a substance in a specific solvent is measured as the saturation concentration, where adding more solute does not increase the concentration of the solution and begins to precipitate the excess amount of solute. The solubility of a substance is an entirely different property from the rate of solution, which is how fast it dissolves.

https://en.wikipedia.org/wiki/Solubility

*Re-write words you underlined*

3

_____ _____ _____

_____ _____ _____

*Using a complete sentence, summarize or rephrase the passage*

4

# Read Text for Comprehension

Read this article for deeper understanding. No summary is required, although you may want to circle, underline, or mark key ideas and words.

**Example (1)** - Let us consider the possible reaction of aqueous solution of NaCl with aqueous solution of $AgNO_3$. We would place a few drops of the NaCl solution in the reaction container followed by a few drops of $AgNO_3$ solution and observe an immediate cloudiness (white precipitate) that indicates a solid precipitate has formed. A precipitation chemical reaction has occurred.

In order to determine the possible identity of the solid product that forms, we first identify the ions present in each of the two aqueous solutions we started with: $Na^+$, $Cl^-$ (from NaCl) and $Ag^+$, $NO_3^-$ ( from $AgNO_3$).

Next we examine the ions for possible new combinations that may lead to a reasonable product formula.

The combination of ions (NaCl, $AgNO_3$) that existed in solution prior to the experiment had been soluble and therefore should remain as such without separating out as solid after the reaction. This allows us to eliminate combinations like NaCl and AgNO3 from the list of possibilities.

This leaves us with only two other possibilities, AgCl and $NaNO_3$. From the knowledge of **Solubility Rules** we can determine which of these two products is insoluble. Solubility Rule indicates that nitrate salts are soluble. Therefore, $NaNO_3$ cannot be the precipitate in this reaction. Also solubility Rule states that most chloride salts are soluble. AgCl is listed as an exception to this rule. In this case, *it is* AgCl which is the precipitate.

Once the chemical identity of the solid product is determined, we can then determine the **balanced formula equation**, the **complete ionic equation** as well as the **net ionic equation**, describing the chemistry that has occurred.

a) The **balanced formula equation** for the reaction of aqueous $AgNO_3$ with NaCl is written as:

$$\mathbf{AgNO_3}\textit{(aq)} + \mathbf{NaCl}\textit{(aq)} \rightarrow \mathbf{AgCl}\textit{(s)} + \mathbf{NaNO_3}\textit{(aq)}$$

Note that in the above equation, the physical state of the AgCl product is denoted by the letter s, to indicate that it is the precipitate. The number of atoms of each element is same before and after the reaction, indicating that the equation is balanced.

b) The **complete ionic equation**, indicates which reactants and products exist as ions and which ones do not:

$$\mathbf{Ag^+}\textit{(aq)} + \mathbf{NO_3^-}\textit{(aq)} + \mathbf{Na^+}\textit{(aq)} + \mathbf{Cl^-}\textit{(aq)} \rightarrow \mathbf{AgCl}\textit{(s)} + \mathbf{Na^+}\textit{(aq)} + \mathbf{NO_3^-}\textit{(aq)}$$

The ions that actually undergo change in the chemical reaction and participate in the formation of the insoluble product are called ***participating ions***. In the above reaction, $Ag^+$ and $Cl^-$ are the participating ions. Those that do not undergo change are called ***spectator ions***. In the above reaction, $Na^+$ and $NO_3^-$ are the spectator ions.

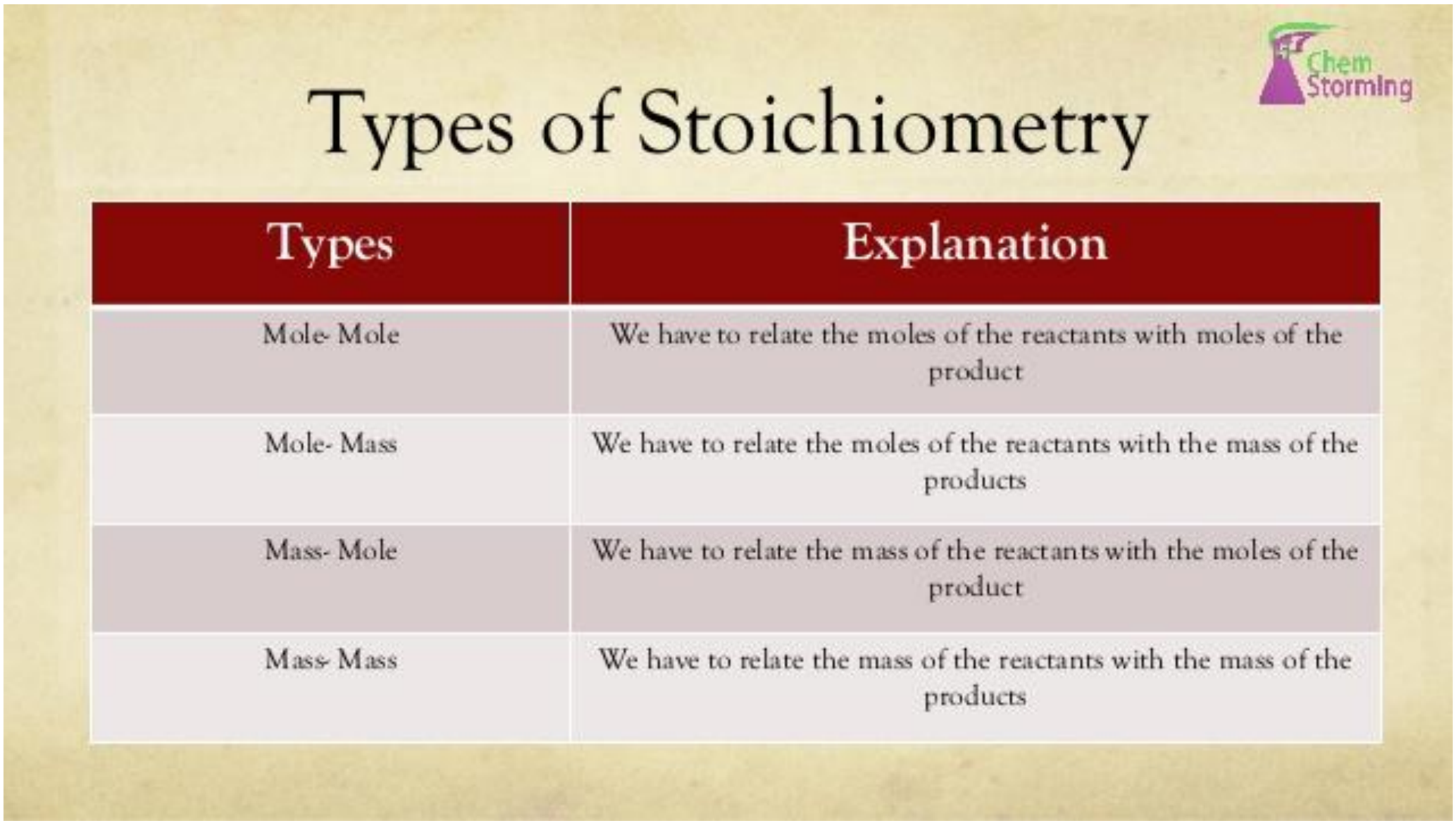
c) The **net ionic equation** displays only the participating ions on the reactant side, and the precipitate on the product side. The physical states of the reactants and products are also indicated. The spectator ions are not included.

$$\mathbf{Ag^+}\textit{(aq)} + \mathbf{Cl^-}\textit{(aq)} \rightarrow \mathbf{AgCl}\textit{(s)}$$

http://swc2.hccs.edu/pahlavan/intro_labs/Exp_10_Precipitation_Reactions_(Metathesis_Reactions).pdf

# Draw Illustration

**Copy and Label the Illustration in the Space Provided**




https://www.slideshare.net/pritinayak/stoichiometry-part-1-introduction

**Draw (Copy) the Illustration Here**

# Interpret a Graph

**Write the title of the graph _____**

**Circle the type of chart this represents**

*Bar Chart* *Line Chart* *Pie Chart* *Other*

**If applicable,**

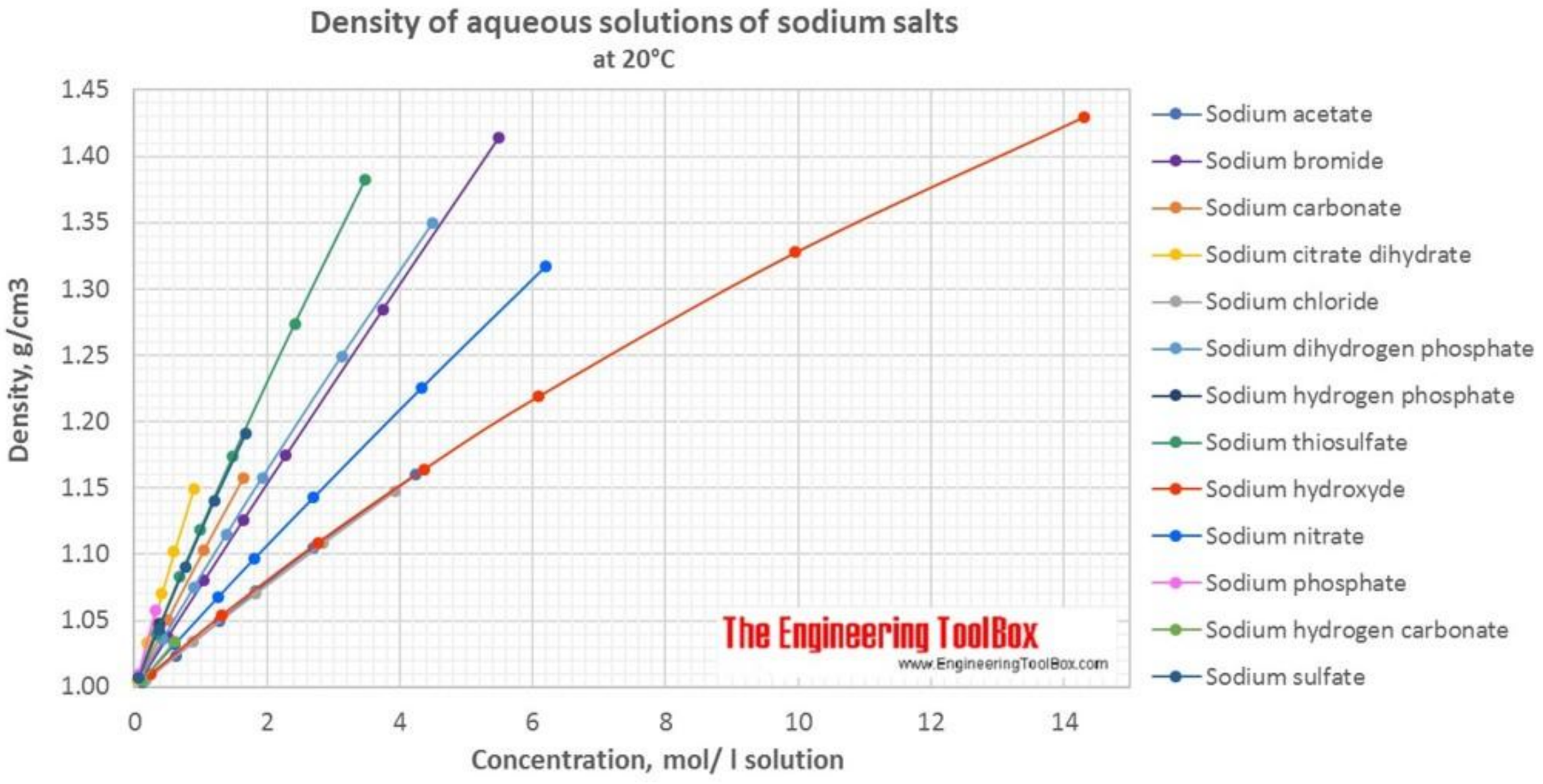
**What does the X-axis represent _____**

**What does the Y-axis imply _____**

**Summarize what this graph represents or conveys**

**_____**

https://www.engineeringtoolbox.com/density-aqueous-solution-inorganic-sodium-salt-concentration-d_1957.html



# Show-Off Your Smarts!

**Instructions**

- Complete as an individual or small group.
- Discuss your ideas/answers/responses in a small group.
- Select one person to present your responses to the class.

**Q1. How can this information be applied to a young-person's life?**

**Q2. How does this information apply to (or impact) communities?**

**Q3. When do scientists need to apply this information? How?**

**Q4. How would a person from 100 years ago view this information?**

**Q5. How does this topic connect to other science topics or math?**

*Write down at least three words introduced or covered by this topic.*

1.
2.
3.
4.
5.
6.

# Make a Poster

In the space provided here, create/draw a poster which conveys the concepts you have learned on this topic.