

A Model of Solutions

Read from **Lesson 1: Model of Solutions** in the **Chemistry Tutorial Section, Chapter 13** of **The Physics Classroom**:

Part a: [What is a Solution?](#)

Part b: [Solubility and Structure](#)

Solutions



In chemistry, a **solution** is a homogeneous mixture of two or more substances. The **solute** is the substance that is dissolved, while the **solvent** is the substance responsible for dissolving it. An **aqueous solution** is a solution in which water acts as the solvent. For example, dissolving table salt (the solute) in water (the solvent) creates a **saltwater solution**. Solutions can exist in various phases—solid, liquid, or gas. In chemistry labs, aqueous solutions are the most common, as water is a widely used solvent.

Part 1: Mixture or Solution?

For #1-10, answer: a) Is this a mixture or a solution? b) If it's a solution, identify the solute and the solvent.

1. Windex or similar glass cleaner
2. Bottled Italian dressing
3. Rubbing alcohol (70% isopropyl alcohol, 30% water)
4. A salad made of lettuce, tomatoes, and cucumbers
5. A bronze coin made of 88% copper and 12% tin.
6. Sugar dissolved in hot tea
7. Smoke from a campfire
8. Seawater collected from the ocean
9. Carbonated soda (unopened can)
10. Instant coffee dissolved in hot water

Part 2: Solubility

Solubility refers to the maximum amount of solute that can dissolve in a given solvent. In water, solubility varies widely depending on the substance. **Generally, "like dissolves like."** Polar molecules dissolve other polar molecules and ionic compounds, while nonpolar molecules dissolve other nonpolar molecules. Alcohols, which exhibit both polar and nonpolar characteristics, can dissolve in both types of solvents—but they do not dissolve ionic solids.



Questions

For each compound in the table:

- a. Write the chemical formula for the compound.
- b. Identify the types of intermolecular forces it exhibits.
- c. Predict its solubility in the following solvents: water, carbon tetrachloride (CCl_4), and alcohol.

For example:

Solute	Chem. Formula	Type of IMF	Soluble in H_2O ?	Soluble in CCl_4 ?	Soluble in Alcohol?
<i>Sodium Chloride</i>	<i>NaCl</i>	<i>Ionic bonds</i>	<i>Yes</i>	<i>No</i>	<i>No</i>

Solutions

Solute	Chemical Formula	Type of IMF	Soluble in H ₂ O?	Soluble in CCl ₄ ?	Soluble in Alcohol?
1. Iodine					
2. Ethanol					
3. Potassium phosphate					
4. Benzene	C ₆ H ₆				
5. Ammonium chloride					
6. Propane					
7. Calcium nitrate					
8. Toluene	C ₆ H ₅ CH ₃				
9. Isopropyl Alcohol					
10. Bromine					

11. Aaron Agin and Ellie Ment are discussing a compound from their solubility lab. They observe that the compound dissolves in boron trifluoride (BF₃) but not in water.
- Aaron and Ellie need to determine whether the unknown compound is ionic, polar covalent, or nonpolar covalent. If you were in their lab group, how would you classify the compound, and what reasoning supports your answer?
 - Aaron claims that because the unknown compound is a liquid, it should be able to dissolve table salt. Is his assumption correct? Provide an explanation.
 - Based on its observed solubility, would you expect this unknown liquid to be soluble in methanol? Justify your response.