

Chapter 13: Solutions

Solution = a _____ mixture

In order for a solution to form, _____ must occur.



Components of a solution:

▪ **Solvent:**

▪ **Solute:**

In $\text{NaCl}(aq)$, $\text{H}_2\text{O} =$
 $\text{NaCl} =$

One of the **fluid phases** () or () must be present in order for a solution to form.

Soluble (s) + (l) solvent \rightarrow

(l) + (l) \rightarrow

(g) + (l) solvent \rightarrow

(g) + (g) \rightarrow

(s) + (s) \rightarrow

Like dissolves like

Recall that polar substances tend to dissolve other polar substances, and nonpolar substances tend to dissolve other nonpolar substances

Common Polar Solvents

H_2O

CH_3OH

Acetone

These tend to dissolve:

Common Nonpolar Solvents

C_6H_{14}

C_7H_8

CCl_4

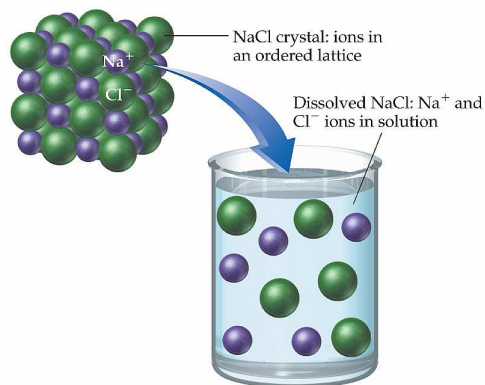
These tend to dissolve:

Which solvent, water or hexane, will the following substances be more likely to dissolve in?

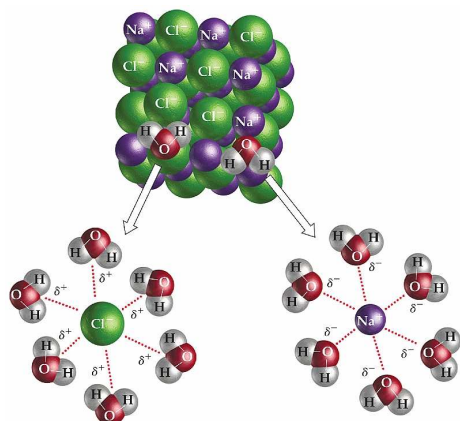
- ethanol
- CBr_4
- I_2
- CuCl_2
- NH_4Cl
- greases, oils, etc.

Dissolving an ionic compound

When an ionic compound dissolves, its ions **separate!**



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(...but only if the ionic compound is **soluble**. Insoluble compounds remain in the ionic lattice)

Saturation

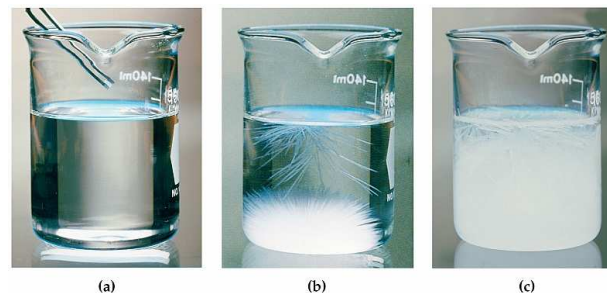
Even soluble compounds have a limit to how much solute will dissolve

Solubility of NaCl: 36 g per 100 mL H_2O

- **Saturated solution:** holds the maximum amount of solute
- **Unsaturated solution:** holds less than the max
- **Supersaturated solution:** temporarily has dissolved **more** than the maximum amount of solute

Examples:

- 15 g salt dissolved in 100 mL H_2O
- 50 g salt poured into 100 mL H_2O , with undissolved solid on the bottom
- 38 g salt completely dissolved in 100 mL H_2O



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% Concentration

Concentration: a measure of how much solute is dissolved in a solution

Mass percent concentration:

$$\text{mass \%} = \frac{\text{mass solute}}{\text{mass solution}} \times 100\%$$

12.1 g NaCl are dissolved in 120.1 g H₂O. What is the mass percent concentration?

Bleach is a 6.25% NaOCl (sodium hypochlorite) solution in H₂O. What mass NaOCl is in 487 g bleach?

When you're given a mass %, make a conversion factor out of it! **100 g** solution contains ___ g NaOCl.

Vinegar is 5.0% acetic acid in H₂O. How many grams of vinegar will 17.2 g acetic acid make?

Molarity

$$\text{Molarity (M)} = \frac{\text{moles solute}}{\text{liters solution}} = \frac{\text{mol}}{\text{L}}$$

14.2 g NaCl is dissolved in H₂O to make 250. mL solution. What is the molarity of the solution?

What mass of NaCl(s) is required to make 250. mL of 3.5 M NaCl(aq) solution?

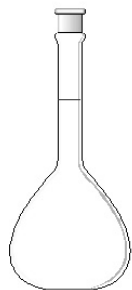
Molarity is a conversion factor between:

Preparing a solution

To prepare a solution by dissolving a solid:

1. Measure mass of solid
2. Add to correct size volumetric flask
3. Dissolve the solid in water
- 4.

How do you prepare 1.5 L of a 2.75 M $\text{Cu}(\text{NO}_3)_2(\text{aq})$ solution by dissolving $\text{Cu}(\text{NO}_3)_2(\text{s})$?



volumetric flask

How many mL of solution will 2.87 g $\text{CaCl}_2(\text{s})$ make if the solution is 0.85 M?

Dilution

Dilution: adding solvent to an existing solution

Dilution will _____ the concentration.

The dilution equation: $M_1V_1 = M_2V_2$

How do you prepare 500. mL of a 1.5 M solution by dilution of a 6.0 M stock solution?

have:

want:

If 75.0 mL of 12 M $\text{HCl}(\text{aq})$ are diluted to 425 mL, what is the final concentration?