

DID YOU KNOW?

Misleading Labelling

Milk is sometimes labelled as “homogenized,” meaning that the cream is equally distributed throughout the milk. This use of the word does not match the chemistry definition of homogeneous. Using the strict chemistry definition, milk is not a homogeneous mixture, but a heterogeneous mixture. Milk is not a solution.

solution: a homogeneous mixture of substances composed of at least one solute and one solvent

homogeneous mixture: a uniform mixture of only one phase

solute: a substance that is dissolved in a solvent (e.g., salt, NaCl)

solvent: the medium in which a solute is dissolved; often the liquid component of a solution (e.g., water)

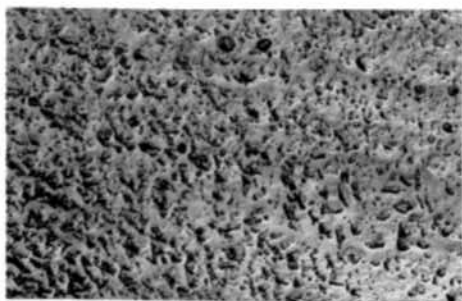


Figure 1

Gasoline, shown here in a spill on asphalt, is a nonaqueous solution containing many different solutes (mostly hydrocarbons such as benzene and paraffin) in an octane solvent. The composition of gasoline is not fixed: It varies with the source of the raw material, the manufacturer, and the season.

6.1 Defining a Solution

Many of the substances that we use every day come packaged with water. We buy other substances with little or no water, but then mix water with them before use. For example, we may purchase syrup, household ammonia, and pop with water already added, but we mix baking soda, salt, sugar, and powdered drinks with water. Most of the chemical reactions that you see in high school occur in a water environment. Indeed, most of the chemical reactions necessary for life on our planet occur in water.

Because so many substances dissolve in it, water is often referred to as the universal solvent. Of course, this is an exaggeration. Not all things dissolve in water. Imagine if they did; we would not be able to find a container for water.

Before restricting our study to mixtures involving water, we will review the more general definition and types of a solution.

Solutions

Solutions are **homogeneous mixtures** of substances composed of at least one **solute** and one **solvent**. Liquid-state and gas-state solutions are clear (transparent)—you can see through them; they are not cloudy or murky in appearance. Solutions may be coloured or colourless. Opaque or translucent (cloudy) mixtures, such as milk, contain undissolved particles large enough to block or scatter light waves. These mixtures are considered to be heterogeneous.

It is not immediately obvious whether a clear substance is pure or is a mixture, but it is certainly homogeneous. Homogeneous mixtures in the liquid state and the gas state are always clear with only one phase present. If you were to do a chemical analysis of a sample of a homogeneous mixture (i.e., a solution), you would find that the proportion of each chemical in the sample remains the same, regardless of how small the sample is. This is explained by the idea that there is a uniform mixture of particles (atoms, ions, and/or molecules) in a solution. Empirically, a solution is homogeneous; theoretically, it is uniform at the atomic and molecular level.

Both solutes and solvents may be gases, liquids, or solids, producing a number of different combinations (Table 1). In metal alloys, such as bronze or the mercury amalgam used in tooth fillings, the dissolving has taken place in liquid form before the solution is used in solid form. Common liquid solutions that have a solvent other than water include varnish, spray furniture polish, and gasoline. Gasoline, for example, is a mixture of as many as 400 different hydrocarbons and other compounds (Figure 1). These substances form a solution—a

homogeneous mixture at the molecular level. There are many such hydrocarbon solutions, including kerosene (a Canadian-invented fuel for lamps and stoves), and turpentine (used for cleaning paintbrushes). Most greases and oils will dissolve in hydrocarbon solvents.

Table 1: Classification of Solutions

Solute in solvent	Example of solution
gas in gas	oxygen in nitrogen (in air)
gas in liquid	oxygen in water (in most water)
gas in solid	oxygen in solid water (in ice)
liquid in gas	water in air (humidity)
liquid in liquid	methanol in water (in antifreeze)
liquid in solid	mercury in silver (in tooth fillings)
solid in liquid	sugar in water (in syrup)
solid in solid	tin in copper (in bronze)