The Learning Lab

Chemistry

Lower Secondary Intensive Practice

Elements, Compounds and Mixtures

Notes (II)

Solutions and Suspensions

Name _____

I.D. _____

Date _____

Day _____ Time _____

Teacher _____

photo flickr/ Eduards Pulks

Chemical such as copper(II) sulfate can dissolve in a variety of solvents to form solutions of carrying colours.

Colour me pretty

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STUDENT OUTCOMES

At the end of today's lesson, students should be able to:

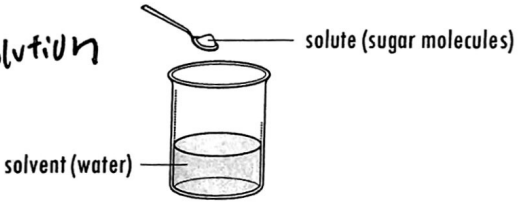
- ☐ Differentiate between solutes, solvents and solutions
- ☐ Recognise that solutions and suspensions are mixtures
- ☐ define *solutions* and *suspensions* and describe their properties
- ☐ state the similarities and differences between solutions and suspensions
- ☐ define *solubility*
- ☐ Describe the factors affecting solubility of a solute
- ☐ Describe the factors affecting the rate of dissolving of a solute

Solutions

A solution is a **homogeneous mixture** made up of two or more different substances physically combined together.

A solution usually consists of a **solvent**, the substance **used for dissolving**, and one or more **solute(s)** which are **dissolved**. For example, in an aqueous solution of sugar, the solvent is water and the solutes are the sugar molecules.

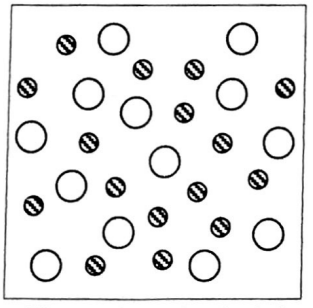
Minor component in solution



For a solvent to dissolve a solute, the particles of the solvent must be able to separate the particles of the solute and occupy the spaces in between.

The diagram below shows the arrangement of particles in a solution after the solute is completely dissolved and all the solute particles are evenly distributed throughout the entire solution.

There can only be a change between solute and solvent when generally they are the same state.



Key
- ⊘ solvent particle
- ○ solute particle

When a solute is dissolved, the solute particles are interspersed between the solvent particles.

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Properties of solutions

- Solutions have a **homogeneous** composition with **uniform** physical and chemical properties throughout. The colour, density, appearance and other physical and chemical properties are uniform throughout the solution.
- When a solution is filtered, no residue is left on the filter paper.
- When a solution is left to stand, the solute does **not** separate from the solvent.

Examples of solutions

Solutions can exist in any of the three physical states.

Solid solutions

- Dental fillings (amalgam) are solutions consisting of mercury, silver, tin, copper and trace amounts of zinc.
- Sterling silver is a solution of silver and copper.
- Brass is a solution of copper and zinc.
- Bronze is a solution of copper and tin.

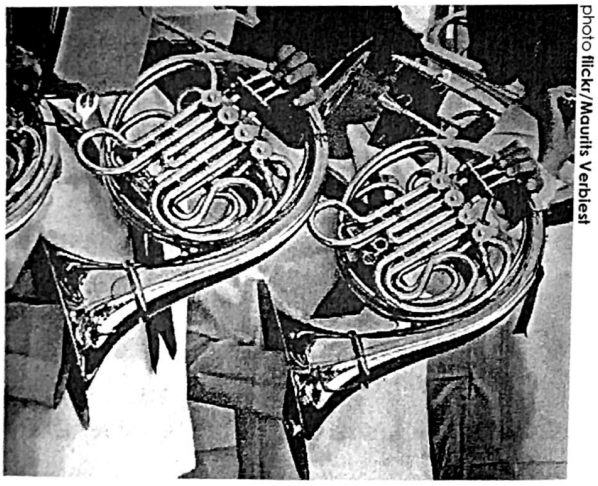

photo flickr/Maurits Verbiest

Brass is used in the making of musical instruments.

photo flickr/angelspayson

Statues made of bronze alloys are better able to withstand the test of time.

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Liquid solutions

- Liquid solvents containing dissolved solutes, e.g. sugar solution
- Mixture of **miscible** liquids that can mix, e.g. ethanol and water

Try it yourself!

Identify the solvent and solute in each liquid solution below.

a Sugar solution

Solute _____

Solvent _____

b Seawater

Solute _____

Solvent _____

c Vinegar

Solute Ethanoic acid

Solvent _____

Gaseous solutions

- Air is a solution that consists mainly of elements such as nitrogen and oxygen. Noble gases are also present. It also consists of compounds such as carbon dioxide, water vapour.
- Natural gas is a solution of gases such as methane and ethane.

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Solubility

Solubility is a measure of the **ability of a solute to dissolve in a given amount of solvent at a given temperature**. It is usually measured in grams per 100 cm^3 of solvent

Concentration of solution

The concentration of a solution is a measure of the amount of solute dissolved in a given amount of solvent. **The more solute dissolved, the higher the concentration of the solution**. A solution containing a **small** amount of dissolved solute particles per unit is known as a **dilute solution**. On the other hand, a solution containing a **large** amount of dissolved solute particles per unit is known as a **concentrated solution**.

A solution is **saturated** if it contains the **maximum** amount of solute that can be dissolved at the given temperature. Any solute added would remain undissolved.

For example, the solubility of table salt is 360 g per 1000 cm^3, measured at 20 °C. This means that adding 360 g of table salt into 1000 cm^3 of water at 20 °C will result in a saturated salt solution. Any additional table salt added to this solution would remain undissolved. Likewise, adding 36 g of table salt into 100 cm^3 of water at 20 °C will result in a saturated salt solution.

Factors affecting solubility

Temperature

As temperature increases, the solubility of most solid solutes in water increases. However, there are some exceptions.

Type of solute

Different (solid) solutes have different degrees of solubility in the same solvent.

Type of solvent

Based on the **type and nature of the solvent** used, a substance would show different solubilities.

For instance, common salt is more soluble in water than in oil. This is because the particles in common salt can form more effective interactions with water molecules, than with oil molecules.

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Rate of dissolving

The rate of dissolving measures the amount of solute that dissolves in a given volume of solvent per unit time.

Factors affecting the rate of dissolving

Temperature

As the temperature increases, the rate of dissolving for most solid solutes in water increases.

Particle size of solute

The particle size of a solute would affect the rate of dissolving. By breaking a solute into smaller pieces or using its powdered form, the total exposed surface area for interaction between the solute particles and solvent is increased. Thus, as **the particle size of a solute decreases, the rate of dissolving increases**.

Stirring effect

For solutions that contain liquid and/or solid solutes, **stirring increases the rate of dissolving**.

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Suspensions

A suspension is a **heterogeneous mixture** made up of particles of an **insoluble** substance **suspended in a liquid or gas**. The liquid or gas is known as the **medium**.

Properties of suspensions

- Suspensions have a **heterogeneous** composition with **different** physical and chemical properties throughout.
- Suspensions usually appear **opaque**. This is because some of the particles dispersed in the medium cause light to diffuse when light is passed through a suspension.
- The components of a suspension can be easily separated using **physical** methods such as **filtration**. The insoluble particles in the medium are left behind as **residue** during filtration.
- When a suspension is left to stand, the suspension **separates** into **distinct layers**. The particles in suspensions settle to the **bottom** of the container. This is known as **sedimentation**.

Going Further

Colloids

- There are some mixtures, such as fresh milk and foam, that have properties that appear to differentiate them from solutions and suspensions.

- Unlike suspensions, these substances do **not** separate into different layers when left to stand.
- Unlike solutions, the dimensions of the particles dispersed throughout the medium are **larger** than one nanometre.

These substances are **colloids**, which consist of substances **evenly distributed (dispersed)** throughout a **dispersion medium**. When left to stand, the particles in a colloid **remain dispersed** throughout the dispersion medium.

When light is shone through a colloid, the particles dispersed throughout the dispersion medium cause the light to scatter. This is known as the Tyndall effect. By observing for the Tyndall effect, one can determine if a given mixture is a colloid or suspension.

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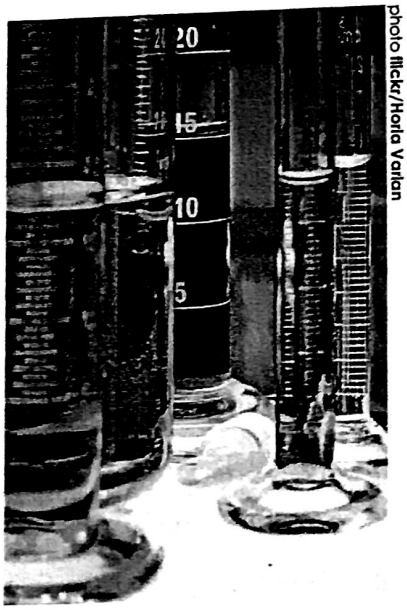
(B)



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