

Solutions

Printable revision sheet — Galaxscia

LEVEL 1

What is a solution?

In chemistry, a **solution** is a **homogeneous mixture** of two chemical species. This means the components cannot be told apart with the naked eye: everything is perfectly mixed. The word "solution" is mostly used for liquid mixtures. When the solvent of a solution is water, we speak of an **aqueous solution**.

Example : When syrup is poured into a glass of water and stirred, the result is a uniform liquid in which the water and the syrup cannot be told apart.

Different types of solution

There are several ways of forming a solution:

Liquid + liquid: limited by miscibility (the ability of two liquids to mix).

Example: water and vinegar.

Solid + liquid: limited by the solubility of the solid. Example: salt in water.

Gas + liquid: limited by the solubility of the gas. Example: carbon dioxide dissolved in a fizzy drink.

Key points — revision questions

What is a solution in chemistry?

What does "aqueous solution" mean?

What are the three types of mixture that can form a solution?

Give an example of a solution whose solute is a gas.

LEVEL 2

Miscibility

Miscibility is the ability of two liquids to mix with each other.

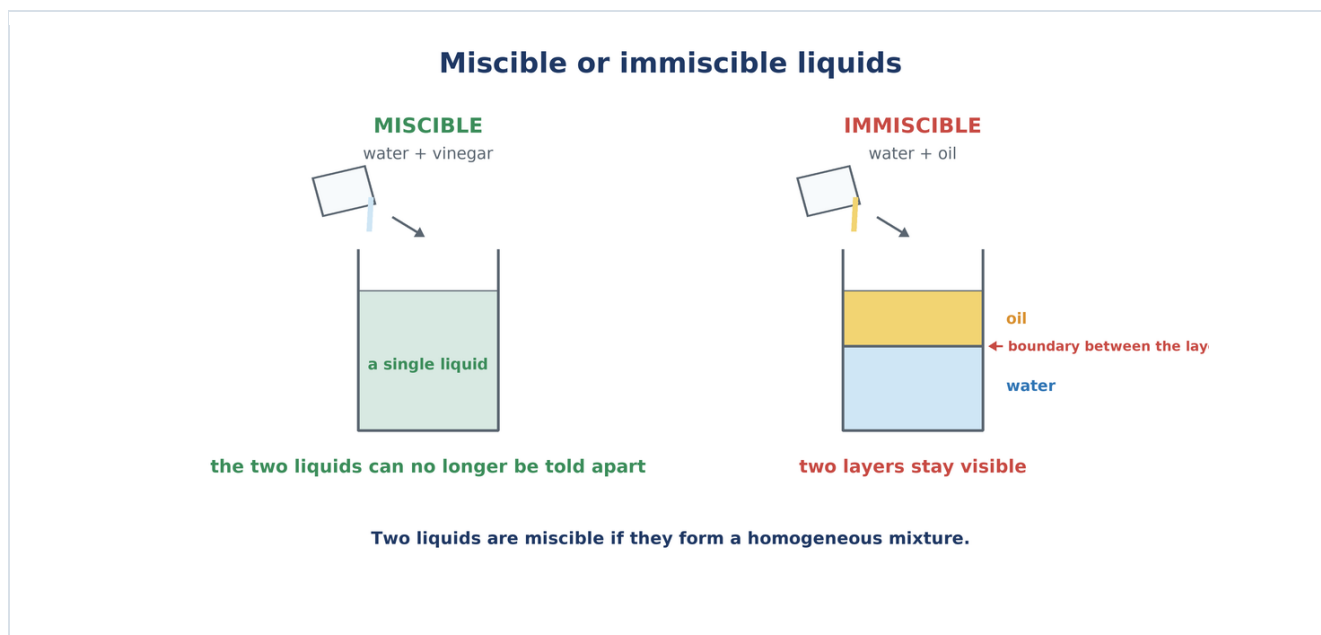
If they are miscible → the mixture is homogeneous, and the two liquids cannot be told apart.

If they are immiscible → they stay separate, often in distinct layers.

Example : - Water + vinegar: miscible (homogeneous mixture). - Water + oil: immiscible (two visible layers).

Why do some liquids mix?

It depends on the **chemical nature** of the molecules. In general, two liquids of similar chemical nature are miscible. Otherwise, they do not mix.



Key points — revision questions

What is miscibility?

Give two examples of miscible liquids.

Give two examples of immiscible liquids.

What happens when water and oil are mixed?

LEVEL 3

Dissolving

Dissolving is the process by which a substance (the solute) spreads out through a liquid (the solvent), forming a homogeneous solution.

The solvent: the majority species, often a liquid. E.g. water.

The solute: the minority species, which is dissolved. E.g. salt, sugar, CO₂.

Example : When sugar is put into coffee, the grains disappear and spread out evenly: this is dissolving.

Solubility

Solubility is the maximum amount of solute that can be dissolved in one litre of solvent, at a given temperature.

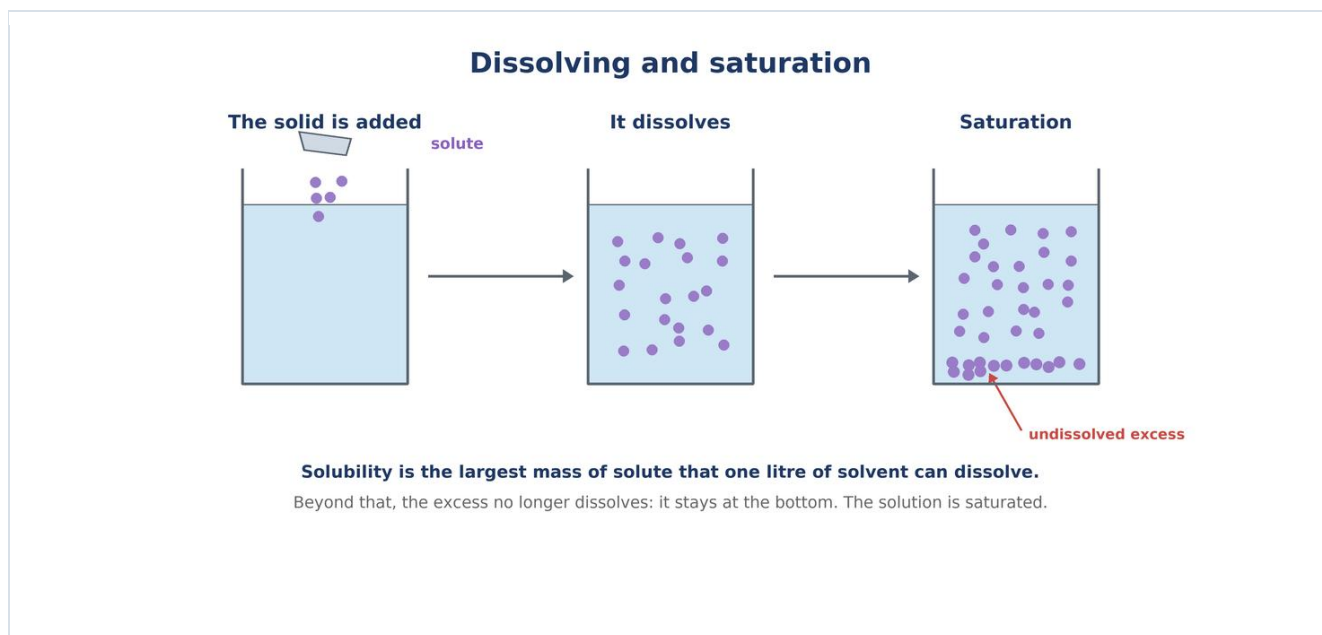
It is expressed in grams per litre (g/L).

Beyond this value, the excess solute does not dissolve. The solution is then said to be saturated. (this is saturation)

Example : - Solubility of salt in water: 365 g/L → in 1 L of water, up to 365 g of salt can be dissolved. - Solubility of CO₂ in water: 1.688 g/L → much lower, which is why an opened drink quickly loses its bubbles.

Insoluble substances

Some substances do not dissolve at all in a given solvent; they are said to be **insoluble**. Example: sand in water.



Key points — revision questions

What is the difference between a solvent and a solute?

How is solubility expressed?

What is a saturated solution?

Give an example of a solid dissolving in a liquid and of a gas dissolving in a liquid.

Between salt and CO₂, which is more soluble in water? Justify your answer using the numbers.

LEVEL 4

What is concentration?

The **concentration** of a solution tells you how much solute is dissolved in a given amount of solvent. The higher the concentration, the more solute the solution contains. There are several ways of expressing concentration:

Mass concentration: this is the one most used at secondary school. It is the mass of solute dissolved in 1 litre of solution.

It is expressed in grams per litre (g/L).

Formula for mass concentration

Mass concentration is worked out with the formula:

$$C = m/V$$

where:

C = mass concentration (in g/L)

m = mass of solute dissolved (in g)

V = volume of solution (in L)

Example : 20 g of sugar is dissolved in 500 mL of water. We know that $m = 20 \text{ g}$ $V = 0.5 \text{ L}$ $C = m/V$

$$\text{So } C = 20/0.5 = 40 \text{ g/L.}$$

The sugar concentration of the solution is 40 g/L.

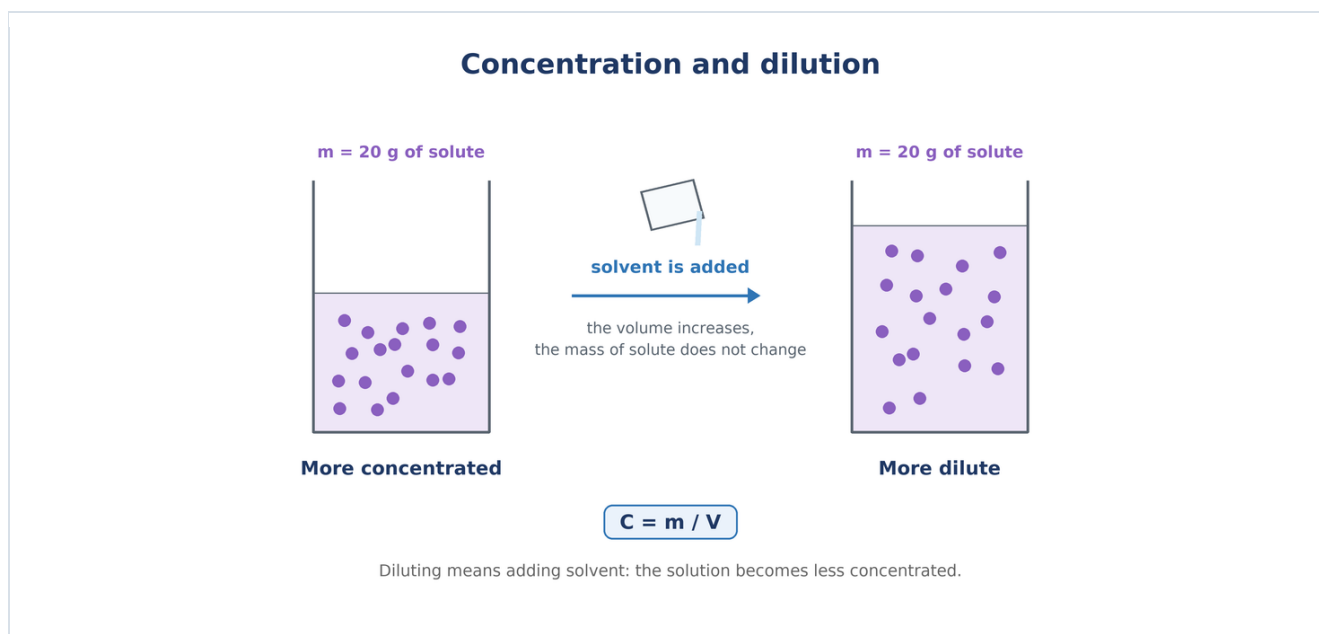
Dilution and concentration

Solutions of different concentrations can be prepared:

By adding more solute, the solution becomes more concentrated.

By adding more solvent, the solution becomes less concentrated (this is a dilution).

Example : If you add water to a very sweet fruit juice, it becomes less sweet. You have diluted the solution.



Key points — revision questions

What is the concentration of a solution?

What is the formula for mass concentration?

What is the unit of mass concentration?

What happens if solvent is added to a solution?

What does "dilution" mean?