Percent concentration of the solution - definition

Dye solutions in water
Source: domena publiczna.

Link to the lesson

> **Before you start you should know**
>
> - that the molecular dispersion consists of the solvent and the substance dissolved in it;
> - that the solvent is water in aqueous solutions;

> **You will learn**
>
> - to calculate the percent concentration of the solution based on its mass or mass of solvent and mass of solute;
> - to estimate the mass of the solution based on the percent concentration of solution and the mass of solute;
> - to determine the mass of solute based on the percent concentration and mass of the solution.

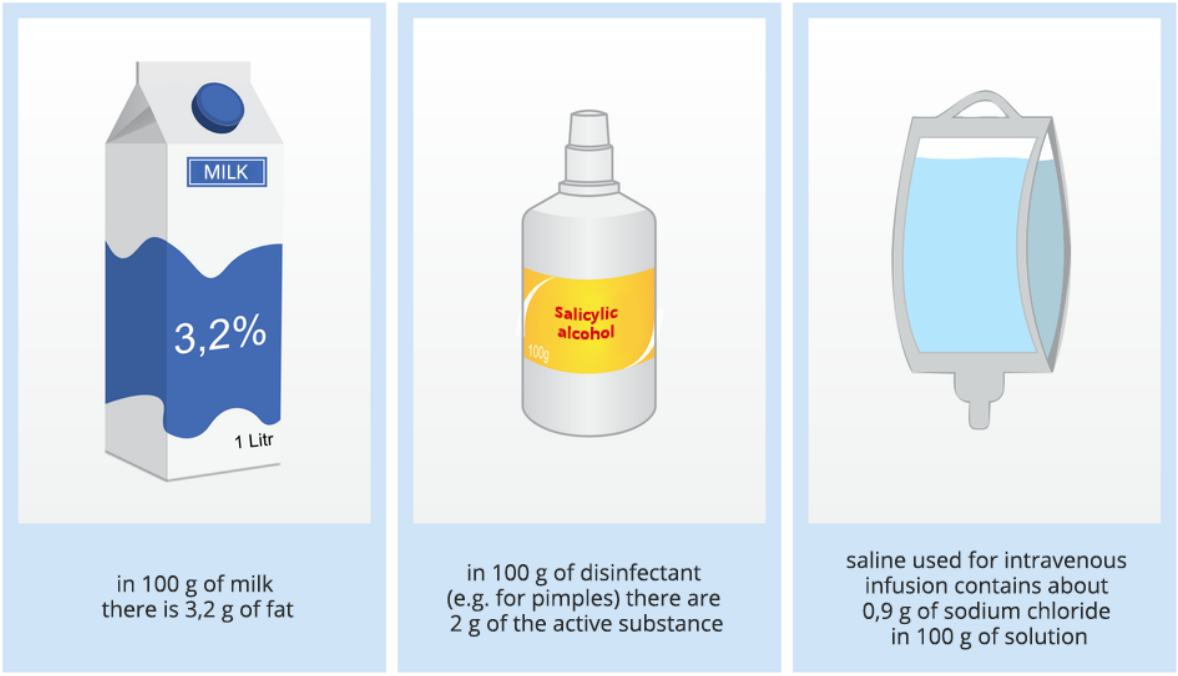
Nagranie dostępne na portalu epodreczniki.pl

Nagranie dźwiękowe abstraktu.

The composition of the solution

The terms „concentrated solution", „diluted solution" or „saturated solution" only indicate the amount of the given solute is in solution. Sometimes it is necessary to provide its exact content. There are several ways to present the composition of the solution, i.e. its concentration.

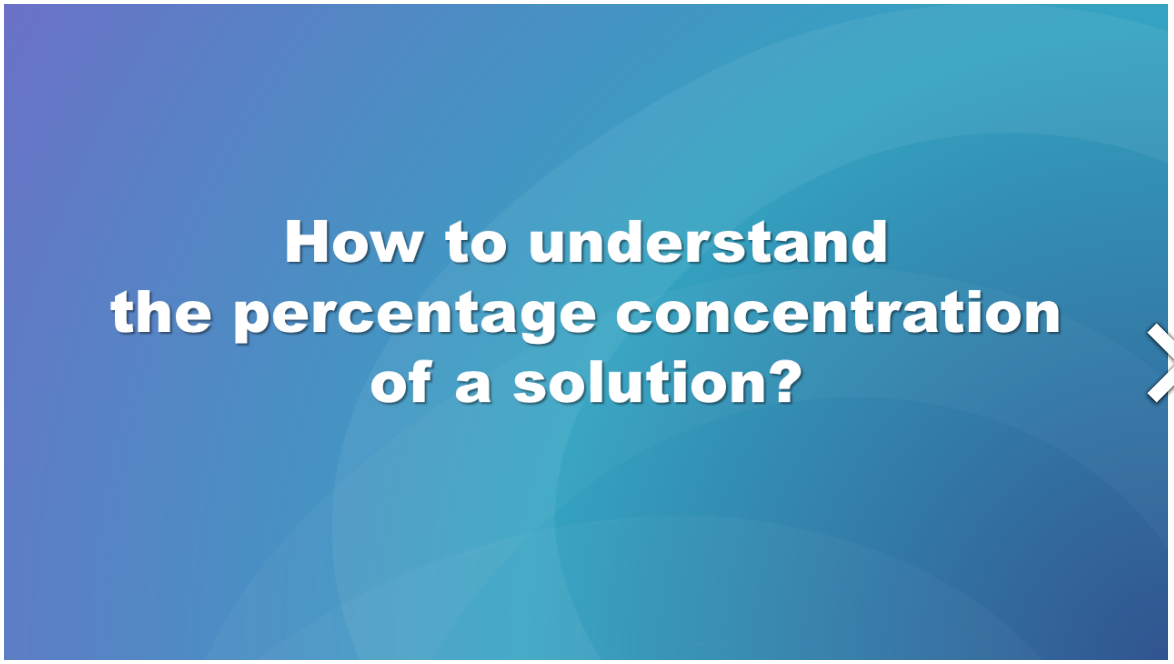
One of them is percent concentration. It determines how many parts of the mass (in weight) of dissolved substance is found in 100 parts of the mass (in weight) of **solution**. A 5% means that there are 5 grams of solute in 100 grams of solution.



Every day we encounter articles on which packages the contents of their ingredients are given

Task 1

Watch the presentation „How to understand the percentage concentration of a solution?” and note which formula can be used to calculate the percent concentration.



Source: GroMar Sp. z o.o., licencja: CC BY-SA 3.0.

Nagranie dostępne na portalu epodreczniki.pl

Nagranie audio prezentuje how to undertand the percent concentration of a solution.

The percent concentration can be calculated using the formula: $C_p = \frac{m_s}{m_r} \cdot 100\%$

Where following symbols mean:
C_p – percent concentration,
m_s – mass of the substance,
m_r – mass of the solution.

Recall that the mass of the aqueous solution (m_r) is the sum of the mass of the solvent ($m_{solv.}$), usually water and mass of the solute (m_s):

$m_r = m_{solv.} + m_s$

Size	Percent concentration	Mass of the substance	Mass of the solution	Mass of the solvent

---

Size	Percent concentration	Mass of the substance	Mass of the solution	Mass of the solvent
size designation	C_p	m_s	m_r	$m_{solvent}$
value	4%	4 g	100 g	100 g – 4 g = 96 g

Calculation of the percent concentration of a solution of a substance

If we know the mass of the solvent or the mass of the solution and the mass of the dissolved substance, we can determine the percent concentration of the solution. In all calculations we must remember about the mass units that we always insert into the formula.

> **Task 2**
>
> Calculate the percent concentration of sugar solution if 250 g of the solution contains 100 g of this substance.

> **Task 3**
>
> Calculate the percentage concentration of the sodium chloride solution that was created after dissolving 10 g of this substance in 250 g of water. Write down the result to the second decimal place.

> **Hint**
>
> 1. We calculate the mass of the solution, which is the sum of the mass of water and mass of sodium chloride (solute):
>
> $m_r = m_{solv.} + m_s = 250\ g + 10\ g = 260\ g$
>
> 2. The next part of the task can be solved in two ways – using the formula for the percent concentration or using the proportion.
>
> $c_p = \frac{m_s}{m_r} \cdot 100\%$
>
> $c_p = \frac{\text{mass of sodium chloride}}{\text{mass of the solution of sodium chloride}} \cdot 100\%$
>
> $c_p = \frac{10g}{260g} \cdot 100\% = 3.85\%$
>
> 100 g—X

260 g—10 g

$X = \frac{100\ g \cdot 10\ g}{260\ g} = 3.85\ g$

3. Answer:
After dissolving 10 g of sodium chloride in 250 g of water, a solution of this substance with a concentration of 3.85% was obtained.

Calculating the mass of individual components of the solution

Knowing the percent concentration of the solution and its mass, the mass of solute can be calculated. Similarly, we can determine the mass of the solution based on the information on the percent concentration of the solution and the mass of the dissolved substance contained in it. Both right proportion and appropriately converted formula for the percent concentration can be used in the calculations.

Percent concentration formula	The formula for the mass of substance	The formula for the mass of solution
$c_p = \frac{m_s}{m_r} \cdot 100\%$	$m_s = \frac{c_p \cdot m_r}{100\%}$	$m_r = \frac{m_s}{c_p} \cdot 100\%$

c_p – percent concentration
m_s – mass of substance
m_r – mass of solution

Exercise 1

Calculate how many grams of water should be added to 120 g of sugar to get a 30% solution

Task 4

Calculate the amount of copper(II) sulphate contained in 250 g of 2% aqueous solution of this substance.

> **Hint**
>
> 1. Result:
>   We know that:
> c_p = 2%
> m_r = 250 g
>
> 2. This task can be solved in two ways – using the formula for the percent concentration (after its conversion) or using the proportion.
>
> $100\ g — 2\ g$
>
> $250\ g — X$

Answer:

The mass of copper(II) sulphate in 250 g of the 2% solution is 5 g.

Task 5

Calculate the mass of 1% potassium chloride aqueous solution containing 1.5 g of this substance. Write down the mass of water that is contained in the solution.

Hint

1. Result: We know that:
   c_p = 1%
   m_s = 1.5 g

2. This task can be solved using the converted formula for percent concentration or using the proportion.

100 g—1 g

X—1,5 g

Exercise 2

Select the correct definition of percent concentration.

- Number of grams of solute in 100 g of solution
- Maximum number of grams of substance that can be dissolved in 100 g of solvent at a given temperature to obtain a saturated solution
- Maximum number of grams of substance that can be dissolved in 100 g of solution at a given temperature to obtain a saturated solution
- Number of grams of solute in 100 g of solvent

Prepare the task for calculating the percent concentration of the solution for a friend. Provide four possible answers, including one that is correct.

Question: ...

a. ...
b. ...
c. ...
d. ...

Summary

- Percent concentration is the information about how many parts of the mass (in weight) of the dissolved substance are found in 100 parts of the mass (in weight) of the solution.
- The percent concentration of a solution can be calculated based on the weight of the solution and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_r} \cdot 100\%$.
- The mass of solute can be calculated based on the percent concentration and mass of the solution: $m_s = \frac{c_p \cdot m_r}{100\%}$.
- The percent concentration of the solution can be calculated based on the weight of the solvent and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_{solv.} + m_s} \cdot 100\%$.
- If the density of the solution is known, it is possible to determine the mass of given volume.

Keywords

percent concentration of the solution, solution, solvent, mass of the solution, density of the solution

Glossary

percent concentration of the solution

Nagranie dostępne na portalu epodreczniki.pl

Nagranie słówka percent concentration of the solution.

---

stężenie procentowe roztworu – liczba gramów substancji rozpuszczonej w 100 g roztworu (wyrażona w procentach)

Lesson plan (Polish)

Temat: Stężenie procentowe roztworu – definicja

Adresat

Uczeń szkoły podstawowej (klasy 7. i 8.)

Podstawa programowa:

Szkoła podstawowa. Chemia.

V. Woda i roztwory wodne. Uczeń:

7) wykonuje obliczenia z zastosowaniem pojęć: rozpuszczalność, stężenie procentowe (procent masowy), masa substancji, masa rozpuszczalnika, masa roztworu, gęstość roztworu (z wykorzystaniem tabeli rozpuszczalności lub wykresu rozpuszczalności).

Ogólny cel kształcenia

Uczeń interpretuje stężenie procentowe roztworu

Kompetencje kluczowe

- porozumiewanie się w języku ojczystym;
- porozumiewanie się w językach obcych;
- kompetencje matematyczne i podstawowe kompetencje naukowo-techniczne;
- kompetencje informatyczne;
- umiejętność uczenia się.

Kryteria sukcesu
Uczeń nauczy się:

- obliczać stężenie procentowe roztworu na podstawie jego masy lub masy rozpuszczalnika i masy substancji rozpuszczonej;
- szacować masę roztworu na podstawie stężenia procentowego roztworu i masy substancji rozpuszczonej;
- określać masę substancji rozpuszczonej na podstawie stężenia procentowego i masy roztworu.

Metody/techniki kształcenia

- **aktywizujące**
    - dyskusja.
- **podające**

    - pogadanka.
- **eksponujące**
    - film.
- **programowane**
    - z użyciem komputera;
    - z użyciem e-podręcznika.
- **praktyczne**
    - ćwiczeń przedmiotowych.

Formy pracy

- praca indywidualna;
- praca w parach;
- praca w grupach;
- praca całego zespołu klasowego.

Środki dydaktyczne

- e-podręcznik;
- zeszyt i kredki lub pisaki;
- rzutnik multimedialny;
- tablica interaktywna, tablety/komputery;
- metodnik lub kartki zielone, żółte i czerwone.

Przebieg lekcji

Faza wstępna

1. Nauczyciel rozdaje uczniom metodniki lub kartki w trzech kolorach: zielonym, żółtym i czerwonym do zastosowania w pracy techniką świateł drogowych. Przedstawia cele lekcji sformułowane w języku ucznia na prezentacji multimedialnej oraz omawia kryteria sukcesu (może przesłać uczniom cele lekcji i kryteria sukcesu pocztą elektroniczną lub zamieścić je np. na Facebooku, dzięki czemu uczniowie będą mogli prowadzić ich portfolio).
2. Prowadzący wspólnie z uczniami ustala – na podstawie wcześniej zaprezentowanych celów lekcji – co będzie jej tematem, po czym zapisuje go na tablicy interaktywnej/tablicy kredowej. Uczniowie przepisują temat do zeszytu.
3. BHP – przed przystąpieniem do eksperymentów uczniowie zapoznają się z kartami charakterystyk substancji, które będą używane na lekcji. Nauczyciel wskazuje na konieczność zachowania ostrożności w pracy z nimi.

Faza realizacyjna

1. Nauczyciel, wprowadzając uczniów w zagadnienie stężenia procentowego roztworu, podaje kilka przykładów jego istotności, odwołując się do przemysłu. Informuje, że

w laboratoriach chemicznych i w życiu codziennym stosuje się roztwory o pewnej zawartości substancji w ich danej ilości, czyli o znanym stężeniu. Jednym ze sposobów wyrażania stężeń roztworów jest stężenie procentowe.
2. Prowadzący zajęcia wyświetla ilustrację „Codziennie spotykamy się z artykułami, na których opakowaniach podano zawartość ich składników" z abstraktu i analizuje ją, interpretując opisy.
3. Nauczyciel wyświetla prezentację „Jak zrozumieć stężenie procentowe roztworu?" z abstraktu. Po projekcji wprowadza wzór na stężenie procentowe roztworu i na jego podstawie definiuje stężenie procentowe roztworu – uczniowie zapisują informacje w zeszytach. Następnie prezentuje na tablicy multimedialnej tabelę „Interpretacja 4-procentowego roztworu o masie 100 g" i dokonuje jej analizy na forum.
4. Nauczyciel, odnosząc się do obliczania stężenia procentowego roztworu, odwołuje uczniów do abstraktu i prosi, by obejrzeli i przeanalizowali instrukcję obliczania stężenia procentowego z definicji oraz z wykorzystaniem proporcji. Prosi chętnego ucznia o rozwiązanie zadania na tablicy.
5. Nauczyciel informuje uczniów, że znając stężenie procentowe roztworu oraz jego masę, można obliczyć masę substancji rozpuszczonej. Podobnie na podstawie informacji o stężeniu procentowym roztworu i masie zawartej w nim substancji rozpuszczonej można określić masę roztworu. Przy obliczeniach korzysta się zarówno z odpowiedniej proporcji, jak i przekształconego wzoru na stężenie procentowe. Nauczyciel na podstawie kolejnego polecenia z abstraktu tłumaczy uczniom, jak można dokonać obliczeń z wykorzystaniem proporcji. W odniesieniu do następnego polecenia prosi chętnego o dokonanie obliczeń tego zadania.
6. Prowadzący zajęcia prosi o wykonanie ćwiczenia interaktywnego (praca indywidualna).

Faza podsumowująca

1. Nauczyciel prosi uczniów o rozwinięcie zdań:
    - Dziś nauczyłem się…
    - Zrozumiałem, że…
    - Zaskoczyło mnie…
    - Dowiedziałem się…

   W celu przeprowadzenia podsumowania może posłużyć się tablicą interaktywną w abstrakcie lub polecić uczniom pracę z nią

Praca domowa

1. Odsłuchaj w domu nagrania abstraktu. Zwróć uwagę na wymowę, akcent i intonację. Naucz się prawidłowo wymawiać poznane na lekcji słówka.
2. Wykonaj w domu notatkę z lekcji metodą sketchnotingu.

W tej lekcji zostaną użyte m.in. następujące pojęcia oraz nagrania

Pojęcia

> **percent concentration of the solution**
>
> Nagranie dostępne na portalu epodreczniki.pl
>
> Nagranie słówka percent concentration of the solution.
>
> ---
>
> **stężenie procentowe roztworu** – liczba gramów substancji rozpuszczonej w 100 g roztworu (wyrażona w procentach)

Teksty i nagrania

Nagranie dostępne na portalu epodreczniki.pl

Nagranie dźwiękowe abstraktu.

Percent concentration of the solution - definition

The terms „concentrated solution", „diluted solution" or „saturated solution" only indicate the amount of the given solute is in solution. Sometimes it is necessary to provide its exact content. There are several ways to present the composition of the solution, i.e. its concentration.

One of them is percent concentration. It determines how many parts of the mass (in weight) of dissolved substance is found in 100 parts of the mass (in weight) of **solution**. A 5% means that there are 5 grams of solute in 100 grams of solution.

The percent concentration can be calculated using the formula: $C_p = \frac{m_s}{m_r} \cdot 100\%$

Where following symbols mean:
C_p – percent concentration,
m_s – mass of the substance,
m_r – mass of the solution.

Recall that the mass of the aqueous solution (m_r) is the sum of the mass of the solvent ($m_{solv.}$), usually water and mass of the solute (m_s):

$m_r = m_{solv.} + m_s$

If we know the mass of the solvent or the mass of the solution and the mass of the dissolved substance, we can determine the percent concentration of the solution. In all calculations we must remember about the mass units that we always insert into the formula.

Knowing the percent concentration of the solution and its mass, the mass of solute can be calculated. Similarly, we can determine the mass of the solution based on the information on the percent concentration of the solution and the mass of the dissolved substance contained in it. Both right proportion and appropriately converted formula for the percent concentration can be used in the calculations.

c_p – percent concentration
m_s – mass of substance
m_r – mass of solution

- Percent concentration is the information about how many parts of the mass (in weight) of the dissolved substance are found in 100 parts of the mass (in weight) of the solution.
- The percent concentration of a solution can be calculated based on the weight of the solution and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_r} \cdot 100\%$.
- The mass of solute can be calculated based on the percent concentration and mass of the solution: $m_s = \frac{c_p \cdot m_r}{100\%}$.
- The percent concentration of the solution can be calculated based on the weight of the solvent and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_{solv.} + m_s} \cdot 100\%$.
- If the density of the solution is known, it is possible to determine the mass of given volume.

Lesson plan (English)

Topic: Percent concentration of the solution - definition

Target group

Elementary school student (grades 7. and 8.)

Core curriculum:

Elementary school. Chemistry.

V. Water and aqueous solutions. Student:

7) performs calculations using the following notions: solubility, percent concentration (mass percentage), mass of substance, solvent mass, mass of solution, solution density (using solubility table or solubility plot).

General aim of education

The student interprets the percentage concentration of the solution

Key competences

- communication in the mother tongue;
- communication in foreign languages;
- mathematical competence and basic competences in science and technology;
- digital competence;
- learning to learn.

Criteria for success
The student will learn:

- to calculate the percentage concentration of a solution based on its mass or mass of solvent and mass of solute;
- to estimate the mass of the solution based on the percentage of solution and the mass of solute;
- to determine the mass of solute based on the percentage and mass of the solution.

Methods/techniques

- **activating**
    - discussion.
- **expository**
    - talk.

- **exposing**
    - film.
- **programmed**
    - with computer;
    - with e-textbook.
- **practical**
    - exercices concerned.

Forms of work

- individual activity;
- activity in pairs;
- activity in groups;
- collective activity.

Teaching aids

- e-textbook;
- notebook and crayons/felt-tip pens;
- projector;
- interactive whiteboard, tablets/computers;
- methodician or green, yellow and red cards.

Lesson plan overview

Introduction

1. The teacher hands out Methodology Guide or green, yellow and red sheets of paper to the students to be used during the work based on a traffic light technique. He presents the aims of the lesson in the student's language on a multimedia presentation and discusses the criteria of success (aims of the lesson and success criteria can be send to students via e-mail or posted on Facebook, so that students will be able to manage their portfolio).
2. The teacher together with the students determines the topic – based on the previously presented lesson aims – and then writes it on the interactive whiteboard/blackboard. Students write the topic in the notebook.
3. Health and safety – before starting the experiments, students familiarise themselves with the safety data sheets of the substances that will be used during the lesson. The teacher points out the need to be careful when working with them.

Realization

1. The teacher, introducing students to the problem of the percentage concentration of the solution, gives some examples of its significance, referring to the industry. It informs that in chemical laboratories and in everyday life, solutions with a certain content of

substances in their given amount, i.e. known concentration, are used. One of the ways of expressing concentration of solutions is the percentage concentration.
2. The lecturer displays an illustration of „Every day we meet the articles on which the contents of their ingredients have been provided" from the abstract and analyzes it, interpreting the descriptions.
3. The teacher displays the presentation „How to understand the percentage concentration of the solution?" From the abstract. After projection, he introduces the formula for the percentage concentration of the solution and on the basis of it defines the percentage concentration of the solution - the students write the information in the notebooks. Then he presents the table „Interpretation of a 4-g solution with 100g weight" on the multimedia board and analyzes it on the forum.
4. The teacher, referring to the calculation of the percentage of the solution, refers the students to the abstract and asks them to view and analyze the instructions for calculating the percentage concentration by definition and using the proportion. He asks a willing student to solve the task on the board.
5. The teacher informs students that knowing the percentage concentration of the solution and its mass, it is possible to calculate the mass of solute. Similarly, the mass of the solution can be determined based on the information on the percentage concentration of the solution and the mass of dissolved substance contained in it. The calculation uses both the appropriate proportion and the converted formula for the percentage concentration. On the basis of the next abstract command, the teacher explains to the students how to make calculations using the proportions. With regard to the next command, he asks you to make calculations of this task.
6. The lecturer asks you to do an interactive exercise (individual work).

Summary

1. The teacher asks the students to finish the following sentences:
    - Today I learned ...
    - I understood that ...
    - It surprised me ...
    - I found out ...

    The teacher can use the interactive whiteboard in the abstract or instruct students to work with it

Homework

1. Listen to the abstract recording at home. Pay attention to pronunciation, accent and intonation. Learn to pronounce the words learned during the lesson.
2. Make at home a note from the lesson using the sketchnoting method.

The following terms and recordings will be used during this lesson

Terms

percent concentration of the solution

Nagranie dostępne na portalu epodreczniki.pl

Nagranie słówka percent concentration of the solution.

---

stężenie procentowe roztworu – liczba gramów substancji rozpuszczonej w 100 g roztworu (wyrażona w procentach)

Texts and recordings

Nagranie dostępne na portalu epodreczniki.pl

Nagranie dźwiękowe abstraktu.

Percent concentration of the solution - definition

The terms „concentrated solution", „diluted solution" or „saturated solution" only indicate the amount of the given solute is in solution. Sometimes it is necessary to provide its exact content. There are several ways to present the composition of the solution, i.e. its concentration.

One of them is percent concentration. It determines how many parts of the mass (in weight) of dissolved substance is found in 100 parts of the mass (in weight) of **solution**. A 5% means that there are 5 grams of solute in 100 grams of solution.

The percent concentration can be calculated using the formula: $C_p = \frac{m_s}{m_r} \cdot 100\%$

Where following symbols mean:
C_p – percent concentration,
m_s – mass of the substance,
m_r – mass of the solution.

Recall that the mass of the aqueous solution (m_r) is the sum of the mass of the solvent ($m_{solv.}$), usually water and mass of the solute (m_s):

$m_r = m_{solv.} + m_s$

If we know the mass of the solvent or the mass of the solution and the mass of the dissolved substance, we can determine the percent concentration of the solution. In all calculations we must remember about the mass units that we always insert into the formula.

Knowing the percent concentration of the solution and its mass, the mass of solute can be calculated. Similarly, we can determine the mass of the solution based on the information on the percent concentration of the solution and the mass of the dissolved substance contained in it. Both right proportion and appropriately converted formula for the percent concentration can be used in the calculations.

c_p – percent concentration
m_s – mass of substance
m_r – mass of solution

- Percent concentration is the information about how many parts of the mass (in weight) of the dissolved substance are found in 100 parts of the mass (in weight) of the solution.
- The percent concentration of a solution can be calculated based on the weight of the solution and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_r} \cdot 100\%$.
- The mass of solute can be calculated based on the percent concentration and mass of the solution: $m_s = \frac{c_p \cdot m_r}{100\%}$.
- The percent concentration of the solution can be calculated based on the weight of the solvent and the weight of the solute, using the formula: $c_p = \frac{m_s}{m_{solv.} + m_s} \cdot 100\%$.
- If the density of the solution is known, it is possible to determine the mass of given volume.