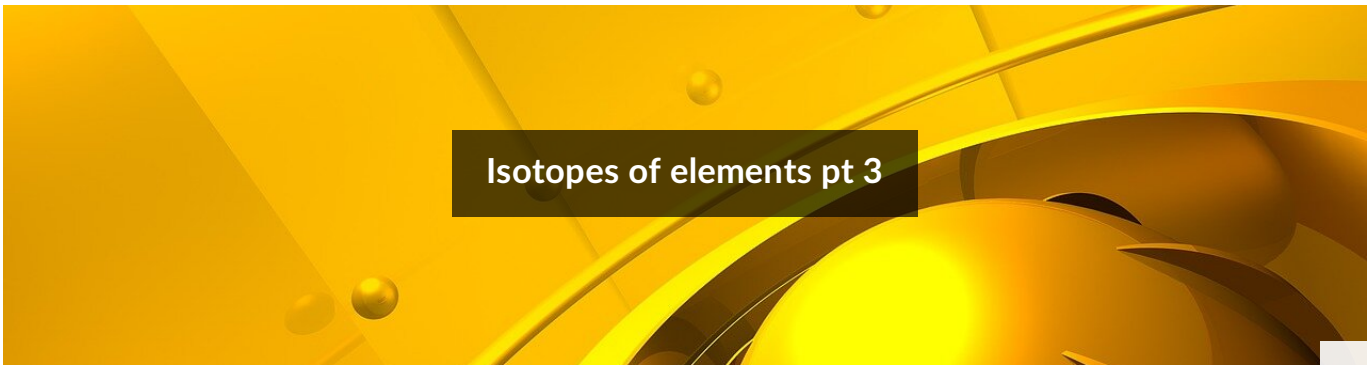
Isotopes of elements pt 3

- Isotopes of elements pt 3
- Lesson plan (Polish)
- Lesson plan (English)



Link to the lesson

> **Before you start you should know**
>
> - what isotopes are;
> - how to describe isotopes using symbols;
> - how atomic structure of isotopes of hydrogen and potassium differ from each other.

> **You will learn**
>
> - to calculate mass of an isotope;
> - to calculate average mass of a chemical element.

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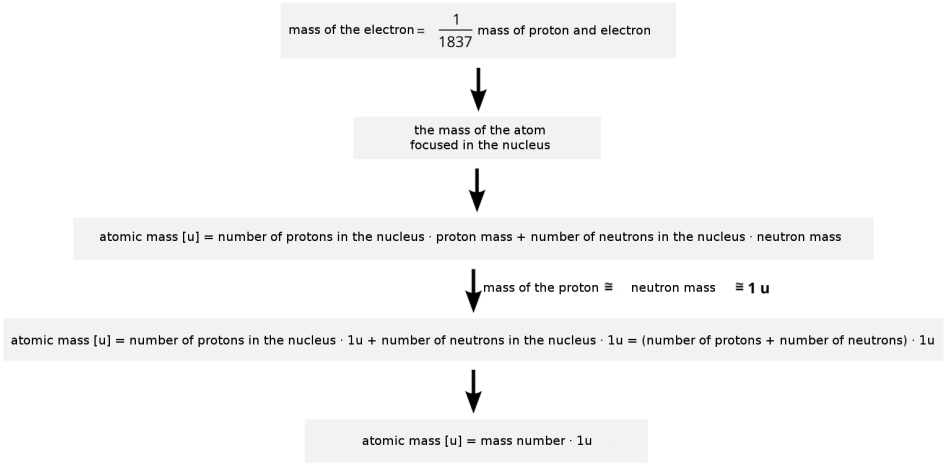
Nagranie abstraktu

Masses of isotopes

Due to the huge differences between the mass of the electron and the mass of nucleons (proton and neutron), atomic mass is determined primarily by the number of its protons and neutrons. Nearly all atomic mass in concentrated in its nucleus.

Name	Symbol	Mass [u]
electron	e (e^-)	$\frac{1}{1837}$
proton	p (p^+)	1
neutron	n (n)	1

Mass of a proton is approximately equal to mass of a neutron and amounts to 1 u (1 u = $1.66 \cdot 10^{-24}$ g). That is why its atomic mass expressed in units will be approximately equal to the number of nucleons in its atomic nucleus. It may be assumed that total mass of protons and neutrons, i.e. mass number, is numerically equal to the atomic mass expressed in atomic mass units [u]. There is a slight difference due to the mass deficit resulting from the difference between the sum of masses of individual components of the atomic nucleus and the resting mass of the nucleus as a whole. Therefore, part of the mass of the atomic nucleus components is converted into energy that binds nucleons in the atomic nucleus.



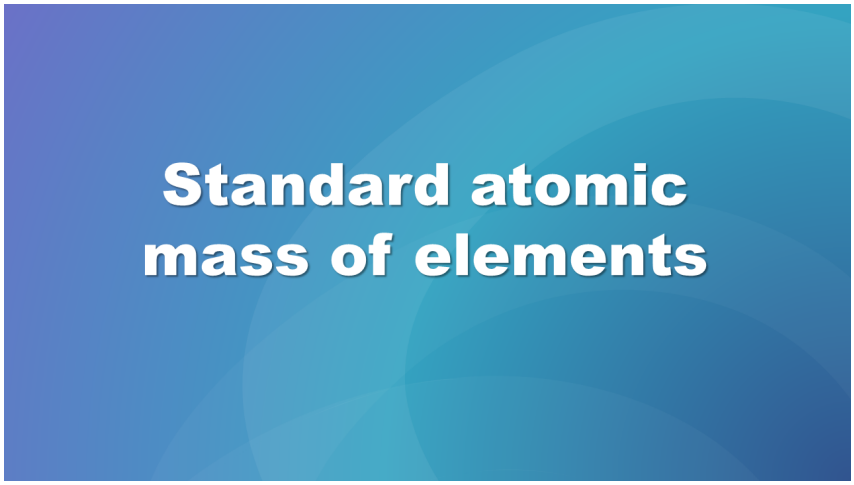
Using all the information provided above and a formula (atomic weight [u] = mass number . 1 u), it can be easily calculated that atomic weight of protium amounts to 1 u, atomic weight of deuterium is 2 u, and the one of tritium is equal to 3 u. The equation should include the so-called mass deficit, which is the difference between the sum of masses of individual components of the atomic nucleus and the resting mass of the nucleus as a whole. Therefore, part of the mass of the atomic nucleus components is converted into energy that binds nucleons in the atomic nucleus.

Using all the information provided above and a formula (atomic weight [u] = mass number · 1 u), it can be easily calculated that atomic weight of protium (^{1}H) amounts to 1 u, atomic weight of deuterium (^{2}H) is 2 u, and the one of tritium (^{3}H) is equal to 3 u.

The average atomic weight of elements

Task 1

Watch presentation “Standard atomic weight of elements”. Note how to calculate average atomic weight of an element.



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Nagranie abstraktu

The atomic weight stated in the periodic table is averaged. That is why fractional values are often assumed. It was taken into account that chemical elements consist of isotopes and each isotope has its share in atomic weight of given element.

Similarly, if you try to determine the average weight of students in the classroom based on information that 5% weigh 40 kg, 15% weigh 60 kg and others, i.e. 80% of students, weigh 50 kg. The average weight of all students would amount to 51 kg:

$$\frac{5\% \cdot 40\text{kg} + 15\% \cdot 60\text{kg} + 80\% \cdot 50\,\text{kg}}{100\%} = 51\,\text{kg}$$

The result would be 51 kg although no student weighs 51 kg.
Similarly with chemical elements – the isotopic composition (percentage composition) of each of them is taken into account while calculating their average atomic masses. The following formula can be used to calculate average atomic mass of elements:

$$\text{average atomic mass of an element} = \frac{\text{mass of an isotope}_1 \cdot \text{X}_1\% + \text{mass of an isotope}_2 \cdot \text{X}_2\% + \ldots + \text{mass of an isotope}_\text{n} \cdot \text{X}_\text{n}\%}{100\%}$$

where:
X% – percentage content of an isotope.

Using the above formula you can calculate average atomic mass of hydrogen:

$$\text{average atomic mass of hydrogen} = \frac{\text{mass of an isotope } {}^1\text{H} \cdot \text{percentage content of an isotope } {}^1\text{H} + \text{mass of an isotope } {}^2\text{H} \cdot \text{percentage content of an isotope } {}^2\text{H}}{100\%}$$

$$\frac{1{,}00782503207(10)\ \text{u} \cdot 99.985\% + 2{,}01410177785(36)\ \text{u} \cdot 0.015\%}{100\%} = 1.008\ \text{u}$$

Exercise 1

Standard atomic mass of an element is:

- weighted average of atomic weights of isotopes, resulting from the percentage of individual isotopes in a natural mixture
- arithmetic mean
- average mass of isotopes

Answer the questions and then turn the flashcard over, clicking on it, and check if your answer is correct.

What determines the atomic weight?	Number of protons and neutrons that are in it
Where is most of atomic mass concentrated?	In its nucleus
How is atomic weight expressed?	In atomic mass units, i.e. units [u]
What is taken into account while calculating average atomic mass of an element?	Its isotopes, each of which has its share in the atomic mass of a given element
How many forms of potassium elements are there in nature?	Three isotopes
What is standard atomic mass of an element?	It is weighted average of atomic weights of isotopes, resulting from the percentage of individual isotopes in a natural mixture

Summary

- Isotopes are atoms of the same chemical element that have the same number of protons and different number of neutrons.
- Most natural chemical elements are a mixture of isotopes with a constant composition.
- Atomic weight of a chemical element is an average atomic mass obtained after taking into account its isotopic composition.
- Mass of an isotope is numerically approximately equal to its mass number due to the mass deficit resulting from the difference between the sum of masses of individual components of the atomic nucleus and the resting mass of the nucleus as a whole. Therefore, part of the mass of the atomic nucleus components is converted into energy that binds nucleons in the atomic nucleus.

Keywords

isotope, atom, proton, neutron, atomic weight

Glossary

isotopes

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Nagranie dźwiękowe słówka

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izotopy – odmiany tego samego pierwiastka, które mają jednakową liczbę atomową (liczbę protonów w jądrze) i różną liczbę masową (liczbę neutronów w jądrze)

Lesson plan (Polish)

Temat: Izotopy pierwiastków cz. 3

Adresat

Uczeń szkoły podstawowej (klasy 7. i 8.)

Podstawa programowa

Szkoła podstawowa. Chemia.

I. Wewnętrzna budowa materii. Uczeń:

5) stosuje pojęcie masy atomowej (średnia masa atomów danego pierwiastka, z uwzględnieniem jego składu izotopowego).

Ogólny cel kształcenia

Uczeń oblicza standardową masę atomową danego pierwiastka.

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 masę izotopu;
- obliczać średnią masę pierwiastka chemicznego.

Metody/techniki kształcenia

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

Formy pracy

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

Środki dydaktyczne

- e-podręcznik;
- zeszyt i kredki lub pisaki;
- tablica interaktywna, tablety/komputery.

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.

Faza realizacyjna

1. Nauczyciel, nawiązując do poprzedniej lekcji, prosi wybranego ucznia, żeby zdefiniował pojęcie izotopu.
2. Praca w parach. Uczniowie otrzymują polecenie analizy tabeli dotyczącej masy cząstek wchodzących w skład atomu z abstraktu. Dyskutują na temat tego, dlaczego prawie cała masa atomu skupiona jest w jego jądrze, a następnie zapisują swoje wyjaśnienia. Wskazane pary omawiają swoje opracowania na forum klasy.
3. Uczestnicy zajęć zapoznają się z treścią przedstawioną na schemacie wyjaśniającym zagadnienie masy atomowej. Następnie nauczyciel omawia je z uczniami.
4. Uczniowie oglądają prezentację „Standardowa masa atomowa pierwiastków", prezentującą metodę obliczania średniej masy atomowej pierwiastka. Następnie wykonują na tablicy obliczenia z zadań omówionych w filmie.
5. Uczniowie, pracując indywidualnie lub w parach, wykonują ćwiczenia interaktywne sprawdzające i utrwalające wiadomości poznane w czasie lekcji. Wybrane osoby omawiają prawidłowe rozwiązania ćwiczeń interaktywnych. Prowadzący uzupełnia lub prostuje wypowiedzi podopiecznych.

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.

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

Pojęcia

> **isotopes**
>
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> ---
>
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Teksty i nagrania

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Similarly, if you try to determine the average weight of students in the classroom based on information that 5% weigh 40 kg, 15% weigh 60 kg and others, i.e. 80% of students, weigh 50 kg. The average weight of all students would amount to 51 kg:

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$\mathrm{X}\%$ – percentage content of an isotope.

Using the above formula you can calculate average atomic mass of hydrogen:

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Lesson plan (English)

Topic: Isotopes of elements pt 3

Target group

Elementary school student (grades 7. and 8.)

Core curriculum:

Elementary school. Chemistry.

I. Internal structure of matter. Pupil:
5) uses the concept of atomic mass (average mass of atoms of a given element, including its isotopic composition).

General aim of education

The student calculates the standard atomic mass of a given element.

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:

- calculate the mass of the isotope;
- calculate the average mass of a chemical element.

Methods/techniques

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

Forms of work

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

Teaching aids

- e-textbook;
- notebook and crayons/felt-tip pens;
- interactive whiteboard, tablets/computers.

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.

Realization

1. The teacher, referring to the previous lesson, asks the chosen student to define the concept of an isotope.
2. Work in pairs. Students are instructed to analyze the table on the mass of particles included in the atom from the abstract. They discuss the question of why almost the whole mass of the atom is concentrated in its nucleus, and then they write their explanations. The indicated couples discuss their studies on the class forum.
3. Participants will familiarize themselves with the content presented in the diagram explaining the issue of atomic mass. Then the teacher discusses them with the students.
4. Students watch the presentation „Standard atomic mass of elements", presenting the method of calculating the average atomic mass of the element. Then they perform on the board calculations of the tasks discussed in the film.
5. Students, working individually or in pairs, carry out interactive exercises to check and consolidate knowledge learned during the lesson. Selected people discuss the correct solutions for interactive exercises. The teacher completes or straightens the statements of the proteges.

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.

The following terms and recordings will be used during this lesson

Terms

> **isotopes**
>
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Texts and recordings

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