COVET

Continuing Professional Development in Vocational Education and Training

Connecting Direct-Current Sources

Inspiration for online teaching

In the COVET project, we have collected many great examples of teaching that have been transformed from the classic off-line version into a modern online learning method.

These sample lessons have been created by VET teachers from different EU countries. We present them to you as inspiration for your work.

The lessons are particularly suitable for vocational teachers, but can also serve as a training tool for teachers, trainers and lecturers in other educational settings.

All sample lessons, training materials as well as all information about the project are available at:
https://www.covet-project.eu/

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Connecting Direct-Current Sources

2nd year students of mechanic-tool setter apprenticeship programme

Off-line version of the preparation:

Goal: Students will learn how voltage and current change when connecting the sources of DC voltage in a circuit. This information will be presented to them using circuit diagrams and then they will be given exercises to practise their knowledge. The result of connecting sources with different voltages, typically the burning up of the sources, will be shown in a diagram and students will be made aware of the consequences of such connection.

Teaching methods: explanation, drawing up diagrams, calculating exercises, and other activities according to the classroom situation

Aids:

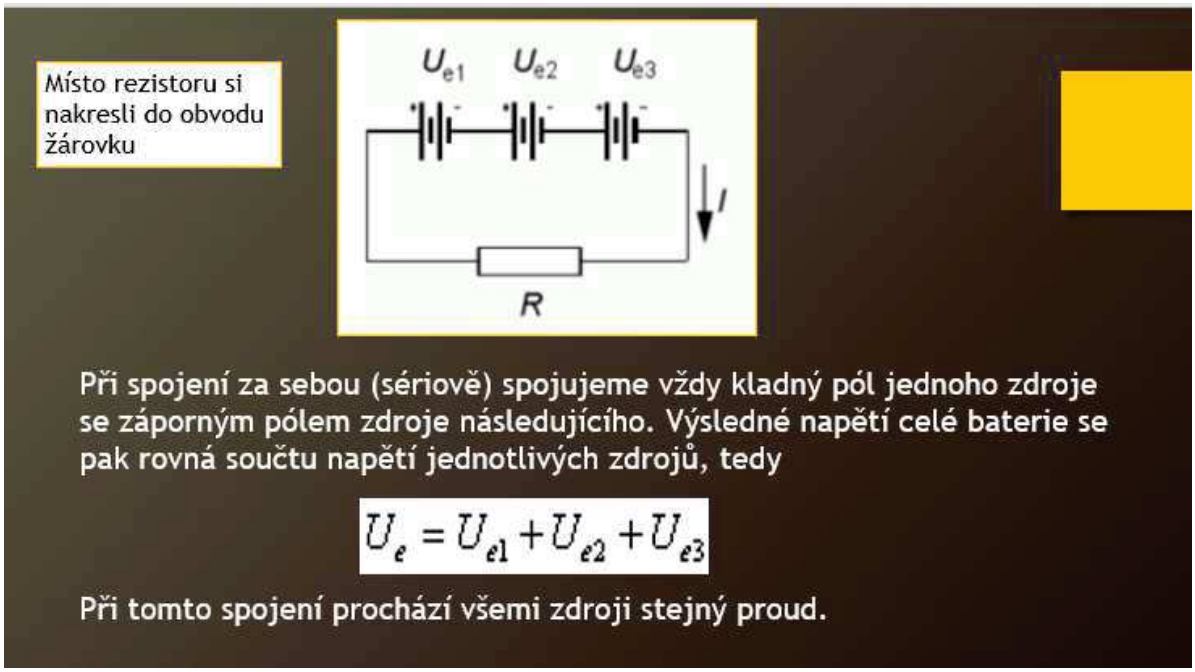
Presentation: diagrams and highlighted passages to remember, exercises with subsequent display of the correct solution

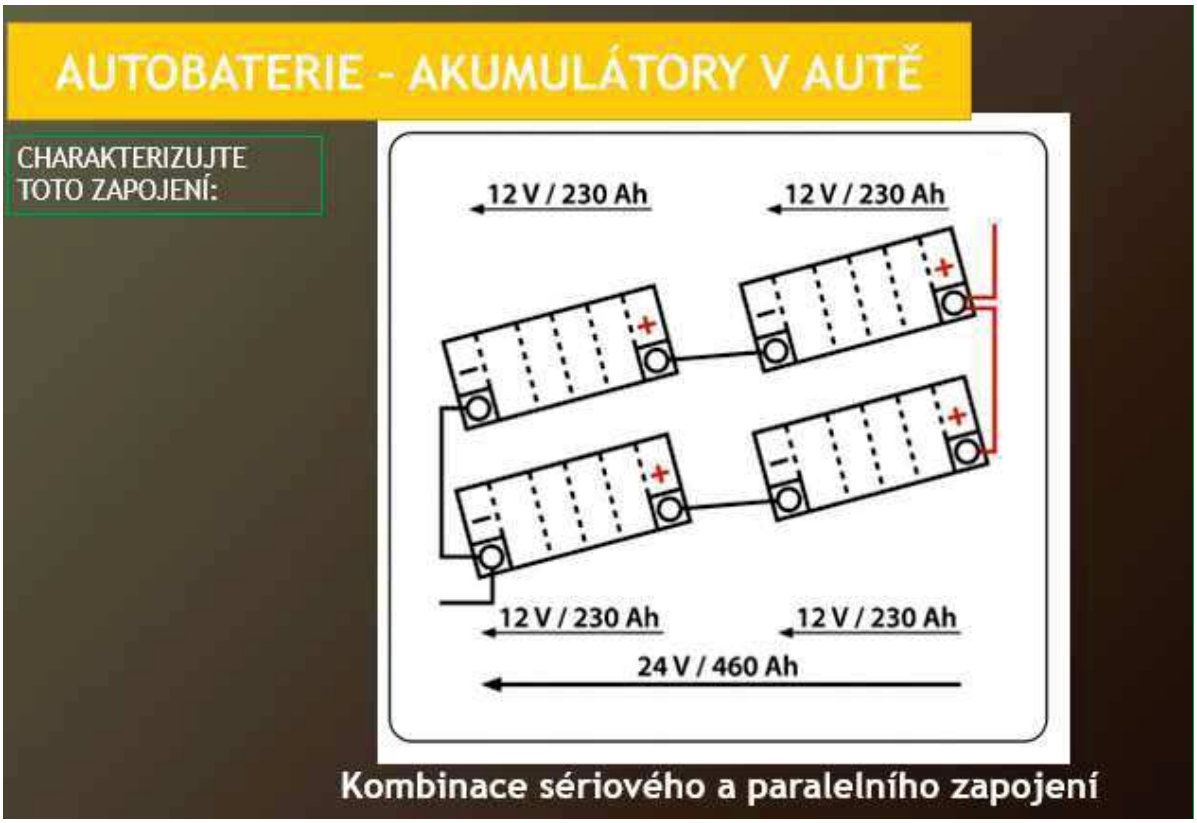
Learning sheets that summarize the content presented. To be handed out to the students once the lesson is over.

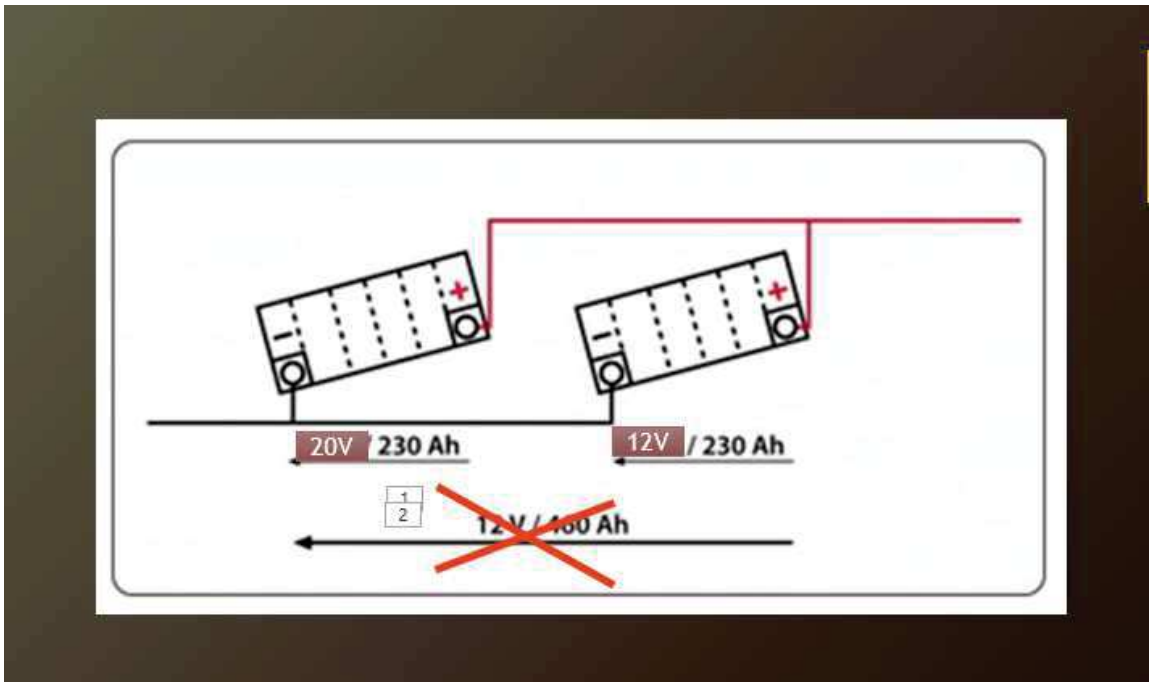
The course of activities in the lesson:

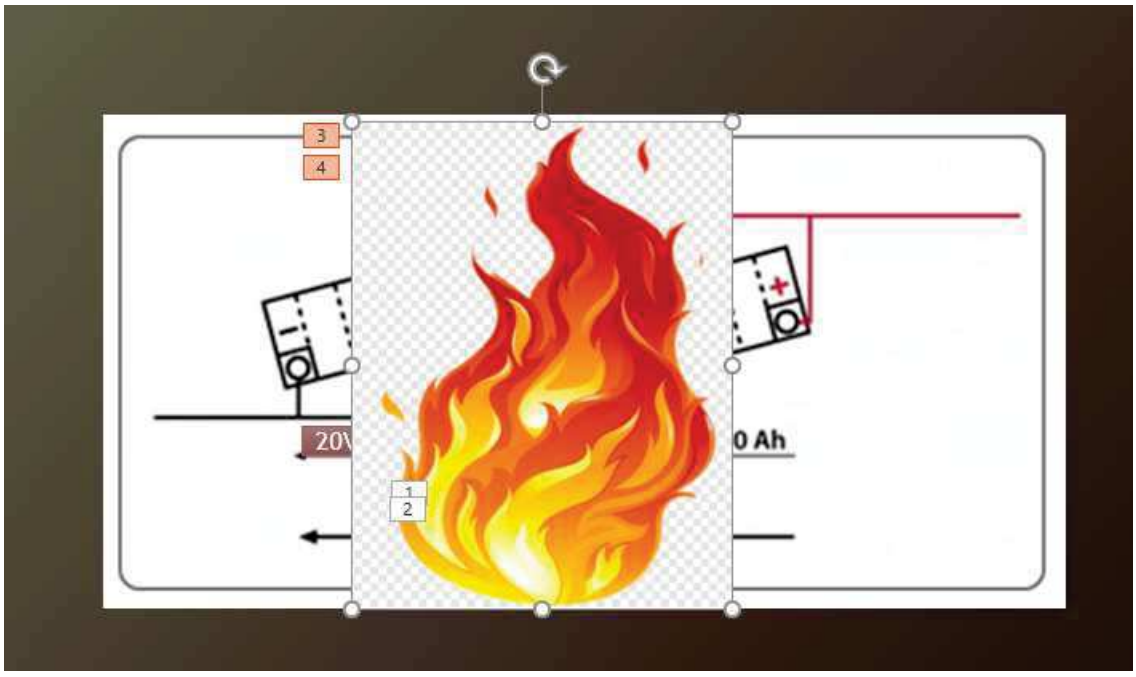
- Repeat the concept of DC voltage
- Repeat the concept of series and parallel circuits
- Repeat and draw the symbol for DC source, as part of the connection in an electrical circuit with bulb and switch
- Ask the students to connect another source in the diagram, first in parallel and then in series. They will write down the voltage value next to the each of sources – both sources will have the same voltage. Explain how the resulting current and voltage values in the circuit will change when another source of the same voltage is connected.
- Draw two sources in a circuit - but this time, of different voltages -> animation of the sources burning up
- Assign a task for the next lesson: a simple calculation for sources connected in parallel and in series
- Hand out learning sheets
- Discuss how the lesson went

A few slides from the PPT *presentation*:









Online version of the preparation

When at school, I did not have the tools to teach electricity in physics in such a way so that each student could independently work on their tasks of wiring basic components in electronics and draw their own conclusions.

Therefore, I was looking for a way to let the students at **least simulate** electronics research, so that they could **draw their own conclusions/findings** from the behaviour of electrical circuits and components. It is also important to try to get students to discuss their own conclusions with other classmates. Their findings derived from the simulated measurements of electric circuits are not

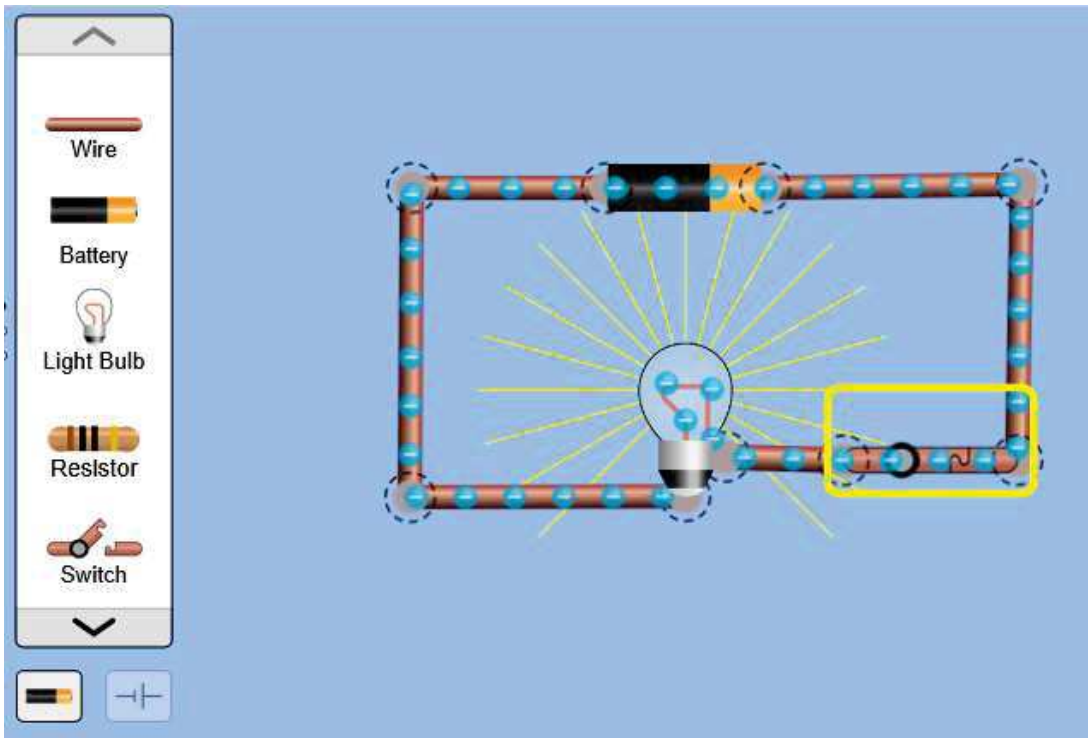
frequently correct and such discussions can lead to disputes or even rude accusations with my groups of students. It is therefore necessary to **set rules** and to monitor the discussion and compliance with such set rules. It is also difficult for the teacher to **guide the students' discussion using questions in such a way so that the students** reach the **correct conclusions in a given time slot of the lesson**.

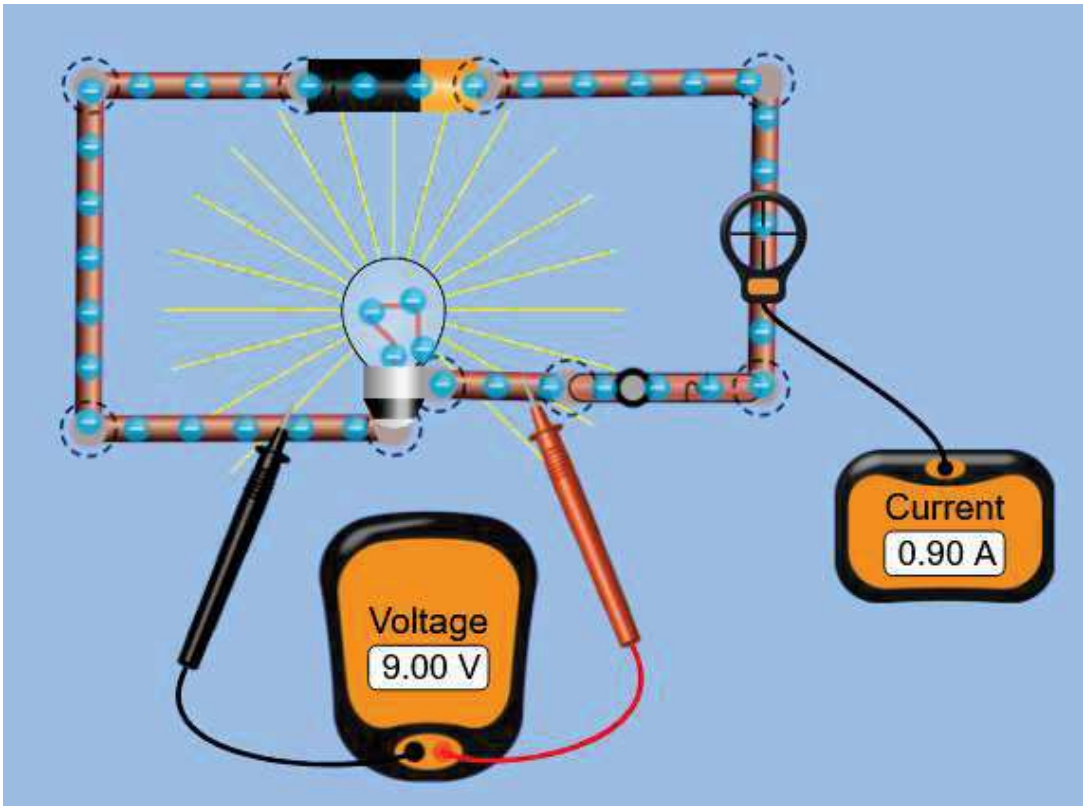
For the online version of this lesson, and nowadays when schools are not closed anymore, also for use in face-to-face teaching combined with online access to learning materials, the **simulation program** for simple electrical wiring is suitable for the above mentioned learning objectives. **circuit-construction-kit-dc.**

Students were assigned a research task to explore the topic by simulating the connection of sources in different variations. In doing so, they all had to **go through the previously learned** and correctly, one can even say **practically,** construct the circuit and connect the measuring instruments - voltmeter and ammeter. They processed the measured data into a table, which they each **designed themselves**, and then **drew conclusions** from them. Everyone **did** this part **at home at their own pace**, which was important in case of the very first task of working with a simulation program they were unfamiliar with. If everyone had done this in class at school, some would not have completed the task and their motivation and interest in the subject would have been significantly reduced. They all managed to set the connection in this way, thus learning how to use the simulation program. They also all managed to write down the measured quantities**. However, as far as the conclusions are concerned, each of them did that at a different level. It was the classroom discussion that helped** to either reinforce or correct their way of thinking about the problem. The students turned in the research paper via Teams and I was then able to make excerpts from their work and their conclusions and submit them anonymously for discussion.

- I drew up a research sheet
- In the sheet, I formulated tasks for the students and sent it out
- I sent the students a link to the above-mentioned simulation program
- I explained how to use the simulation program. I was available for consultations if necessary
- After they submitted their research sheets in the Teams program, I went through them and made preparations to discuss the conclusions

Example of a simple circuit:





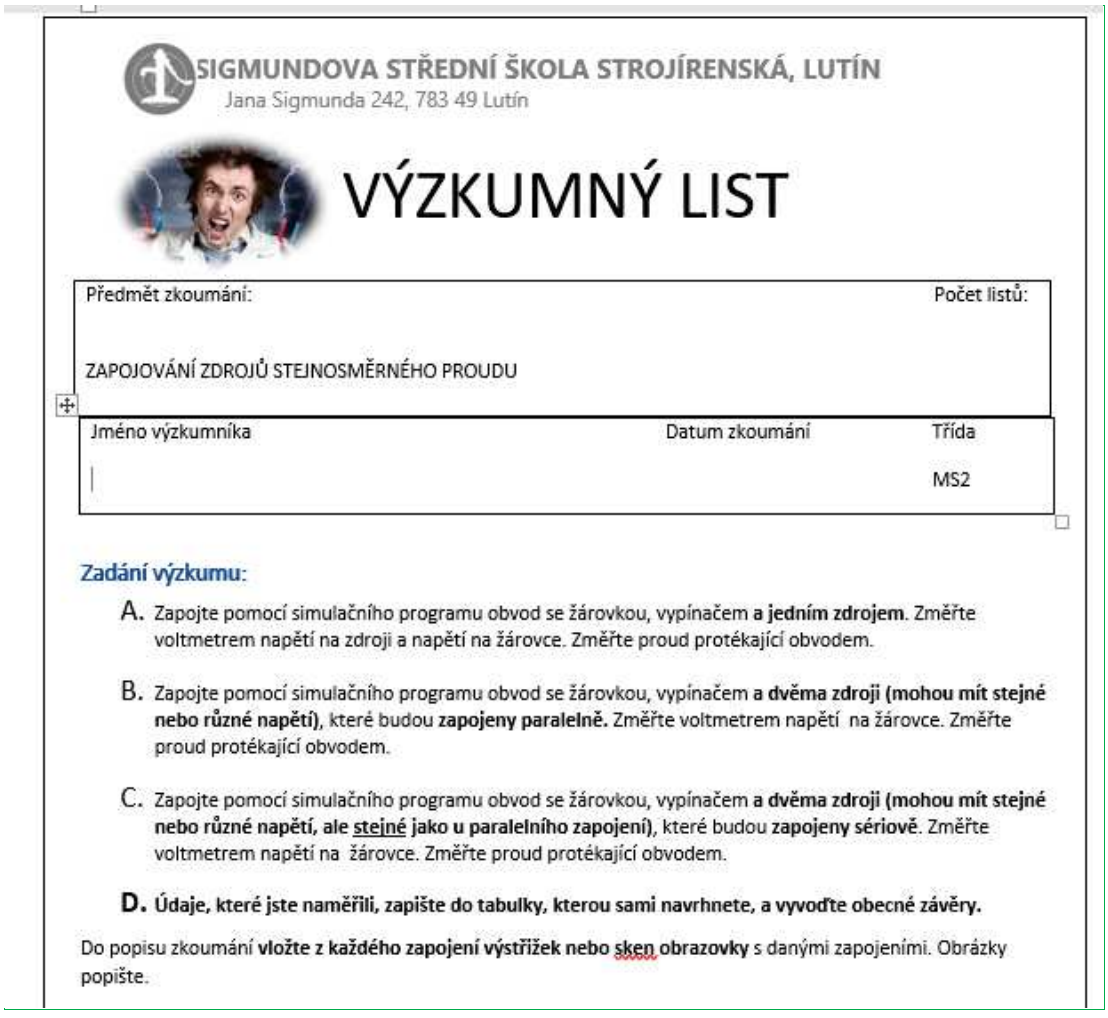
It will only take the students a couple of minutes to learn how to use the programme.

The course of activities therefore changed as follows:

- Through the Teams, the students received a link to the simulation program;

- Also through Teams, they received a research task - sheet: CONNECTING DIRECT-CURRENT SOURCES;
- It the lesson preceding the discussion lesson I introduced them to the simulation programme. It is very user-friendly, therefore the students managed to work with it in quite a short time and they were not afraid of failing when working on their own at home
- **Individual homework** – on their PCs, they constructed the circuits, made connections and measured current and voltage;
- **Individual homework** - they also did a simulation using sources of different voltages, to find out that the sources burned up;
- **Individual homework - t**hey wrote down their findings in the research sheets;
- We discussed the findings in the following meeting and some students managed to correct their wrong conclusions
- At the very end several students briefly summed up, in their own words, the key learnings gained while doing the simulations. Such summing up is very important for further work in the given field based on the previously learned**.**

A few examples of the students' research sheets - some wrong conclusions are shown as well (which were then corrected in the discussion):



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VÝZKUMNÝ LIST

Předmět zkoumání:	Počet listů:
ZAPOJOVÁNÍ ZDROJŮ STEJNOSMĚRNÉHO PROUDU	

Jméno výzkumníka	Datum zkoumání	Třída
		MS2

Zadání výzkumu:

A. Zapojte pomocí simulačního programu obvod se žárovkou, vypínačem **a jedním zdrojem**. Změřte voltmetrem napětí na zdroji a napětí na žárovce. Změřte proud protékající obvodem.

B. Zapojte pomocí simulačního programu obvod se žárovkou, vypínačem **a dvěma zdroji (mohou mít stejné nebo různé napětí)**, které budou **zapojeny paralelně.** Změřte voltmetrem napětí na žárovce. Změřte proud protékající obvodem.

C. Zapojte pomocí simulačního programu obvod se žárovkou, vypínačem **a dvěma zdroji (mohou mít stejné nebo různé napětí, ale stejné jako u paralelního zapojení)**, které budou **zapojeny sériově**. Změřte voltmetrem napětí na žárovce. Změřte proud protékající obvodem.

D. Údaje, které jste naměřili, zapište do tabulky, kterou sami navrhnete, a vyvoďte obecné závěry.

Do popisu zkoumání **vložte z každého zapojení výstřižek nebo sken obrazovky** s danými zapojeními. Obrázky popište.

Description of the Research

Table of Measurements:

Popis zkoumání

Tabulka naměřených hodnot:

Způsob zapojení	Napětí U (V)	Proud I (A)
Jeden zdroj	9V	0.9A
2 zdroje paralelní zapojení U1 je 9V U2 je 9V	9V	0.9A
2 zdroje paralelní zapojení U1 je 9V U2 je 3V	6V	0,6A
2 zdroje sériové zapojení U1 je9V U2 je 9V	18V	1.8A
2 zdroje sériově zapojené U1 je 9V U2 je 3V	12V	1.2A

Zapojení paralelní s rozdílným napětím ve zdrojích U1 je 9V a U2 je 3V při tomto zapojení dochází ke zkratu.

Feedback on the lesson

Whether done fully online or with the introduction and further discussion face-to-face, the simulation programme proved to be a great improvement. As the students were actually able to try and fail on their own, it stimulated their interest and confidence. I have seen a major improvement of results and involvement. It also contributed to greater success in the following lessons in the given field. Prior to the closure of schools we could not really make students work with a simulating programme from home, as some would not have the necessary PC equipment, however everyone managed to get the necessary equipment during the online learning.

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