A4 Combining batteries

Oh no! You want to watch some television, but the remote control isn't working. The batteries are dead.

You open the battery compartment to replace the batteries.

It looks similar to the battery holder you have used in the previous experiments! In the battery holder, you inserted three individual batteries and used them together like a single battery.



Figure 1: Remote control with the battery compartment opened.



Find out how you must connect the individual batteries together so that an incandescent lamp lights up just as brightly as with the battery holder.



Write down your ideas and guesses:

You need the following for the experiment:

- □ aluminum foil
- \Box 7 batteries
- □ 1 battery holder
- □ 2 cables with alligator clips
- electrical tape
- □ 2 incandescent lamps (3.5 volts)
- □ 2 incandescent lamps (6 volts)
- □ 2 incandescent lamp sockets



Figure 2: Required materials.



Lay out all the materials as shown in the photo. Prepare two circuits.

- 1. **Comparison circuit:** Build a simple circuit with the 3.5-volt lamp and the battery holder. This circuit will not change during the experiment.
- 2. **Experimentation circuit:** Build a simple circuit with the 3.5-volt lamp to the point where you need to connect it to the batteries.

Tips for the experimentation circuit:

- Press the alligator clamps firmly on the battery terminals to establish a connection between the lamp socket and the battery.
- How to connect the batteries to each other:
 - Always connect the positive pole of one battery to the negative pole of the next one.

This is a **series connection**.

- Put crumpled aluminum foil between the terminals of each pair of batteries. This prevents loose connections!
- Firmly connect the batteries together using electrical tape. Let your partner help you with this.



How to conduct the experiment:

- 1. In the experimentation circuit, connect the 3.5-volt lamp with one battery, then successively with two, three, and four batteries.
- 2. Compare the lamp's brightness with the comparison circuit after each step.
- 3. Enter your observations in the **"3.5-volt lamp"** column of the table. Tip: You will find a selection of terms above the table that you can choose from.
- 4. Install the 6-volt lamp in the comparison circuit.
- 5. Repeat the entire experiment with the 6-volt lamp and enter your observations in the **"6-volt lamp"** column.

Observe and write in the table:

How does the lamp shine compared to the lamp in the comparison circuit? more brightly – equally brightly – less brightly – much less brightly

Number of batteries	3.5-volt lamp	6-volt lamp
1		
2		
3		
4		



Evaluate your observations:

1. With two, three, and four batteries, the lamp shines more brightly than with one

battery because more ______ is available.

- 2. In your opinion, what will happen if you operate the lamp with five or even ten batteries connected in series?
- 3. Sketch a circuit diagram of four batteries connected in series.

Sketched circuit diagram:		



Doing further research:

1. Build a parallel circuit with two batteries. Tip: Use an interconnecting wire and adhesive film.



Figure 3: Parallel circuit with two batteries.

- 2. Connect an electric motor to the two batteries connected in parallel.
- 3. Connect the second electric motor to two batteries connected in series.
- 4. Which motor runs faster? Which runs longer?