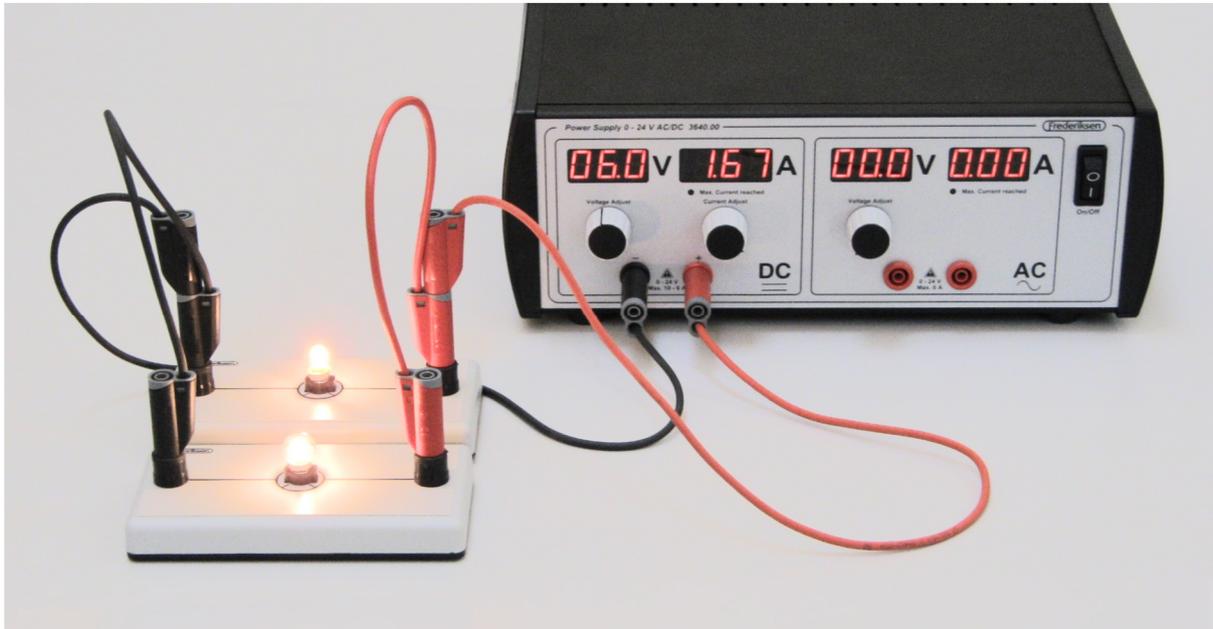


Experiment number	136010-EN	Topic	Electricity		
Version	2017-06-07 / HS	Type	Student exercise	Suggested for	grade 7-8 p. 1/4



## Objective

To examine voltage and current in circuits with simple combinations of bulbs (incandescent lamps).

## Principle

For one bulb alone – and for series and parallel connections of two bulbs – we find the voltage and current needed to make the bulbs light up normally.

The simplest setup uses a power supply with built-in voltmeter and ammeter. (Other types of power supply may be used if two separate instruments are added as shown below to the right.)

## Equipment

Two lamp sockets with safety sockets  
Two **identical** light bulbs; 6 V, 1 A<sup>1</sup>  
Safety cables

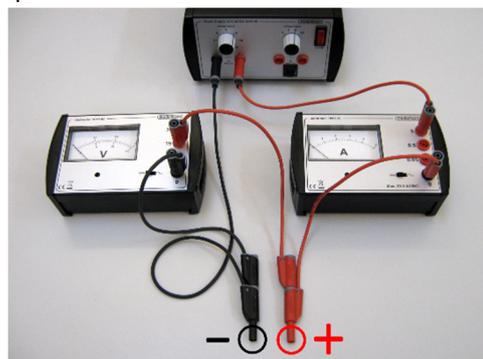
A power supply like 364000 or 363000 with built-in voltmeter and ammeter

- or -

A power supply plus external voltmeter and ammeter

## Using external instruments

If external instruments are used, connect them as shown below. The two plugs marked – and + will correspond to the power supply sockets on the rest of the photos in this manual.



<sup>1</sup> Light bulbs are made with rather loose specifications. The current consumption can vary quite a bit – which in itself doesn't matter. What is important in this

experiment is that the two bulbs are as **similar** as possible. (If necessary, swap with another team.)

## Procedure

The power supply consists of two sections: One for DC and one for AC. We will use DC here.

Before you start, turn the “Current Adjust” knob halfway up and leave it there.

Use the “Voltage adjust” knob for setting the voltage.

Write down all measurements!



### 1 – Measurements on a single bulb

Turn the voltage down every time you change the setup!

Hook up the circuit as shown on the picture.

Slowly and carefully turn up the voltage to 6.0 V.

Notice the brightness of the bulb.

Read the current through the bulb at the ammeter. Turn the voltage down again. Write down the current on a “Post-It” and place it on the lamp socket to identify it later.

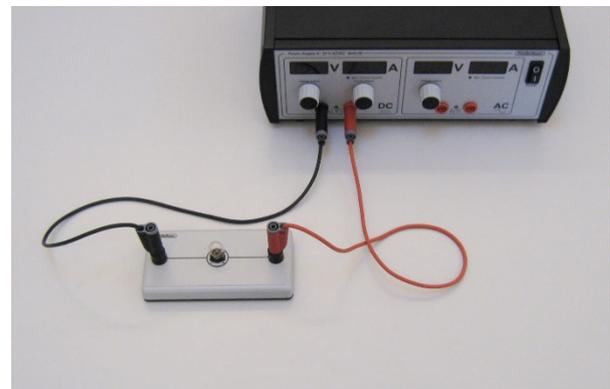
Swap the bulbs around to measure the other one.

Slowly and carefully turn up the voltage to 6.0 V.

Read the current, write it down again. Mark this bulb socket with a “Post-It” also.

If the two current readings are reasonably similar, you are ready to go on.

(If they are not, try to change one of the bulbs or swap with another team in your class. Repeat until you have two bulbs with almost identical current consumption.)



A single bulb

### 2 – Parallel connection

Remember to turn the voltage down every time you change the setup!

Hook up the circuit as shown on the picture.

Slowly and carefully turn up the voltage to 6.0 V.

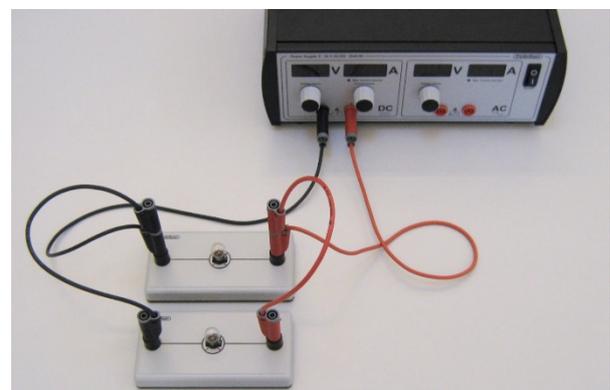
Notice the brightness of the bulbs.

Measure the current through the parallel connection (read the ammeter).

Now, adjust the voltage until the *current* in the parallel connection is approximately the same as the *current* through a single bulb was in part 1.

Notice the brightness of the bulbs.

Read the voltmeter.



Parallel connection

Finally, turn the voltage completely down.

### 3 – Series connection

Turn the voltage down every time you change the setup!

Hook up the circuit as shown on the picture.

Slowly and carefully turn up the voltage to 6.0 V.

Notice the brightness of the bulbs.

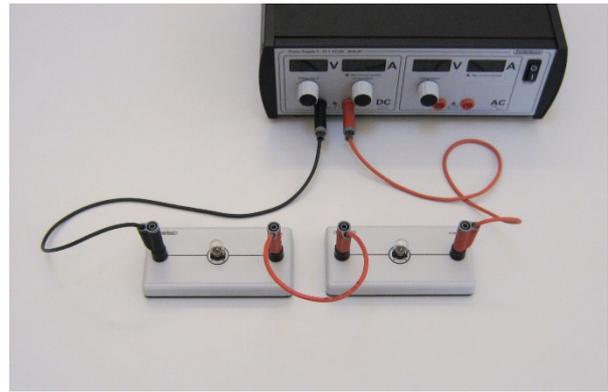
Measure the current through the series connection (read the ammeter).

Slowly and carefully turn up the voltage to 12.0 V.

Notice the brightness of the bulbs.

Measure the current through the series connection.

Finally, turn the voltage down again.



Series connection

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### Post-processing

If the bulbs in the parallel connection each must glow as bright as the single bulb did in part 1 – how large must the voltage and the current be in the parallel connection?

Compare these values with the voltage and current for the single bulb (part 1).

If the bulbs in the series connection each must glow as bright as the single bulb did in part 1 – how large must the voltage and the current be in the series connection?

Compare these values with the voltage and current for the single bulb (part 1).

Try to express a general rule for voltage and current when two identical bulbs are combined in a series or parallel connection.

What kind of connection used in practice in a house when several lights are to be switched on at once? Why?

## Teacher's notes

### Practical preparations

The small E10 bulbs can unfortunately vary markedly in current consumption – even within a single package of ten.

To achieve the smoothest exercise for the students, the teacher can choose to pair the bulbs in advance.

### Concepts used

Voltage  
Current

### Mathematical skills

(There are no formula involved in this exercise although the final questions may lead to a few calculations)

### About the equipment

The current limiter on a power supply as 354000 has many practical and useful applications but here it is only important to turn it sufficiently up to prevent it from interacting with the measurements. There must be enough current for the parallel connection.

Possible extension of the part with the series connection:

Let the students measure the voltage over each of the two bulbs separately.

The results can contribute to the final considerations about a general rule.

## Detailed equipment list

### Specifically for the experiment

412000 Lamp socket E10, 2 connectors (2 pcs.)  
425040 Light bulb 6 V, 1 A (pack of ten, 2 used)

### Standard lab equipment

364000 Power supply (or similar)  
105720 Safety cable 50 cm, black  
105721 Safety cable 50 cm, red  
105710 Safety cable 25cm, black  
105711 Safety cable 25cm, red

### Consumables

"Post-It" (small format) for labelling

### Alternative power supply

Other power supplies can be used with external instrumentation. Examples are mentioned below. More cables are needed.

361600 Power supply 12V AC/DC 3A  
361870 Power supply 0-24 V AC/DC 5A  
361055 Power supply 1-12 V/6 A (stepwise)  
361065 Power supply 2-24 V/5 A (stepwise)  
381560 Voltmeter  
381570 Ammeter  
(Other instruments may also be used)  
105721 Safety cable 50 cm, red (2 more)  
105740 Safety cable 100 cm, black