

Storage of the electric energy from a solar cell in a capacitor

Task and equipment

Information for teachers

Additional information

A capacitor is a passive electric component with the ability to store electrical charge and so the corresponding energy.

Notes on the set up and procedure

A capacitor functions in a similar way to an electrolytic capacitor. Care must therefore be taken to always connect a red connecting cable to the positive pole of the capacitor. Wrong polarity would lead to destruction of the dielectric and so also of the capacitor.

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Task and equipment

Task

How can solar energy be stored without using a rechargeable battery?

Try to store the energy produced by a solar battery in a capacitor.



Student's Sheet

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Equipment



Position No.	Material	Order No.	Quantity
1	Angled connector module, SB	05601-02	4
2	Interrupted connector module, SB	05601-04	1
3	On-off switch module, SB	05602-01	1
4	Motor with indicating disc, SB	05660-00	1
5	Junction module, SB	05601-10	2
6	Straight connector module, SB	05601-01	1
7	Connecting cord, 32 A, 250 mm, red	07360-01	1
8	Connecting cord, 32 A, 250 mm, blue	07360-04	1
9	Connecting cord, 32 A, 500 mm, red	07361-01	1
10	Connecting cord, 32 A, 500 mm, blue	07361-04	1
11	Solar battery, 4 cells, with cable and connectors	06752-20	1
12	Halogen lamp with reflector, 12V / 20W	05780-00	1
12	Mount for halogen lamp with reflector	05781-00	1
13	Support base, variable	02001-00	1
14	Digital stop watch, 24 h, 1/100 s & 1 s	24025-00	1
15	Measuring tape, l = 2 m	09936-00	1
16	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
17	Boss head	02043-00	1
18	Capacitor (gold cap), 1F, SB	05650-10	1
19	DMM with NiCr-Ni thermo couple	07122-00	1
20	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Set-up and procedure

Set-up

Fit the support rod vertically into the support base and fix the boss head to the upper end of the support rod (Fig. 1).



Mount the halogen lamp in the boss head and connect the lamp to the 12 V output of the switched-off power supply (Fig. 2).



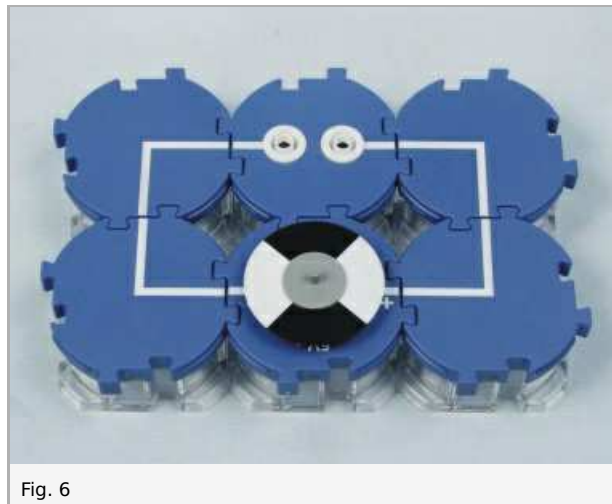
Lower the boss head holding the halogen lamp until the front edge of the halogen lamp is at a distance of about 15 cm from the surface below (Fig. 3).



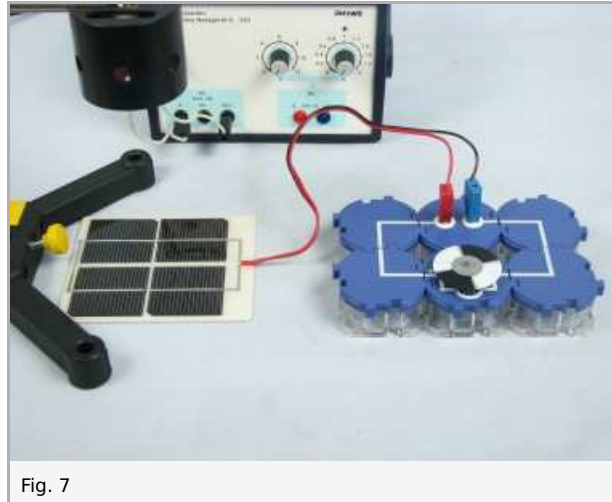
Lay the solar battery directly under the halogen lamp (Figs. 4 and 5).



Construct the circuit shown in Fig. 6.



Connect the solar battery to the circuit (Fig. 7).



Procedure

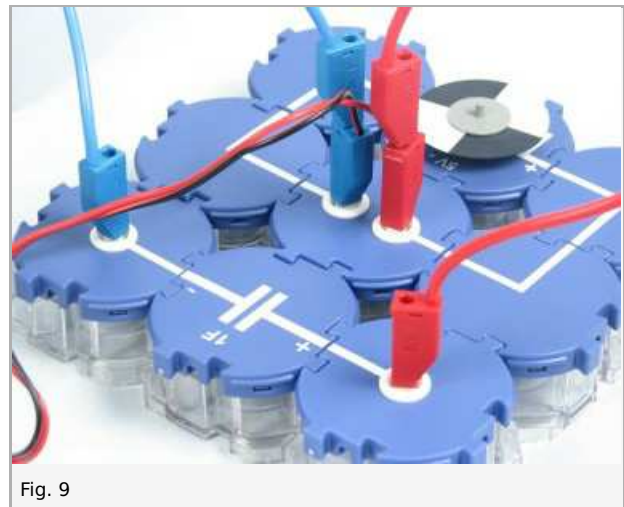
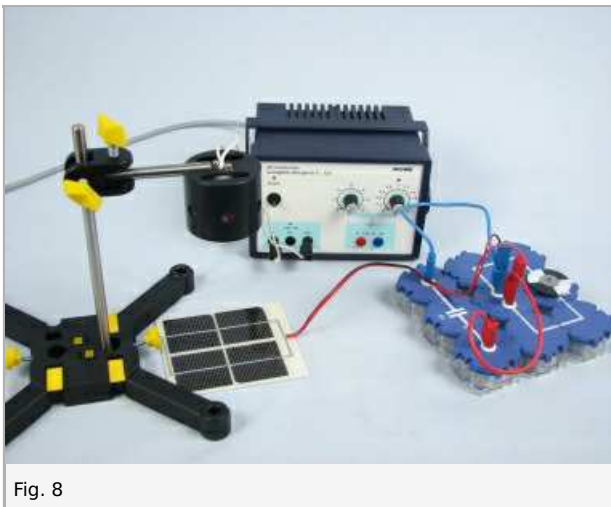
Part 1 of the experiment

Switch the halogen lamp on and simultaneously start the stop watch.

Watch the motor and switch the halogen lamp off after 1 minute.

Note what you observed with regard to the behaviour of the motor under Result - Observations 1.

Now additionally connect the capacitor to the solar battery (Fig. 8).



Switch the halogen lamp on and simultaneously start the stop watch.

Watch the motor and switch the halogen lamp off when the motor stops running.

Note what you observed with regard to the motor under Result - Observations 2.

Part 2 of the experiment

Construct the circuit shown in Fig. 10 and open the switch (Fig. 11).

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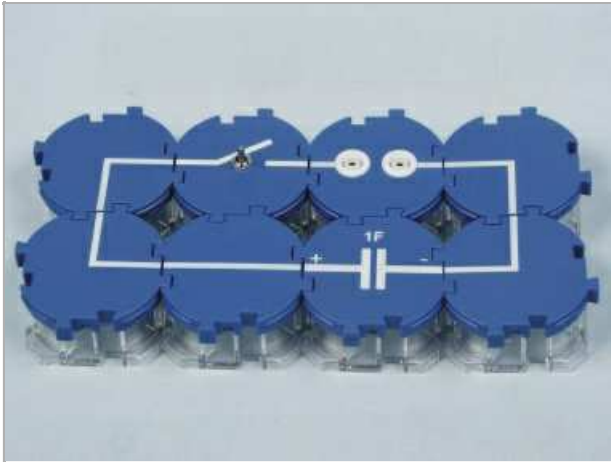


Fig. 10



Fig. 11

Connect the capacitor to the solar battery (Fig. 12).



Fig. 12

Switch the halogen lamp on.

Close the switch (Fig. 13) and simultaneously start the stop watch.



Fig. 13

Open the switch again after half a minute.

Remove the solar battery so that you can measure the voltage of the capacitor (Fig. 14).

Connect the multimeter (Fig. 15).

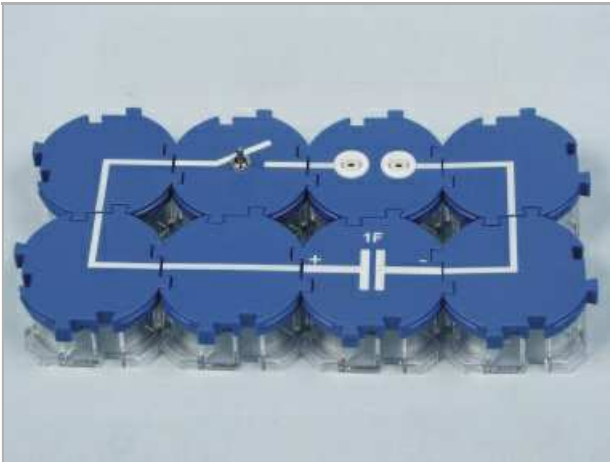


Fig. 14

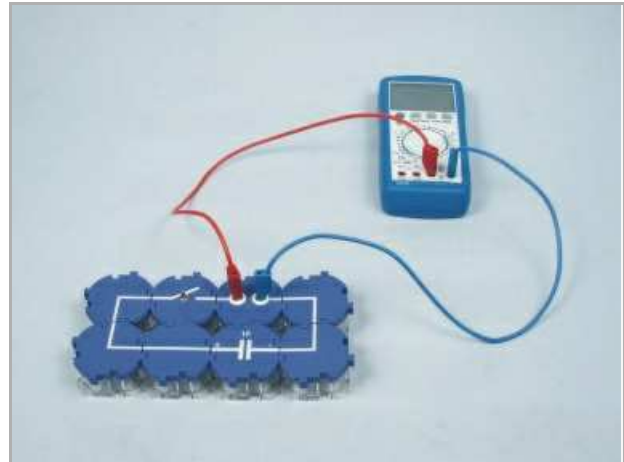


Fig. 15

Close the switch and note the voltage U (measurement range: 20 V-) in Table 1 in the report.

Open the switch. Replace the junction module by the motor (Fig. 16).

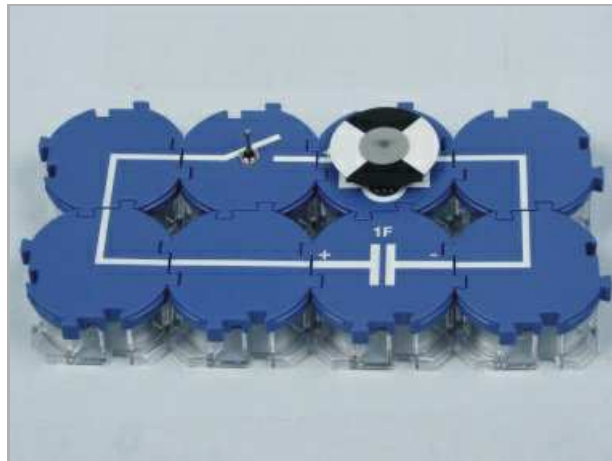


Fig. 16

Close the switch and simultaneously start the stop watch.

Watch the motor. Note the time T that it keeps running in Table 1.

Open the switch when it has stopped running.

Repeat this procedure with

- 1) $t = 1$ min
- 2) $t = 2$ min
- 3) $t = 3$ min

Note your results (running time T and voltage U) in Table 1.

After the last measurement:

Change the circuit and include the multimeter (Fig. 17).

Ensure that the positive pole of the capacitor is connected to the red socket (Fig. 18).

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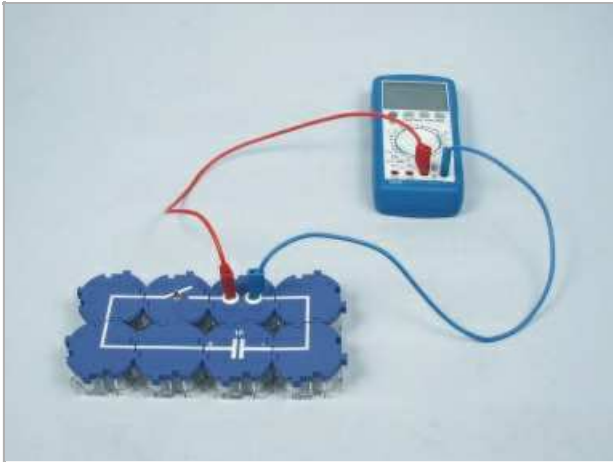


Fig. 17

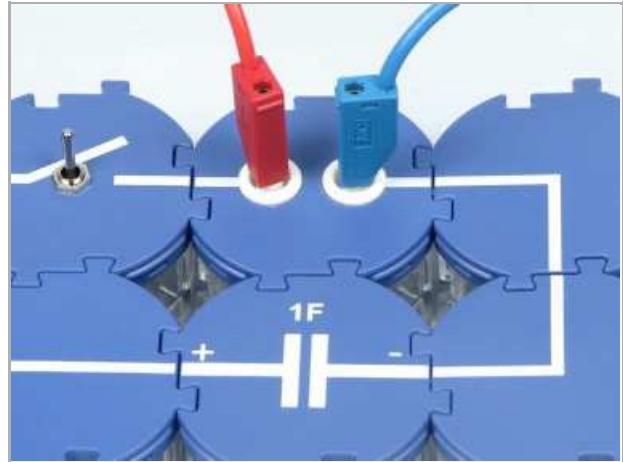


Fig. 18

Measure the voltage at the capacitor and note it in Table 1 under $t=0$.

Report: Storage of the electric energy from a solar cell in a capacitor

Result - Observations 1

How does the motor react when the halogen lamp is switched off?

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Result - Observations 2

How does the motor react when the halogen lamp is switched off?

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Result - Table 1

Record your measured values.

t in min	U in V	Running time T in s
0	1 ± 0	1 ± 0
0,5	1 ± 0	1 ± 0
1	1 ± 0	1 ± 0
2	1 ± 0	1 ± 0
3	1 ± 0	1 ± 0

Evaluation - Question 1

Compare the observations you made in the first part of the experiment. What was the function of the capacitor?

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Evaluation - Question 2

Explain the dependence between the charging time (t), the voltage of the capacitor (U) and the running time of the motor (T).

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Evaluation - Question 3

Why could the capacitor used in this experiment not be charged up to more than 2 V?

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