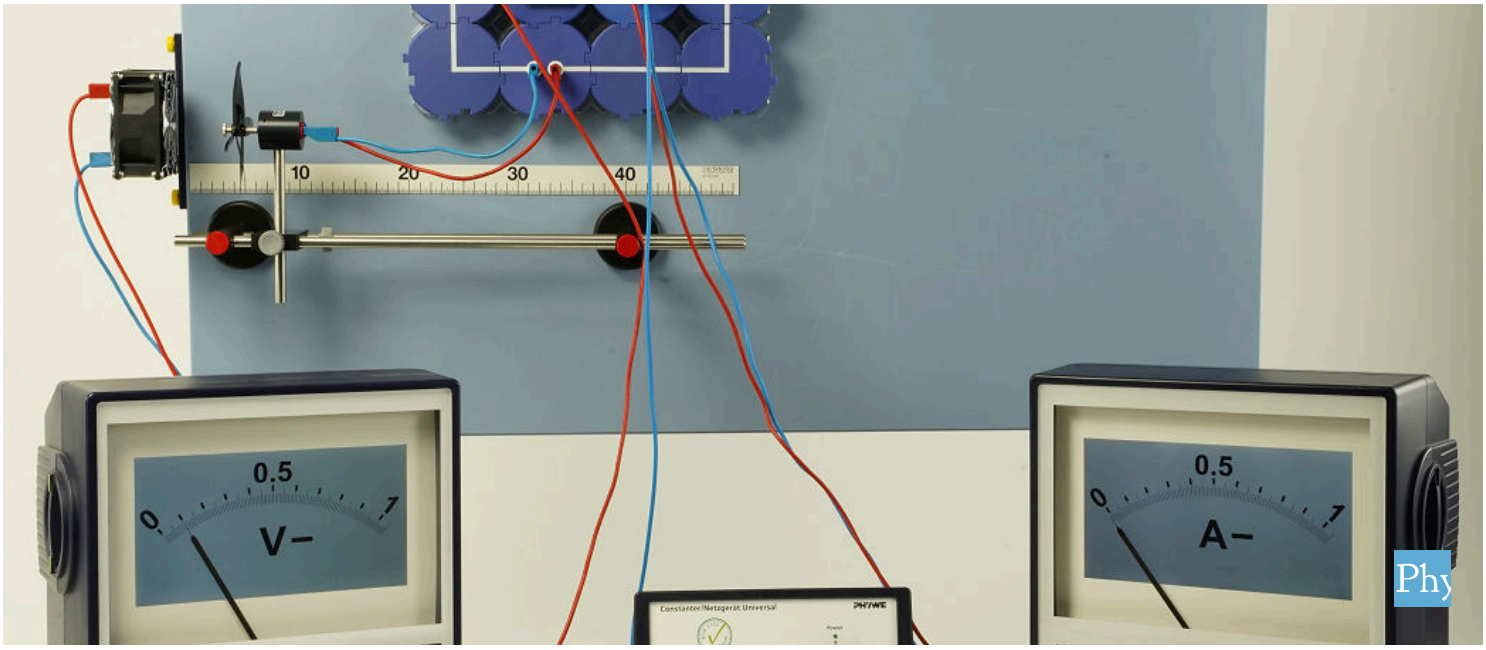
Storage of electrical energy from wind power using a battery with ADM3



Storage of electrical energy from wind energy with a rechargeable battery

Physics	Energy	Energy forms, conversion & conservation
Physics	Energy	Renewable energies: Wind
Physics	Energy	Energy storage

Difficulty level	Group size	Preparation time	Execution time
medium	1	10 minutes	20 minutes

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General information

Application

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Storage of electrical energy from

Wind energy with one battery

With renewable energy sources, improving storage options is very important. When the wind blows continuously, wind turbines store the energy in a battery.

Real wind turbines usually use a lead-acid battery, which has a similar efficiency to the Ni-MH battery used.

This experiment is intended to illustrate how electrical energy from a wind turbine can be stored so that it can be used at another time.

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Other information (1/2)

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Previous

The basics of measuring current and voltage as well as the determination of energy and power from these measurands should be known.

Principle

In an accumulator, electrical energy is converted into chemical energy and stored. The stored energy can then be converted back into the desired form.

This experiment also shows that losses cannot be avoided during conversion and storage.

Other information (2/2)

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Learning

Students recognize the relationship between energy released from a wind turbine for storage and later use.

Note

The blower may be operated with a maximum voltage of 12 V, otherwise the motor could be destroyed.

Pre-shift when handling the generator. Avoid reaching into the rotating rotor blades.

To improve the test results, it is necessary to condition the battery by charging and discharging it several times before the actual test. In the execution, a battery should be charged first, so that an empty battery should be taken.

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Safety instructions

The general instructions for safe experimentation in science lessons apply to this experiment.

For H- and P-phrases please refer to the safety data sheet of the respective chemical.

Theory

- The accumulator is a rechargeable element.
- During charging, electrical energy is converted into chemical energy in an accumulator.
- If a consumer is connected, the chemical energy is converted back into electrical energy.
- Each accumulator has a nominal voltage as a reference value or marking.

Experimental setup - Discharging the battery with a consumable

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	2
3	PHYWE Power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13504-93	1
4	Connector, straight, module DB	09401-01	1
5	Connector, angled, module DB	09401-02	4
6	Connector, T-shaped, module DB	09401-03	1
7	Connector interrupted, module DB	09401-04	3
8	Junction, module DB	09401-10	2
9	Socket for incandescent lamp E10 ,module DB	09404-00	1
10	Switch on/off, module DB	09402-01	1
11	Switch, change-over, module DB	09402-02	1
12	Battery holder module (AA type), SB	05606-00	1
13	Blower, 12V	05750-00	1
14	Generator with metrical thread axis and nut	05751-01	1
15	Rotor, 2 pieces	05752-01	1
16	Clamping holder with 2 clamping possibilit, 0-13 mm,fixing magnet	02151-08	2
17	Sliding mount for optical bench	02151-09	1
18	Support rod,stainl.steel, 100mm	02030-00	2
19	Clamp on holder	02164-00	1
20	Ni-MH accus, size AA, 1.3 Ah / 1.2V, 1 pair	07922-03	1
21	Filament lamps 1.5V/0.15A,E10,10 pieces	06150-03	1
22	Connecting cord, 32 A, 250 mm, blue	07360-04	1
23	Connecting cord, 32 A, 250 mm, yellow	07360-02	1
24	Connecting cord, 32 A, 500 mm, red	07361-01	2
25	Connecting cord, 32 A, 500 mm, blue	07361-04	2
26	Connecting cord, 32 A, 750 mm, red	07362-01	1
27	Connecting cord, 32 A, 750 mm, blue	07362-04	1

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Structure and implementation

Set-up (1/3)

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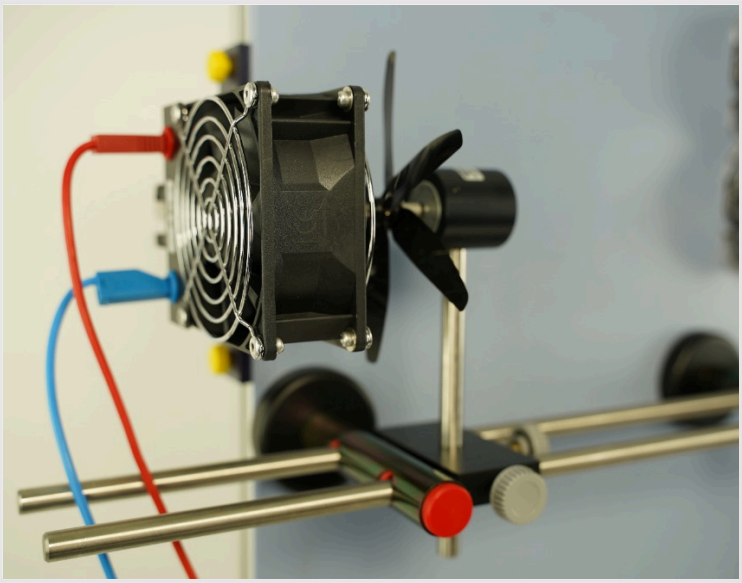

- Attach the blower with the bracket to the left side of the panel (see illustration).
- Align the blower so that it creates a horizontal wind stream along the panel.
- Set up a tripod bench for the windmill. Slide the glider onto the two stand rods and guide the rods through the two holes in the clamps.

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Set-up (2/3)

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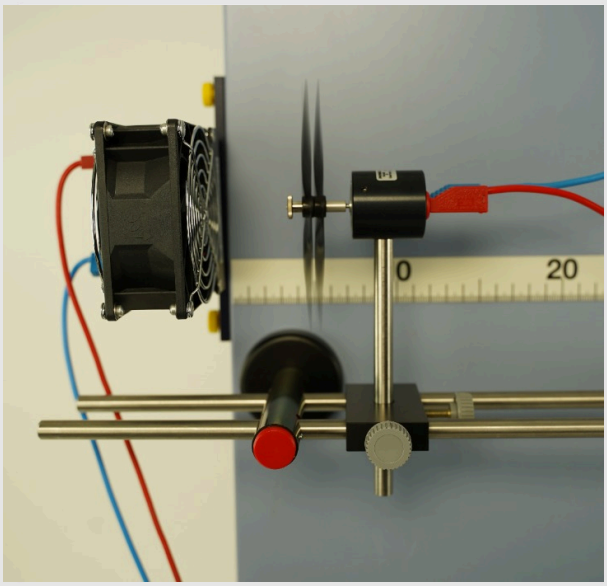

- Place the stand bench against the board and align it horizontally.
- Attach the 6 rotor blades to the wind generator. For a good result, point the matte side of the rotor blades away from the wind.
- Place the wind generator in the hole of the glider.

Set-up (3/3)

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- Set up the circuit according to the illustration, paying attention to the following:
- The polarity of the battery.
- The changeover switch closes the circuit with the incandescent lamp.
- The multimeters should be able to measure the voltage and current in both circuits.
- Connect the blower to the DC output of the power supply.

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Procedure (1/3)

- Set the voltage at the power supply unit to 12 V.
- Flip the switch and charge the battery.
- After 30 seconds, observe the readings and stop loading.
- Set the voltage at the power supply unit to 0 V.

Procedure (2/3)

- Adjust the measuring points in the circuit accordingly.
- Flip the switch and discharge the battery. The fan remains off.
- Observe the bulb and the readings.
- Note the time when the light bulb stops

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Procedure (3/3)

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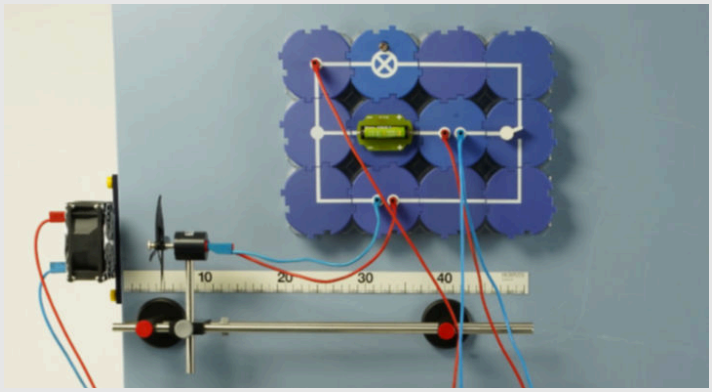
- Repeat the test with a battery charging time of 60 seconds and then also with 120 and 240 seconds.
- Transfer measured values to the table in the evaluation.



Evaluation (1/2)

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The following values have been determined:

	30s	60s	120s	240s
Loading time				
Lighting duration				

Fill in the missing words.

If the charging time is longer, the bulb will shine longer. However, the duration of the light bulb never reaches the length of the [ ].

Check

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Evaluation (2/2)

Drag the correct words into the gaps!

It can be clearly seen that the electrical work involved in _____ the battery is significantly less than that involved in _____ the battery. This is partly due to the _____ of the nickel-metal hydride accumulator, which is about 70%, and partly due to the fact that the incandescent lamp emits most of its energy in the form of _____ and a smaller part in the form of _____. Further, it can be seen that the incandescent lamp requires as much _____ to light as the wind turbine supplied.

charging
efficiency
light
discharging
power
heat

Check

Slide	Score / Total
Slide 15: Lighting duration	0/1
Slide 16: Electrical work	0/6

Total score 0/7

Show solutions | Repeat | Export text

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