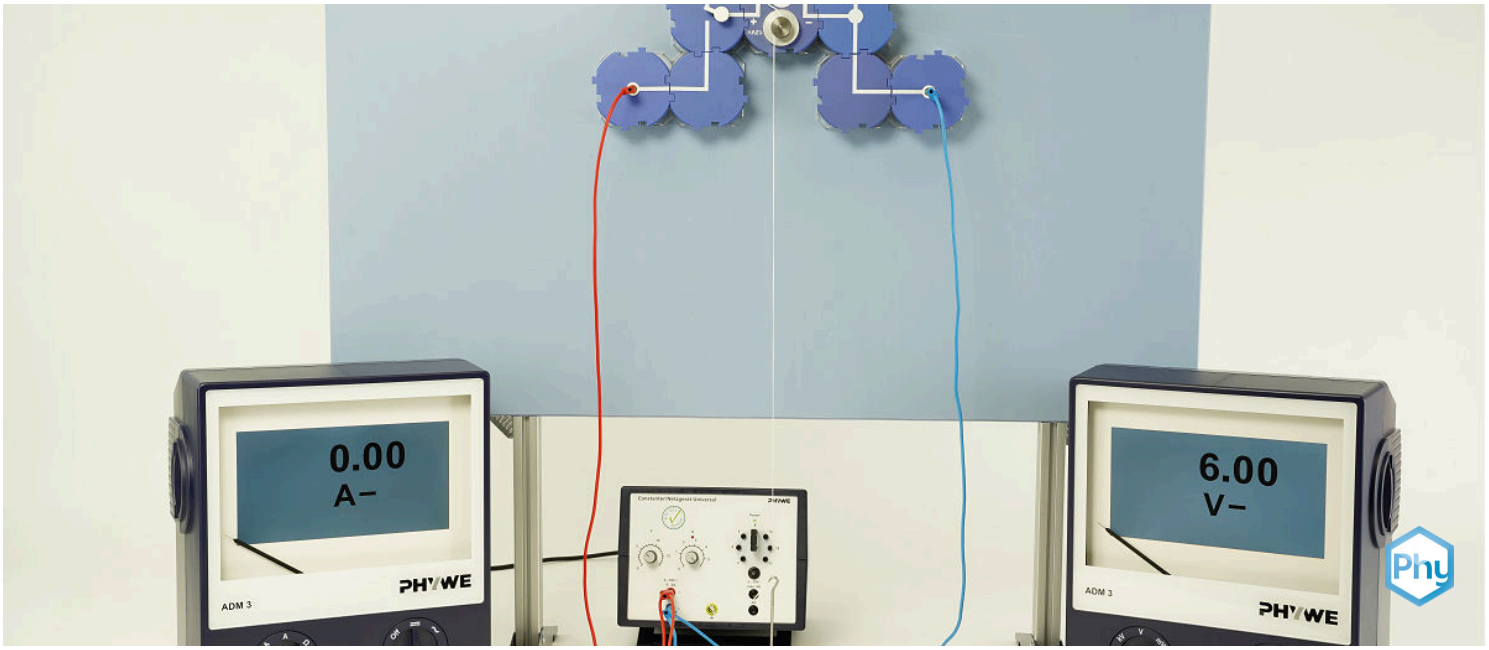
Conversion of electrical energy into mechanical energy and vice versa with ADM3



Physics > Energy > Energy forms, conversion & conservation

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

https://www.curriculab.de/c/6167de892d1cf30003518c0a

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General information

Application

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Source: wikipedia: Ottenstein power station

Conversion of electrical energy into mechanical energy and vice versa

The conversion of energy plays a role in very many areas of life, for example the conversion of mechanical energy into electrical energy in a power plant. It becomes clear that each of these conversion processes has only a certain efficiency and thus each conversion causes losses.

The experiment "Motor - Generator" serves to illustrate a pumped storage power plant, since electrical energy can be stored in mechanical energy and converted back into electrical energy as needed.

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Other information (1/2)

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Previous

Electrical energy is energy that is transmitted by means of electricity or stored in electrical fields.

The potential energy describes the energy of a body in a physical system, which is determined by its position in a force field or by its current configuration.

Principle

With the aid of an electric motor, which first operates as a motor and then as a generator, the energy conversions from electrical energy to mechanical (potential) energy and vice versa are demonstrated qualitatively and measured quantitatively. Subsequently, the efficiency of the respective energy conversion is to be determined.

Other information (2/2)

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Note

Care should be taken to wind the cord neatly onto the alternator pulley.

In these experiments only a voltage of 4...6 V is applied to the motor, otherwise the weight plate is pulled up too quickly. As a result, the 12V motor only works with low efficiency.

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Safety instructions

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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

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- Potential Energy:

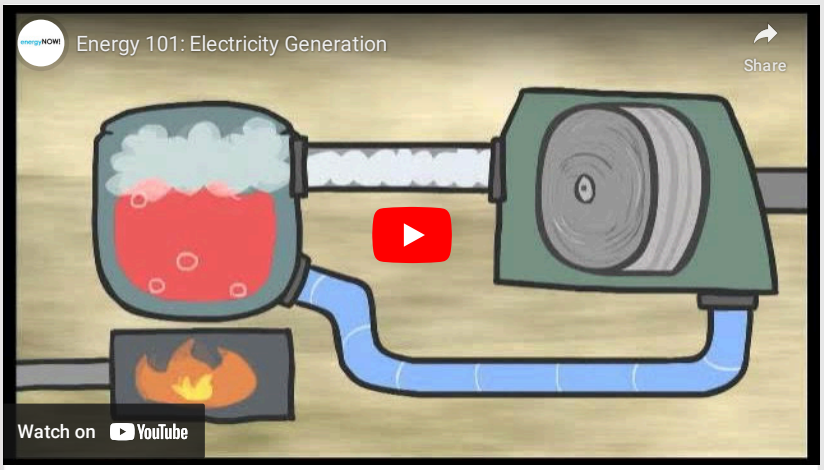
$$E_{Pot} = m \cdot g \cdot h$$

m = mass
g = acceleration due to gravity
h = height above the ground

- Kinetic energy:

$$E_{Kin} = \frac{1}{2} \cdot m \cdot v^2$$

v= speed



Source: YouTube - energynownews

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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	3
6	Connector, T-shaped, module DB	09401-03	1
7	Connector interrupted, module DB	09401-04	1
8	Connector, angled with socket, module DB	09401-12	1
9	Junction, module DB	09401-10	2
10	Switch, change-over, module DB	09402-02	1
11	Socket for incandescent lamp E10 ,module DB	09404-00	1
12	Motor 12 V, module DB	09475-01	1
13	Fishing line, l. 20m	02089-00	1
14	Scale for demonstration board	02153-00	1
15	Heat insulating sheet, felt, 100 mm x 135 mm	04375-00	1
16	Filament lamps 1.5V/0.15A,E10,10 pieces	06150-03	1
17	Weight holder, 10 g	02204-00	1
18	Slotted weight, black, 10 g	02205-01	4
19	Slotted weight, black, 50 g	02206-01	1
20	Connecting cord, 32 A, 250 mm, yellow	07360-02	1
21	Connecting cord, 32 A, 250 mm, red	07360-01	1
22	Connecting cord, 32 A, 250 mm, blue	07360-04	1
23	Connecting cord, 32 A, 750 mm, red	07362-01	1
24	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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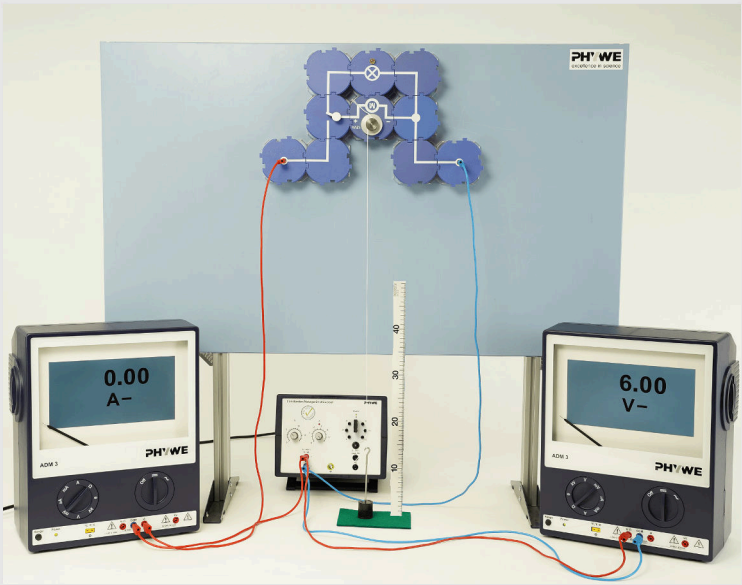

- Build an electric circuit on the blackboard with the building blocks according to the illustration.
- The switch closes the circuit with the lamp. The pulley of the motor should be about 80 cm above the table top.
- Attach the measuring ruler so that it points vertically upwards from the table to the motor.

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Set-up (2/3)

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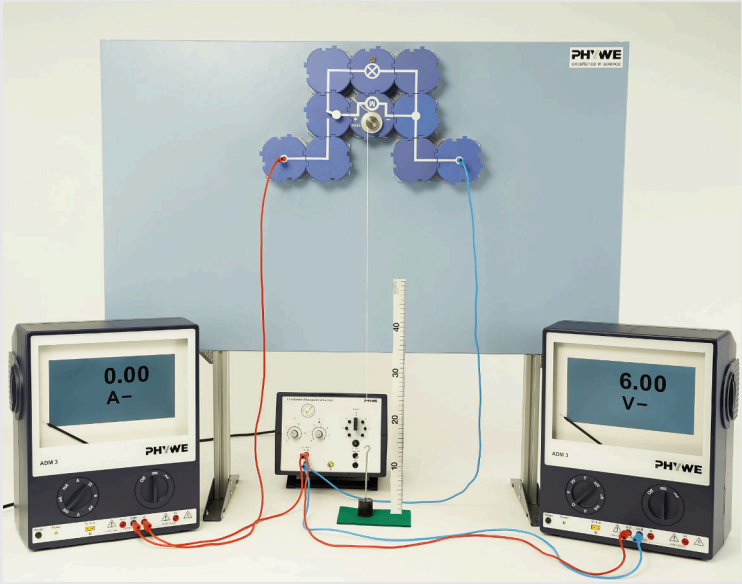

- Attach fishing line to motor pulley; wrap enough line around pulley to fill groove.
- Load weight plate with slotted weights (total mass of body = 100 g), hook onto the cord and place on the table top.
- Connect the DC output of the power supply unit to the circuit and set the voltage to 4...6 V-.

Set-up (3/3)

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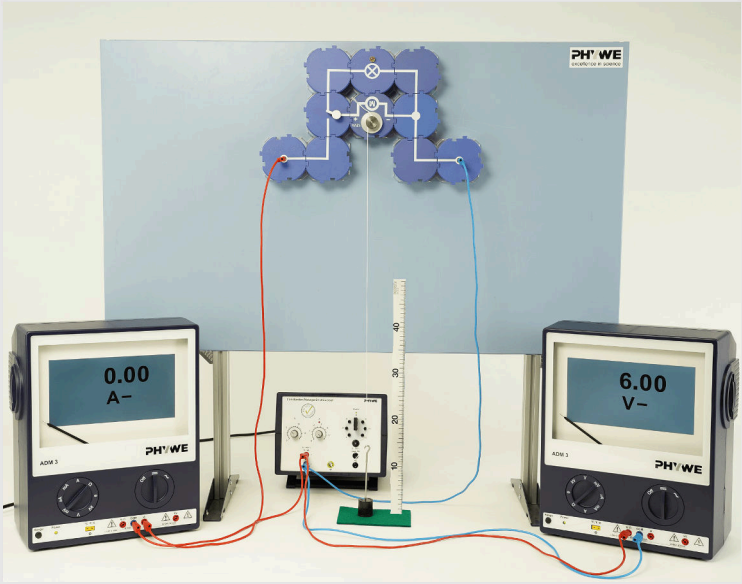

- Connect the ADM3 multimeters in parallel to measure voltage and in series to measure current.

  Note: The measuring devices are only used for qualitative testing. Due to the very short voltage or current rises, it is hardly possible to log accurate measurement data. Use Cobra SMARTsense sensors for this purpose!
- Place the felt plate on the table in such a way that the table is protected from the impact of the weight plate.

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Procedure (1/2)

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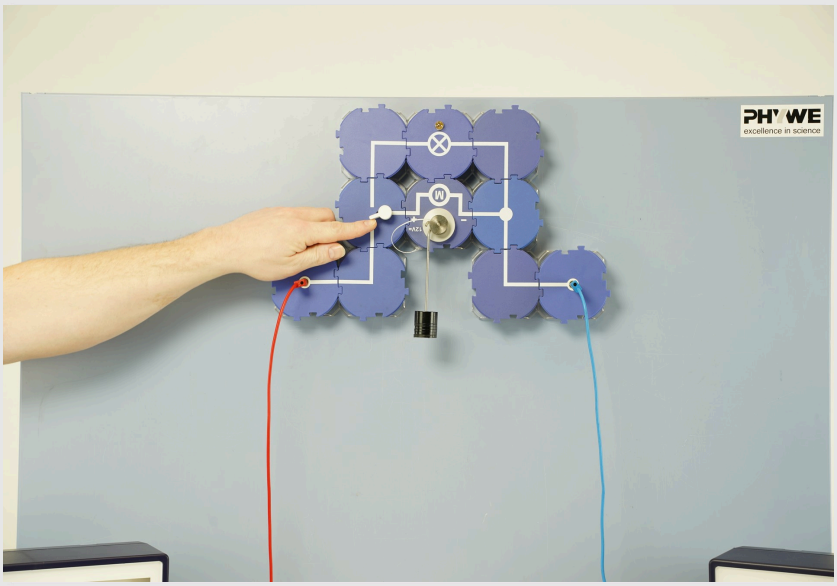
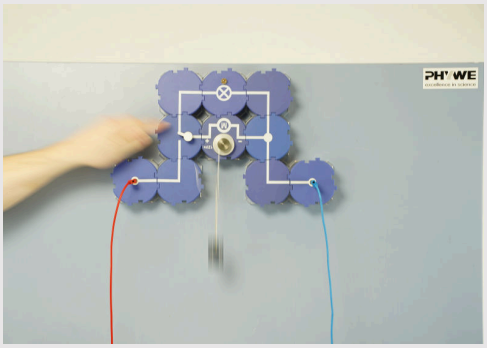
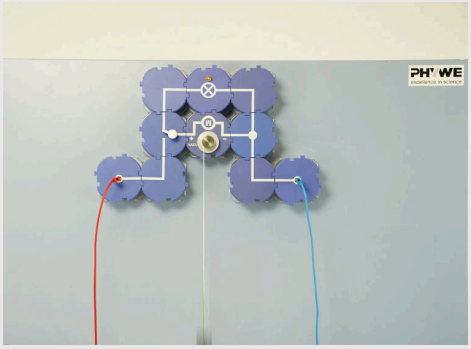
- Switch on the power supply unit.
- Flip the switch so that the motor pulls the weight plate up.
- The preset voltage setting should cause the weight plate to run at an acceptable speed. If this is not the case, increase or decrease the voltage and current.

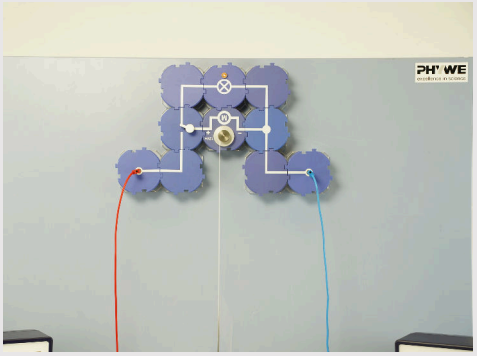


Procedure (2/2)

- Move the weight piece to the top position and set the switch to the position where the circuit with the lamp is closed.
- Drop the weight onto the felt plate while watching the lamp.







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Evaluation

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The motor raises the weight plate with slotted weights. During the downward movement, the light bulb lights up. How does this relate to energy? Drag the words into the correct boxes!

The motor requires _____ energy to lift the body. With a motor, electrical energy can be converted into _____ energy. As the glow of the light bulb proves, a _____ can be used to convert mechanical energy into electrical energy. All of these processes generate heat by friction in the _____ as well as by heating the _____ of the motor. They therefore have an efficiency that is sometimes much lower than 100%.

mechanical
generator
electrical
motor
coils

Check

Slide	Score / Total
Slide 14: Test evaluation	0/5

Total score 0/5

Show solutions Repeat

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