

The transformation of electrical energy to thermal energy

Principle and equipment

Principle

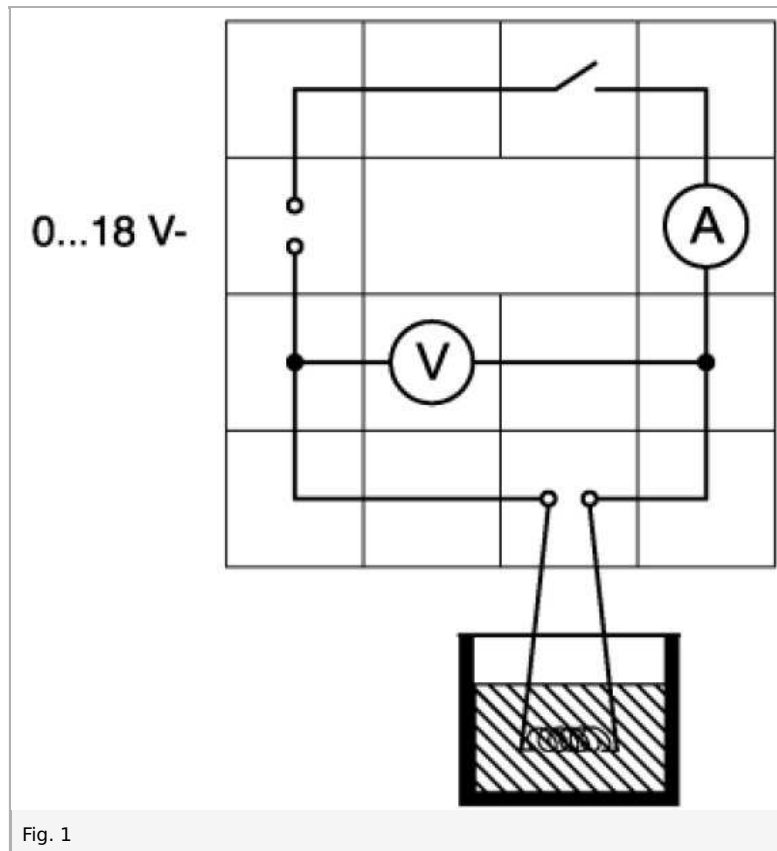
The transformation of electrical energy to thermal energy is to be demonstrated using a model of an immersion heater.

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	2
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Switch on/off, module DB	09402-01	1
5	Connector interrupted, module DB	09401-04	4
6	Support plate w. holder,module DB	09471-00	1
7	Glass tank, 100x50x120 mm	06620-10	1
8	Electr.symbols f.demo-board,12pcs	02154-03	1
9	Conductors/non-conductors, l = 150 mm	06107-50	1
10	Connector, straight, module DB	09401-01	3
11	Connector, angled, module DB	09401-02	4
12	Connector, T-shaped, module DB	09401-03	2
13	Lab thermometer,w.stem,+15..+40C	38057-00	1
14	Constantan wire, 4 Ohm/m, d = 0.4 mm, l = 50 m	06102-00	1
15	Connecting plug, 2 pcs.	07278-05	1
16	Connecting cord, 32 A, 1000 mm, red	07363-01	3
17	Connecting cord, 32 A, 1000 mm, blue	07363-04	3
18	Alligator clips, bare, 10 pcs	07274-03	1
19	Connecting cord, 32 A, 250 mm, red	07360-01	1
20	Connecting cord, 32 A, 250 mm, blue	07360-04	1
Additional material:			
	Glass rod		
	Measuring cylinder		
	Clock		
	Tap water		

Set-up and procedure

- Set up the experiment as shown in Fig. 1; use a round pencil to shape the constantan wire to a coil {10 ... 15 turns) and use crocodile clips to fix the ends of the coil to the connecting plugs in the circuit
- Fill the glass trough with approximately 300 ml of water; position it so that the constantan wire coil is just above the trough bottom, if necessary correct the wire of the coil
- Select the 30 V- and 10 A- measurement ranges, set the power supply to 0 V and switch it on
- Close the switch; set the voltage for a 4 A current; open the switch
- Stir the water and measure the water temperature ϑ_s ; note the measured values for U , I , and ϑ_s in Table 1 under Part 1.
- Close the switch and re-open it after 5 minutes, stir the water and note the temperature ϑ_a attained
- Pour the water away, rinse the glass trough with cold water, then re-fill it with 300 ml of water
- Repeat the measurement at a current of 2 A; enter the measured values for U , I , ϑ_s and ϑ_a under Part 2.
- Finally, remove the glass trough and holder and observe the coil; if necessary dip the coil in water once again (1).



Observation and evaluation

Observation

$t = 5min$

	Table 1	
	Part 1	Part 2
$\frac{U}{V}$	11	5.6
$\frac{I}{A}$	4	2
$\frac{\vartheta_A}{^{\circ}C}$	23	24
$\frac{\vartheta_E}{^{\circ}C}$	31.5	26
$\frac{\Delta\vartheta_A}{^{\circ}C}$	8.5	2
$\frac{E_{el}^K}{W_s}$	13200	3360

1. The coil becomes very hot as soon as it is no longer surrounded by water.

Evaluation