Converting electrical into heat energy - measuring with the joule and wattmeter (P 2.3.4.2)

P 2.3.4

Conversion of electrical energy

P 2.3.4.1 Converting electrical into heat energy – measuring with the voltmeter and ammeter

P 2.3.4.2 Converting electrical into heat energy – measuring with the joule and wattmeter

P 2.3.4.3 CASSY-S Converting electrical into heat energy - measuring with CASSY

Cat. No.	Description	P 2.3.4.1 (a)	P 2.3.4.1 (b)	P 2.3.4.1 (c)	P 2.3.4.2 (a)	P 2.3.4.2 (b)	P 2.3.4.2 (c)	P 2.3.4.3
384 20	Electric calorimeter attachment	1	1	1				
386 48	Dewar vessel calorimeter with base	1	1	1				
388 02	Copper-block calorimeter with heating coil				1	1	1	1
388 03	Aluminum-block calorimeter with heating				1	1	1	1
388 04	Large aluminum-block calorimeter with heating coil				1	1	1	1
388 06	Pair of connecting cables				1	1	1	1
521 35	Voltage source, 0 … 12 V, e. g. Variable extra-low voltage transformer S	1	1	1	1	1	1	1
382 34	Thermometer, -10° to + 110 °C	1						
388 05	Thermometer for calorimeters				1			
666 190	Digital thermometer with 1 input		1			1		
666 193	Temperature sensor NiCr-Ni		1			1		
531 120	Voltmeter, AC, $U < 12$ V, e.g. Multimeter LDanalog 20	1	1	1				
531 130	Ammeter, $I < 6$ A, e.g. Multimeter LDanalog 30	1	1	1				
313 07	Stopclock I, 30s/15min	1	1	1				
664 103	Beaker, 250 ml, ss, hard glass	1	1	1				
665 755	Graduated cylinder, 250 ml: 2	1	1	1				
501 28	Connecting lead, Ø 2.5 mm², 50 cm, black	3	3	3				
501 45	Pair of cables, 50 cm, red and blue	1	1	1	1	1	1	3
531 831	Joule and wattmeter				1	1	1	
524 009	Mobile-CASSY			1			1	
524 0673	NiCr-Ni Adapter S			1			1	1
529 676	NiCr-Ni temperatrue sensor 1.5 mm			1			1	1
524 010USB	Sensor-CASSY							1
524 200	CASSY- Lab							1
	additionally required: 1 PC with Windows 95/NT or higher							1

Just like mechanical energy, electrical energy can also be converted into heat. We can use e.g. a calorimeter vessel with a wire winding to which a voltage is connected to demonstrate this fact. When a current flows through the wire, Joule heat is generated and heats the calorimeter.

The supplied electrical energy

$$W(t) = U \cdot I \cdot t$$

is determined in the first experiment by measuring the voltage U, the current I and the time t, and in the second experiment measured directly using the joule and wattmeter. This results in a change in the temperature of the calorimeter which corresponds to the specific heat capacity

$$Q(t) = m \cdot c \cdot (\vartheta(t) - \vartheta(0)),$$

c: specific heat capacity, m: mass,
$\vartheta(t)$: temperature at time t

To confirm the equivalence

$$Q(t) = W(t)$$

the two quantities are plotted together in a diagram.