Waltenhofen Pendulum (Item No.: P1298500)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 16-19
Topic: Electricity
Subtopic: Electromagnetic induction
Experiment: Waltenhofen Pendulum

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Pendulum, eddy currents, Lenz' law

Task and equipment

Introduction

When a massive body made of conductive material moves through a magnetic field, eddy currents are induced.

Notes

Required voltage: approx. 7 V DC (equivalent approx. 1,5 A) for the first two experiments and 0...14 V DC for the third experiment. Consider that currents of $I > 2\,\mathrm{A}$ must only flow for a limited time, because the acceptable continuous load for currents is exceeded.

Task

Observe the pendulum oscillation of different objects through a magnetic field.

1. Brake the oscillation by switching on the current.
2. Compare the braking time for different pendulum bodies.
3. Compare the braking duration of one pendulum body for different currents.

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Equipment

Position No.	Material	Order No.	Quantity
1	Coil, 600 turns	06514-01	2
2	Iron core, U-shaped, laminated electric steel	06501-00	1
3	Pole pieces for U-cores	06493-00	1
4	On/off switch	06034-01	1
5	Pendulum plates, set of 5	06456-00	1
6	Pendulum rod	06457-00	1
7	Bolt with pin	02052-00	1
8	Stop clock, demo.; diam. 13 cm	03075-00	1
9	Tripod base PHYWE	02002-55	1
10	Support rod, stainless steel, 500 mm	02032-00	1
11	Right angle clamp expert	02054-00	1
12	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
13	Connecting cord, 32 A, 500 mm, red	07361-01	3
14	Connecting cord, 32 A, 750 mm, red	07362-01	1
15	Connecting cord, 32 A, 750 mm, blue	07362-04	1
16	Multimeter ADM1, demo., analog	13810-01	1

Setup and Procedure

Setup

Set-up the experiment as shown in Fig. 1.

The coils of the electromagnet must be connected in series, the end planes facing each other.

Mount the pendulum rod onto the rod with pin so that no clamping friction will occur.

Fig. 1

Procedure

1. Switch off the current and set the pendulum with the rectangular disc without slit to swing. After switching on the current, the pendulum will come to rest quickly.
2. Compare the durations for different pendulum bodies for the braking process from start of the oscillation until complete stop. Therefore, the pendulum bodies have to be released from the same height, when the current has been switched on.
3. Compare for one pendulum body, e.g. the rectangular disc with slit, the braking time for different currents.

Results and evaluation

According to Lenz's law, the body is then subjected to a force which is opposed to the cause of the eddy currents, i.e. the motion of the pendulum. The braking action increases with the strength of the magnetic field.

If slits are cut into the body (or if insulating layers are added), this reduces the generation of the eddy currents.

Technical applications of the damping effect of induction currents are for example the reduction of oscillations in measuring systems (moving coil measuring instrument, reflecting galvanometer, scale) or the eddy current brake.

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