Damping (Item No.: P1003000)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physik	Klasse 7-10	Mechanik	Schwingungen und Wellen	Dämpfung

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

Additional Requirements:

- Drawing cardboard (approx. DIN A4)

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

In the previous experiments the students have experimented several times with oscillating systems. In contrast, in this experiment they should observe the oscillation amplitudes over longer periods of time, become familiar with their decrease over time and measure it. This leads to the term damping, which should be, however, introduced only qualitatively here and not as the logarithmic damping decrement which is normally used.
The *e* function should not be handled here - even though the results are in this form. Rather, it seems more sensible to first - awaken their interest.

Damping (Item No.: P1003000)

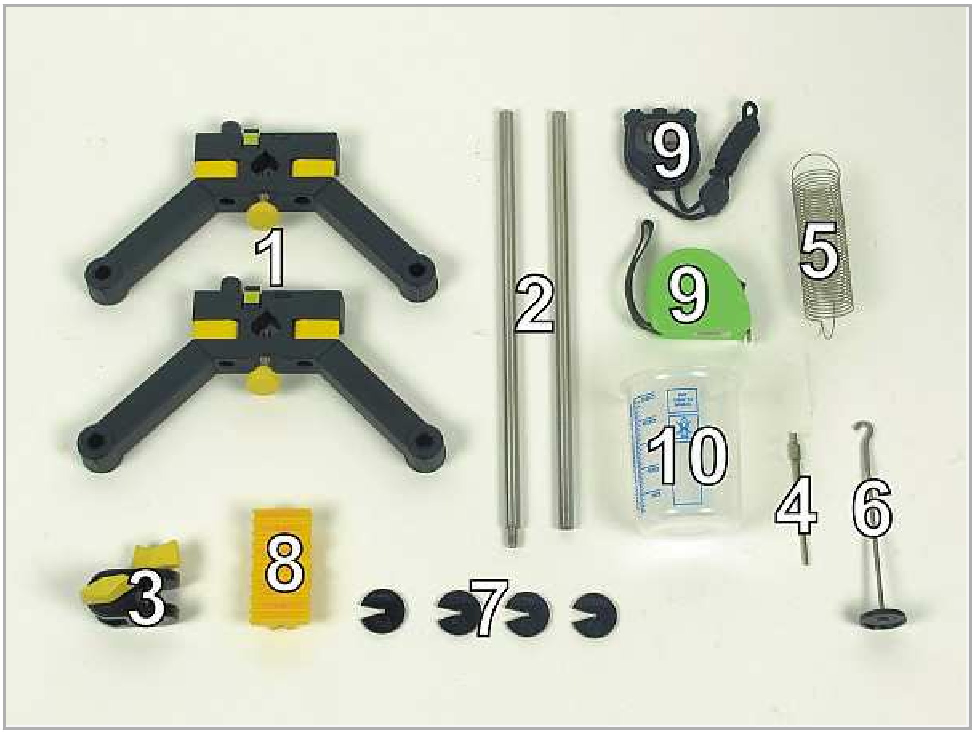
Task and equipment

Task

Do oscillations stop?

A spring pendulum oscillates in air - first only with a mass - then a cardboard disk is added. Measure the deflection after different times and compare them with the original deflection.
Immerse the pendulum mass in water and investigate the deflection after different times.

Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with	02035-00	1
3	Boss head	02043-00	1
4	Holding pin	03949-00	1
5	Helical spring, 3 N/m	02220-00	1
6	Weight holder for slotted weights	02204-00	1
7	Slotted weight, black, 10 g	02205-01	4
8	Glass tube holder with tape measure clamp	05961-00	1
9	Stop watch 4	03078-00	1
9	Measuring tape, l = 2 m	09936-00	1
10	Beaker, 250 ml, low form, plastic	36013-01	1
Additional material			
	Drawing cardbord (approx. DIN A4)		1

Set-up and procedure

Set-up

First screw the splitt support rod together (Fig. 1). Set up a stand with the support base (Fig. 2), put the support rod in the support base and tight it with the screw (Fig. 3).


Fig. 1

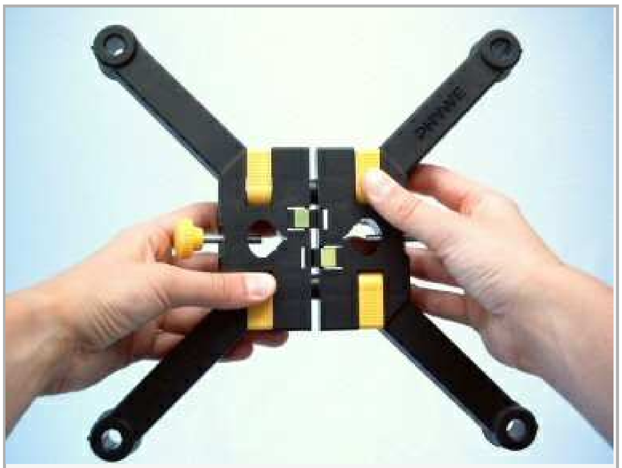


Fig. 2

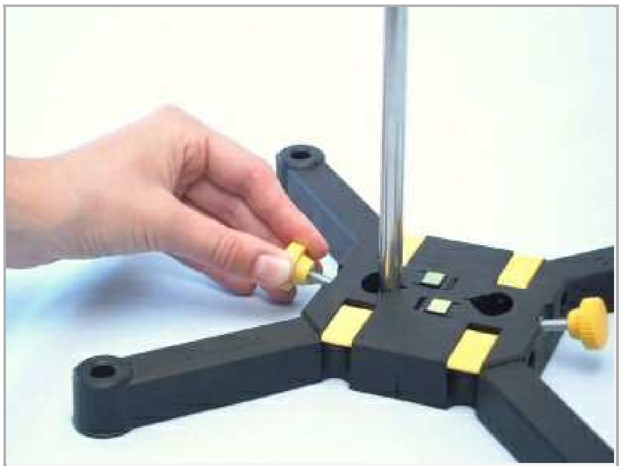


Fig. 3

Attach the bosshead to the support rod. Fix the holding pin in the bosshead and hang the helical spring in it (Fig. 4)


Fig. 4

Clamp the extended measuring tape in the glass tube holder and clamp both on the base of the support rod (Fig. 5).

Fig. 5

Prepare a cardboard disk with a diameter of 7.5 cm; make a hole in its center and a radial slit.

Procedure

- Load the helical spring with a weight of m = 50 g including the weight holder (Fig. 6) and deflect it by Δl_0 = 10 cm.
- Determine the pendulum's maximum deflections Δl_1 between 0.5 min and 3 min in 0.5 min steps. Record the deflection values in Table 1 in the report.

Fig. 6

- Place the cardboard disk on the weight holder under the slotted weights (Fig. 7).
- Deflect the spring pendulum with the disk again by Δl_0 = 10 cm (Fig. 8) and determine the deflections Δl_2 at the above mentioned times. Add the values to Table 1.


Fig. 7

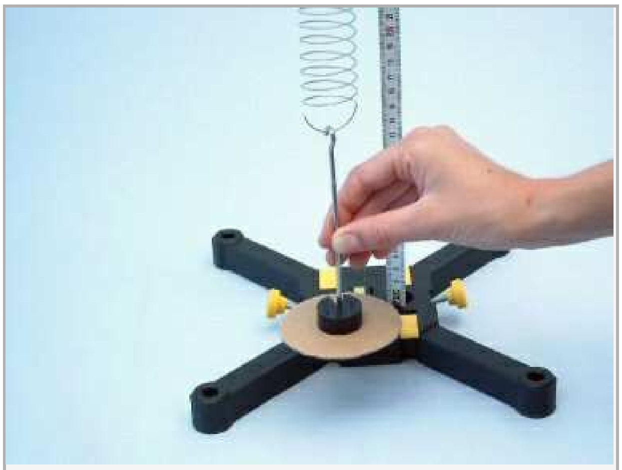


Fig. 8

- Fill the beaker completely with water and immerse the weight holder with a 50 g mass about 4 cm into the water (Fig. 9).
- Deflect the spring pendulum by Δl_0 = 4 cm down to the bottom of the beaker (Fig. 10) and measure the deflection Δl_3 after 5 s. Record the measured value under Chart 1 in the report.


Fig. 9


Fig. 10

In order to disassemble the support base you should press the yellow buttons (Fig. 11).

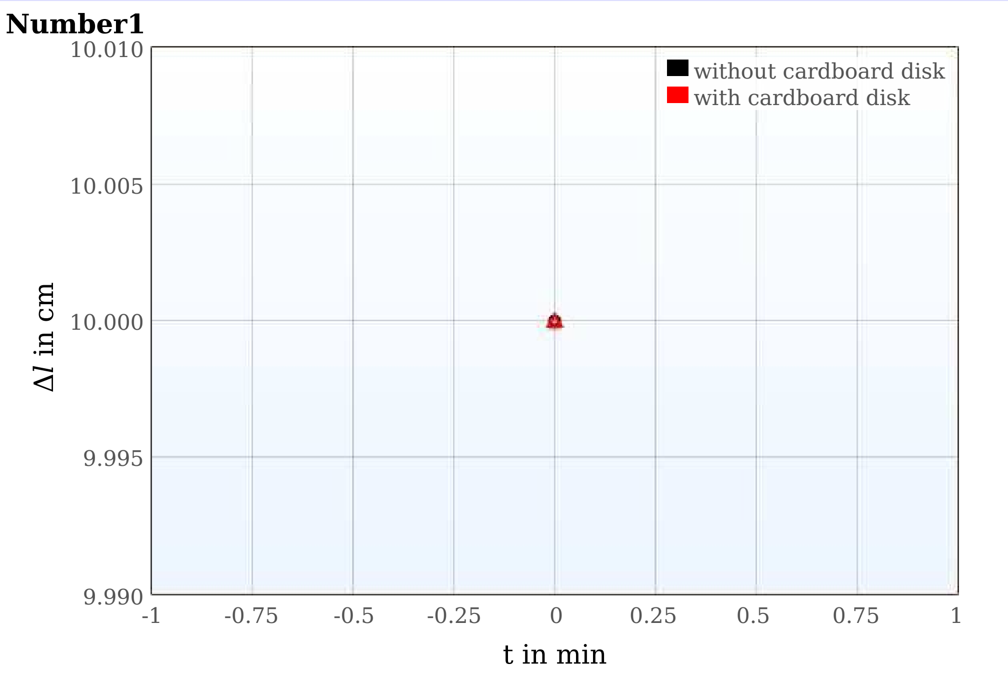
Fig. 11

Report: Damping

Results – Table 1

Record the measured values in Table 1.

t in min	without cardboard disk Δl_1 in cm	with cardboard disk Δl_2 in cm
0	10	10
0.5	1	1
1.0	1	1 ±0
1.5	1	1
2.0	1	1
2.5	1	1
3.0	1	1



Results – Measured values

Record the measured value here:

Δl_0 = 4 cm, t = 5 s, Δl_3 = ... cm

Evaluation – Question 1

The decrease in oscillation amplitude is called damping.

a) Calculate the amount the amplitude (the deflection) Δl_1 has decreased after 3 minutes in cm and in percent.

b) Calculate the decrease in amplitude for Δl_2 (in cm and in %) after 3 min, too.

c) Compare the two results with each other. What do you see?

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Evaluation – Question 2

Which arrangement has the larger damping?

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Evaluation – Question 3

Can you explain this?

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Evaluation – Question 4

What can you conclude from the course of the curves for the longer times *t*? Does the amplitude reach a limit?

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Evaluation – Question 5

What does the limit 0 mean for the oscillation?

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Evaluation – Question 6

Calculate the decrease in amplitude for Δl_3 in cm and in %.

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Evaluation – Question 7

Compare the decrease in amplitude for the pendulum oscillations in air (with and without the disk) with those of the pendulum immersed in water. In which case is the damping (decrease in amplitude) the least, in which the largest?

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Evaluation – Question 8

How can you explain this?

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Robert-Bosch-Breite 10
D - 37079 Göttingen

Tel: +49 551 604 - 0
Fax: +49 551 604 - 107

info@phywe.de
www.phywe.com

Evaluation – Question 8

Why is it nearly impossible to record a curve in water similar to that in air?

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