Compound pendulum (physical pendulum) (Item No.: P1003300)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 10-13
Topic: Mechanik
Subtopic: Schwingungen und Wellen
Experiment: Reversionspendel (Physikalisches Pendel)

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

Additional Requirements:

- Scissors

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

In the "Simple pendulum" experiment (P1002800) the students became acquainted with the correlations between pendulum length and oscillation period of a thread pendulum. In the present experiment they should discover the special property of a reversion pendulum: there are two singular suspension points, at which the oscillation period is the same. The distance between them - the reduced pendulum length l_R - is larger than the distance "center of gravity - suspension point"; consequently, the pendulum must be reversed in order to hang it on the respective singular points*.
In this experiment the students should measure the oscillation period of a reversion pendulum, the suspension points for equal oscillation periods and from this data determine the reduced pendulum length.
Additionally, they should measure the oscillation period of a thread pendulum with a length which corresponds to the reversion pendulum's reduced pendulum length and compare it with the reversion pendulum's oscillation period.

Remark

This is true in the "normal" case. Due to the symmetry of the lever employed as pendulum body in this particular case, the oscillation period is also equal at the suspension point on the same side.

Robert-Bosch-Breite 10
D - 37079 Göttingen
Tel: +49 551 604 - 0
Fax: +49 551 604 - 107
info@phywe.de
www.phywe.com

Compound pendulum (physical pendulum) (Item No.: P1003300)

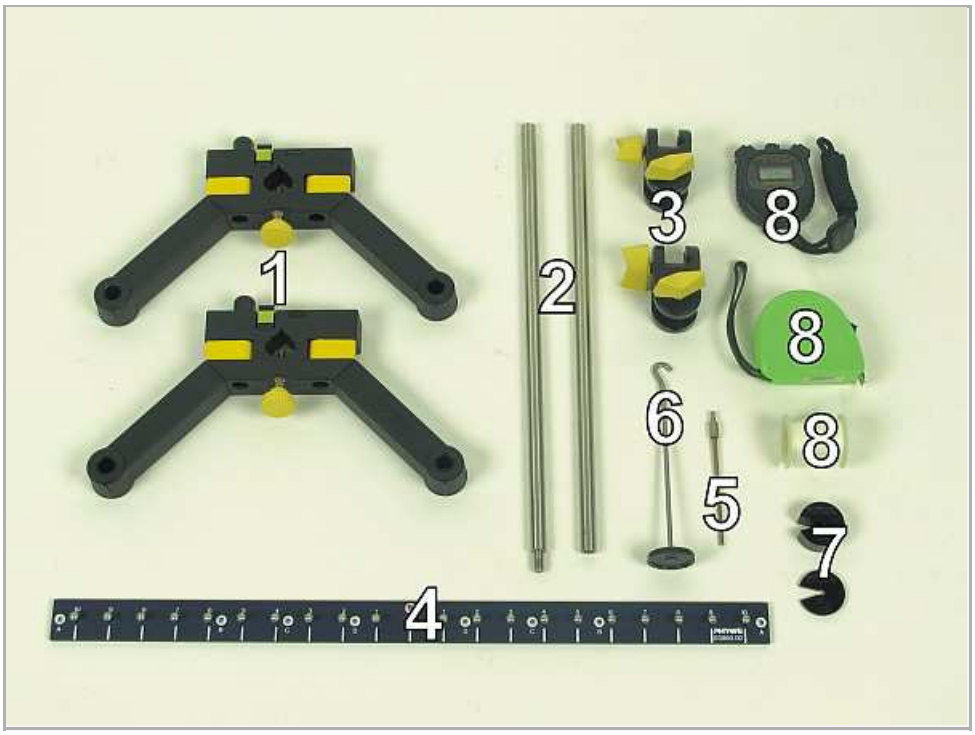
Task and equipment

Task

What property characterises a reversion pendulum?

Measure the time required for 10 oscillations of a reversion pendulum at different suspension points. From this data determine the respective oscillation periods.
Measure the time required for 10 oscillations of a thread pendulum with a pendulum length which equals the "reduced pendulum length" of the rod pendulum.

Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
3	Boss head	02043-00	1
4	Lever	03960-00	1
5	Holding pin	03949-00	1
6	Weight holder for slotted weights	02204-00	1
7	Slotted weight, black, 10 g	02205-01	1
7	Slotted weight, black, 50 g	02206-01	1
8	Stop watch 4	03078-00	1
8	Measuring tape, l = 2 m	09936-00	1
8	Fishing line, l. 20m	02089-00	1

Set-up and procedure

Set-up

Part 1

First screw the splitt support rod together (Fig. 1). Setup a stand with the support base (Fig. 2), put the support rod in the support base (Fig. 3).

Fig. 1

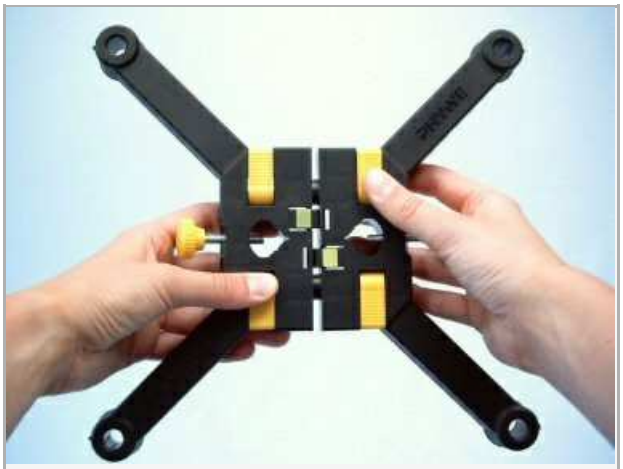


Fig. 2

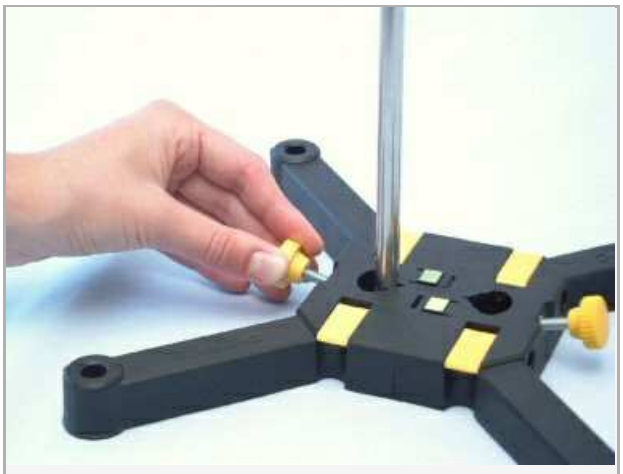


Fig. 3

Put the holding pin in the hole of the lever (Fig. 4). Fix the holding pin and the lever with the bosshead to the support rod.(Fig. 5).

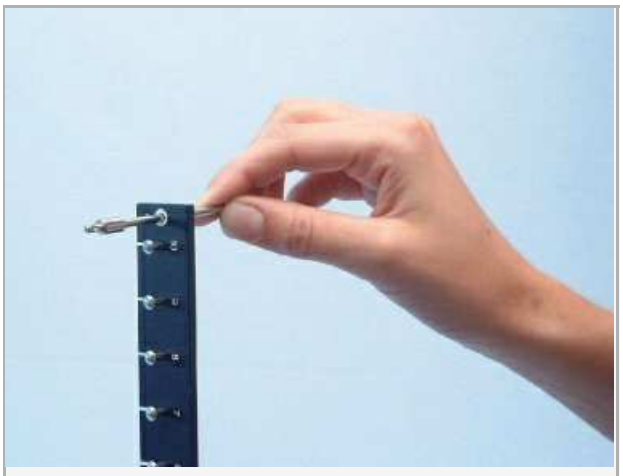


Fig. 4

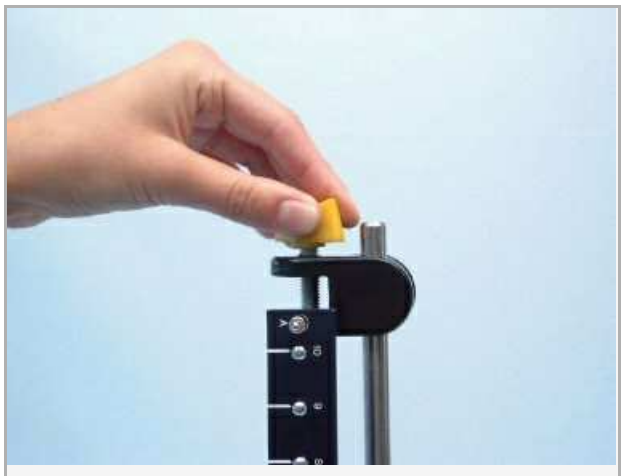


Fig. 5

Use the lever as a rod pendulum (physical pendulum) and hang it successively on the A, B, C, and D - holes on the left side of the lever (Fig. 6).


Fig. 6

Part 2

- Remove the lever.
- Fix the second bosshead to the support rod.
- Secure the holding pin with the upper bosshead so that the hole at its end is horizontal.
- Tie a piece of fish line to the hook of the weight holder and thread it through the hole in the holding pin (Fig. 7).
- Tie the fish line to the second bosshead (Fig. 8).


Fig. 7

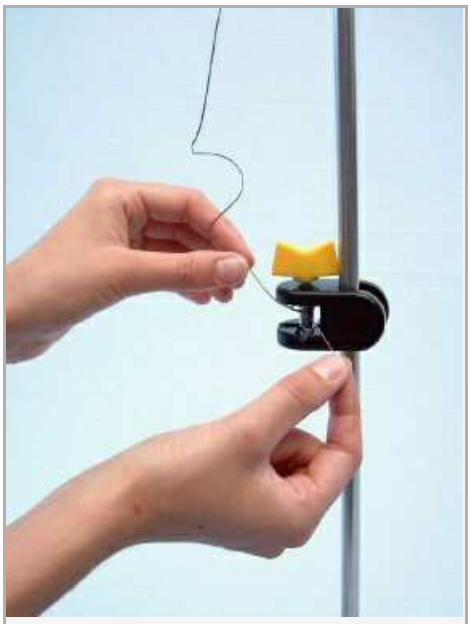


Fig. 8

- Place the weight on the weight holder so that the total weight is 70 g (Fig. 9).
- Adjust the height of the lower bosshead so that the total length from the upper anchor point to the middle of the weights is equal to the reduced pendulum length l_R of the reversion pendulum.


Fig. 9

Procedure

Part 1

- Deflect the lever and let it fall (Fig. 10).
- Measure the time *t* required for 10 oscillations at each suspension point.
- Record all the measured values in Table 1 in the report (for the names of the holes see Fig. 11).
- Measure the distance l_R between the suspension points A_{le} and C_{ri} and record this value in the table, too.
- Hang the lever on point C_{ri} and determine the time required for 10 oscillations again. Note the value in Table 1.

Fig. 10

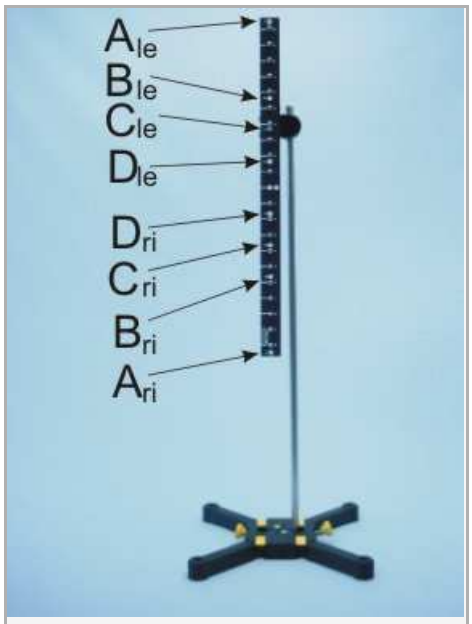


Fig. 11

Part 2

- Using the weight holder with a total mass of 70 g, set up a thread pendulum which length *l* is equal to the reduced pendulum length l_R of the reversion pendulum (part 1).
- Measure the time *t* required for 10 oscillations and note the value in Table 2 in the report.

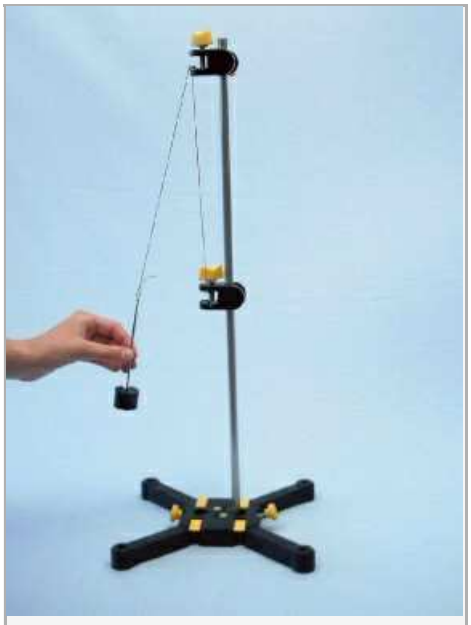


Fig. 12

In order to disassemble the support base you should press the yellow buttons (Fig. 13).

Fig. 13

Report: Compound pendulum (physical pendulum)

Results – Measured values

Record the distance l_R between the suspension points A_{le} and C_{ri} :

l_R = ... cm

Results Part 1 – Table 1

Enter measured values for time *t* in the Table 1.

From the time *t* required for 10 oscillations calculate the oscillation period *T* and record the values in the table.

Suspension point	*t* in s	*T* in s
A_{le}	1	1
B_{le}	1	1
C_{le}	1	1
D_{le}	1	1
C_{ri}	1	1

Evaluation Part 1 – Question 1

Compare the oscillation periods with one another, what do you notice?

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

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

info@phywe.de
www.phywe.com

Evaluation Part 1 – Question 2

Do the oscillation periods for the suspension points C_{ri} and C_{le} differ?

.....

.....

.....

.....

Evaluation Part 1 – Question 3

Can you give reasons for this?

.....

.....

.....

.....

Evaluation Part 1 – Question 4

The distance between the suspension points A_{le} and C_{ri} is termed the "reduced pendulum length l_R". How large is it for this pendulum?

.....

.....

.....

.....

Evaluation Part 1 – Question 5

What can you say about its importance?

.....

.....

.....

.....

Results Part 2 – Table 2

Enter measured values the Table 2. Calculate the oscillation period *T* of the thread pendulum and record the value in Table.

l in cm	*l* in cm	*t* in s	T in s
	1	1	1

Evaluation Part 2 – Question 1

Compare the oscillation period of the thread pendulum with that of the reversion pendulum for the suspension points A_{ri}, C_{le} and C_{ri}. What can you say about it?

.....

.....

.....

.....

Evaluation Part 2 – Question 2

Can you explain where the expression "reversion pendulum" (lat. Reversio = turn back) comes from?

.....

.....

.....

.....

Evaluation Part 2 – Question 3

Express the special property of a reversion pendulum in your own words.

.....

.....

.....

.....

Robert-Bosch-Breite 10
D - 37079 Göttingen

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

info@phywe.de
www.phywe.com