

THREAD PENDULUM - SMALL PENDULUM BALLS

SWD 01.01b



Material:

Item Code	Qty	Description
DS101-1G	1	Support base, large, L=500 mm
DS093-04	1	Sliding saddle "Sepp", H=40 mm
DS095-3K	3	Bosshead cross-pattern, demo 03
DS300-00	1	Support rod, squared, L=1000 mm, 12x12 mm
DS300-15	1	Support rod, squared, L=150 mm, 12x12 mm
DS204-2L	2	Bearing pin with clamp insert
DM385-1P	1	Pendulum bobs, set of 6, dia=24mm
P7100-1A	1	Cord, roll, high tensile strength
DG101-00	1	Ruler, metal, L=1000 mm
P3120-2Z	1	Universal timer "inno"
P1320-4A	1	Light gate "demo" 04
P3120-5B	1	S-shaped assembly platform

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Goal:

Kennenlernen der Begriffe periodischer Vorgang, Auslenkung und Amplitude sowie der Abhängigkeit der Schwingungsdauer von der Pendellänge und von der Masse des Pendelkörpers.

Setup:

The large support base is set up on a stable base. The "Sepp" sliding saddle is mounted centrally on this. The 100 cm support rod is clamped in its clamping column.

At the upper end of this stand rod, a cross-pattern bosshead is clamped and a bearing bolt with clamping insert is clamped into it.



Another cross-pattern bosshead is clamped at a central height. The 150 mm support rod is fixed horizontally in this and another cross-pattern bosshead is fixed at its end with a bearing bolt and clamping insert.

A cord of about 110 cm is looped at one end, and the total length should then be about 100 cm. The open end of the cord is threaded through the hole of the lower bearing pin starting from the bottom and then clamped on the upper bearing pin.

The pendulum ball steel is hooked into the free hanging loop of the cord. By shifting the lower cross-pattern bosshead, the pendulum length is adjusted to 50 cm:

The pendulum length is the distance from the pivot bearing (from the bottom edge of the bearing pin) to the center of gravity of the suspended mass. Since the balls have a diameter of 25.4 mm, a distance of 48.7 cm is set from the upper edge of the ball to the bearing pin.

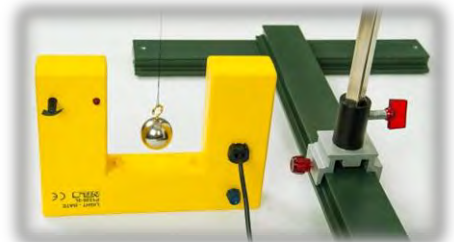
The forked light barrier is connected to input 1 of the universal timer and the timer is attached to the assembly platform.

The light gate is placed on the table and adjusted so that the string of the pendulum hangs exactly in the center of the light signal of the light gate.



At the universal timer the measuring range "L1 START - STOP" is selected.

Behind the forked light gate, the scale 100 cm is placed horizontally on the foot cheeks of the support base. This is moved so that the center of the sphere hangs in the fall line in front of a dm - marking.



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Experiment 1:

It is to be examined whether the deflection (amplitude) has an effect on the oscillation period of a pendulum.

The pendulum length l is set to 50 cm.

The pendulum is deflected about 5 cm from the rest position and released.

The universal timer is switched on.

The time duration of half a pendulum oscillation is now measured. By pressing the "Reset - Button" of the counter several times in succession, several periods can be measured quickly. These are noted and the average value is calculated.

During the measurements, two "left" and two "right" half oscillations are to be measured in each case. If the light barrier is not placed absolutely exactly in the middle of the pendulum cord, the duration of a whole oscillation can still be determined exactly in this way.

The average value of the 4 measurements is calculated and this is doubled, then we get the oscillation period of a full oscillation T .



Deflection (in cm)	Measurement 1	Measurement 2	Measurement 3	Measurement 4	average oscillation period T (in seconds)
5					
10					
15					
40					

The deflection is changed as indicated in the table. The times are measured and entered in the table.

Result:

The period of oscillation is about the same for the first three tests, the value of the fourth measurement is noticeably larger.

The deflection of the pendulum body, provided it is small, has no effect on the oscillation period.

Note:

The maximum deflection is also called amplitude.

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Experiment 2:

To investigate whether the mass of the pendulum bob has an effect on the period of oscillation of a pendulum

For this purpose, the masses of the pendulum balls are determined with an accurate balance:

The pendulum ball aluminum is hooked into the loop of the cord.

The pendulum length l is set to 50 cm.

The pendulum is deflected about 10 cm from its rest position and released.



The results are entered in the table below. The average value of the 4 measurements is calculated and this is doubled, then we obtain the oscillation period of a full oscillation T .

Pendulum ball material	Mass (in g)	Measurement 1	Measurement 2	Measurement 3	Measurement 4	average oscillation period T (in seconds)
Aluminium						
Zinc						
Iron (steel)						
Brass						
Copper						
Lead						

The pendulum balls are changed as indicated in the table, the times are measured and entered in the table.

Result:

The period of oscillation of the spheres is approximately the same.

The mass of the pendulum bob therefore has no effect on the period of oscillation.

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Experiment 3:

To investigate whether the length of the pendulum has an effect on the period of oscillation of a pendulum

The pendulum ball steel is hooked into the loop of the cord. The pendulum length l is set to 50 cm. The pendulum is deflected about 10 cm from the rest position and released.

The results are entered in the table below. The average value of the 4 measurements is calculated and this is doubled, then we obtain the oscillation period of a full oscillation T .



By loosening and moving the lower bosshead, the length of the pendulum can be easily varied. The pendulum lengths from the following tables are set, the times measured and entered in the table.



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Pendulum length l (in m)	Measurement 1	Measurement 2	Measurement 3	Measurement 4	average oscillation period T (in seconds)
0,25					
0,50					
0,75					

Result:

With a longer pendulum length, the period of oscillation also becomes longer.
The pendulum length does have an effect on the period of oscillation.

Conclusion:

The period of oscillation of a string pendulum is independent of the deflection and the weight of the pendulum bob.

We compare the experimental results with the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$