PHYSICAL PENDULUM, REVERSING PENDULUM

SWD 01.04

Material:

Item Code	Qty	Description
DS600-10	1	Assembly for lab table "NTL"
DS600-6G	1	Board holders, pair, magnetic
DS103-1P	1	Panel, green/white, 900x610mm
DS402-3B	1	Pivot bearing with transverse hole, on saddle
DM375-1P	1	Compound pendulum
P3120-2Z	1	Universal timer "inno"
P1320-4A	1	Light gate "demo" 04
C7235-2B	1	Lab-jack small, 150x150 mm

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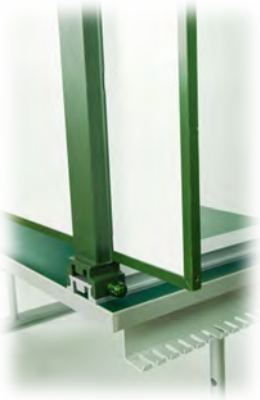
Goal:

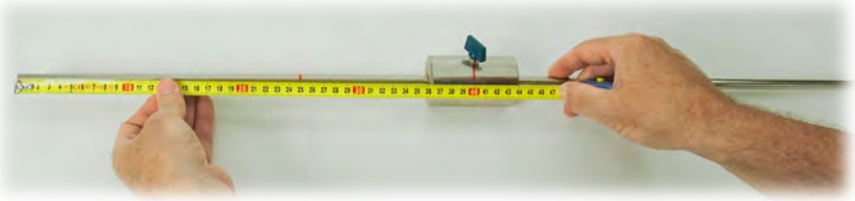
Determination of the reduced pendulum length from the oscillation period - relocation of the center of rotation (A --> A1) to this distance from the original center of rotation - control of this distance (=reduced pendulum length) by checking for the same oscillation period. Reversion = Reversal (here of the center of rotation)

Setup:

The table assembly is set up.
The board holders are mounted on the front ends of the footrest profiles.
The panel is stapled to the board holders.
The swivel bearing is firmly mounted to the upper end of the left board holder.



A mark is made on the compound pendulum at about 25 cm with a non-permanent pencil.
The mass body is screwed at a distance of 40 cm (measured away from the same end).



The pendulum rod is now clamped in the swivel bearing at the 25 cm mark.

The forked light barrier is connected to input 1 of the time counter.

The universal timer is pinned to the board, the light gate is placed on the foot cheek.

The gate is now adjusted so that the pendulum rod 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.

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Experiment 1:

The pendulum is deflected about 15 cm at the lower end and released.

The universal timer is switched on.

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

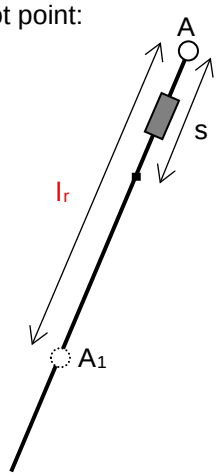
During the measurements, two "left" and two "right" half oscillations are to be measured. If the light barrier is not placed absolutely exactly in the center of the pendulum rod, the duration of a whole oscillation can still be determined exactly.

Measurement Nr.	Duration T ½ / s
1	
2	
3	
4	

Now the duration of a whole oscillation is determined: T = ……. s

The following formula for the mathematical pendulum is now used to determine the new pivot point:

$$lr = \frac{T^2 \times g}{4\,x\,\pi^2}$$ = ……. m = ……. cm



The pendulum rod is removed from the pivot bearing.
The mass body must not be loosened in the process!

The previously determined length "lr" is measured away from the "old" pivot point A and marked on the pendulum rod.

The pendulum rod is turned upside down and clamped centrally in the pivot bearing with the new marking A_1.

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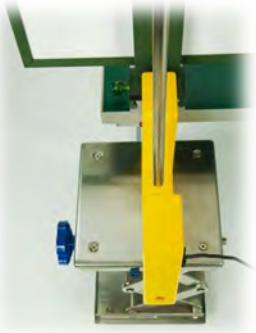

Experiment 2:

With the aid of the laboratory lifting table, the forked light barrier is adjusted again so that the pendulum rod hangs exactly in the center of the light signal of the light barrier.

As in experiment 1, the time duration of half a pendulum swing is measured and the average value is calculated.

Measurement Nr.	Duration T ½ / s
1	
2	
3	
4	

Now the duration of a whole oscillation is determined:

T = …….. s

In case of agreement, the reduced length of the pendulum has been found, whereby the acceleration due to gravity g can be determined from the transformed formula

$$g = \frac{lr\ x\ 4\ x\ \pi^2}{T^2}$$

Note:

The formula given by Huygens for the

period of oscillation of the physical pendulum is:

$$T = 2\pi \cdot \sqrt{\frac{I}{mg.s}}$$

I ... Moment of inertia with respect to the center of rotation
s ... Distance of the center of gravity from the center of rotation

mg . s is also called direction torque = backdriving torque, if the pendulum is horizontal.