

Mechanics

Oscillations

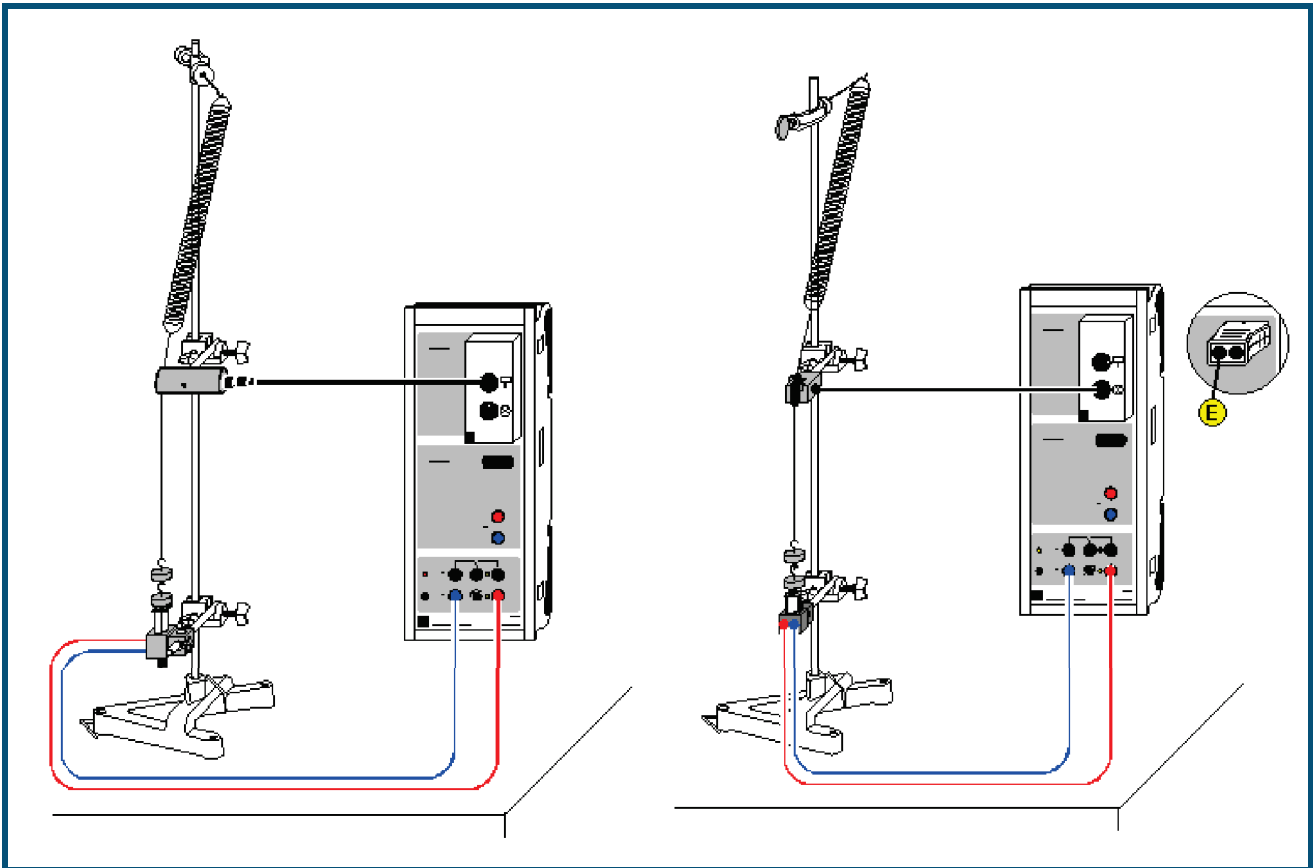
Harmonic oscillations

Determining the oscillation period of a spring pendulum as a function of the oscillating mass

Description from CASSY Lab 2

For loading examples and settings, please use the CASSY Lab 2 help.

Dependence of the period of oscillation of a spring pendulum on the oscillating mass



Experiment description

The harmonic oscillations of a spring pendulum as a function of the time t are recorded for various suspended masses. From the path-time diagram $s(t)$, the period of oscillation T is determined. A plot of T^2 as a function of the suspended mass m confirms the relation $T^2 = (2\pi)^2 \cdot m/D$ (D = spring constant).

Equipment list

1	Sensor-CASSY	524 010 or 524 013
1	CASSY Lab 2	524 220
1	BMW box	524 032
1	Motion sensing element	337 631
	or	
1	Timer S	524 074
1	Combination light barrier	337 462
1	Combination spoked wheel	337 464
1	Multi-core cable, 6-pole	501 16
1	Helical spring, 3 N/m	352 10
1	Set of 12 weights, each 50 g	342 61
1	Holding magnet	336 21
1	Stand base, V-shape, 28 cm	300 01
1	Stand rod, 25 cm	300 41
1	Stand rod, 150 cm	300 46
2	Leybold multiclamps	301 01
1	Clamp with hook	301 08
1	Fishing line, 10 m	from 309 48ET2
1	Pair of cables, 100 cm, red and blue	501 46
1	PC with Windows XP/Vista/7	

Experiment setup (see drawing)


- Clamp the stand rod in the stand base, and fasten the clamp with hook to the upper end of the stand rod.
- Suspend the spring from the hook, and elongate it via a piece of fishing line of approx. 45 cm length by means of the desired number of weights.
- Fasten a multiclamp with the motion sensing element close to the middle of the piece of fishing line.
- Lay the piece of fishing line over the deflection pulley of the motion sensing element so that the oscillations of the pendulum are transmitted to the motion sensing element without slip. In order to keep damping of the oscillation low, see to it that the axis of the spring does not deviate too much from the vertical.
- Position the holding magnet at the lower dead point of the oscillation of the spring pendulum.
- Connect the motion sensing element via the upper socket of the BMW box to the input A of the Sensor-CASSY.
- Connect the holding magnet to the output S of the Sensor-CASSY.

Experiment notes

The holding magnet provides a well-defined start of the oscillation by keeping the weights suspended for a particular measurement in the lower dead point of the oscillation. Depending on the number of suspended weights, the motion sensing element and the holding magnet have to be displaced vertically with respect to the position of the hook. The ideal position of the motion sensing element is close to the middle of the fishing line when the pendulum is in its equilibrium position.

Carrying out the experiment

■ Load settings

- Suspend the desired number of weights, and adjust the height of the holding magnet and of the motion sensing element.
- Calibrate the zero of the path s_{A1} in the equilibrium position of the pendulum – to do this, click the $\rightarrow 0 \leftarrow$ button in [Settings sA1](#).
- If required, invert the sign of the path measurement ($s \leftrightarrow -s$ button in [Settings sA1](#))
- Elongate the pendulum so that the weights are held by the holding magnet.
- Start the measurement with .
- When repeating a measurement, check the zero of the path in the equilibrium position of the pendulum before recording data.

Evaluation

For every path-time diagram, the period of oscillation T is determined by clicking [Measure Difference](#) with the right mouse button (or **Alt+D**) and subsequently clicking two corresponding zero passages with the left mouse button. The value of the period of oscillation then displayed in the status line can be transferred into the prepared display **Input** by means of the mouse (drag & drop). In addition, the mass m associated with T has to be entered in the table. By a fit to a [straight line](#) in the display **Evaluation**, the proportionality $T^2 \propto m$ is confirmed in a further step.

The spring constant D can be determined from the slope of the straight line. Note that the straight line does not pass the origin. For a description of this experiment result, the mass of the spring has also to be taken into account.

Hint

As a complete evaluation requires the experiment to be repeated for various masses m , the period of oscillation T would have to be determined manually in each case. Alternatively, the period of oscillation T can also be determined automatically. For this you only have to open the display instrument T' in the upper line. After the oscillation has been measured, the value display there can be copied directly into the display **Input** (drag & drop).

