Path-time recording (Item No.: P1003200)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physics	Age 16-19	Mechanics	Wave properties and oscillations	Path-time recording

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

Additional Requirements:

- Felt-tip pen
- White paper (DIN A4)

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

Using the leaf spring which the students have become familiar with in one of the previous experiments, they should now be made familiar with the recording of oscillations in a path-time diagram and attempt its evaluation.
The values determined for the oscillation periods with different masses and pendulum lengths can then be compared with the values directly determined with a stop watch in the experiment "Oscillation of a leaf spring".

Remarks

- Since it is necessary to pull the paper simultaneously under the oscillating leaf spring pendulum and measure the time, two students should always perform the experiment together.
- The methods in this experiment should primarily serve to illustrate the way in which a path-time recording is made. The measuring accuracy is of secondary concern.
- For the third part of the experiment, an oscillation which cannot easily be measured with a hand-held stop watch was deliberately chosen in order to demonstrate the use of path-time recording.

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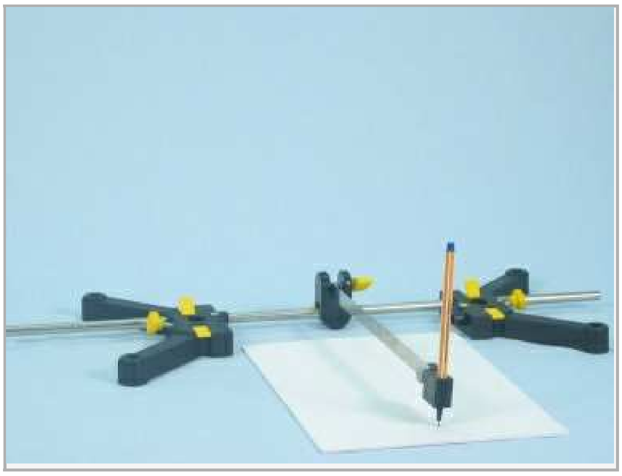
Task and equipment

Task

How can oscillations be recorded?

In this experiment you will plot the oscillations of a leaf spring with different masses and pendulum lengths on a piece of drawing paper. In each case, you will determine the oscillation period from the graphic recording of the oscillations.



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

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	Slotted weight, black, 10 g	02205-01	2
4	Slotted weight, black, 50 g	02206-01	1
5	Holding pin	03949-00	1
6	Stop watch 4	03078-00	1
7	Measuring tape, l = 2 m	09936-00	1
8	Leaf spring	02228-00	1
9	Leaf spring attachment	02228-05	1
Additional material			
	Felt-tip pen		
	White paper (DIN A4)		

Set-up and procedure

Set-up

Screw the split 600 mm support rod together (Fig. 1). Connect the two halves of the support base with the 600 mm support rod and tighten the locking levers (Fig. 2). Clamp the bosshead onto the support rod (Fig.3).


Fig. 1

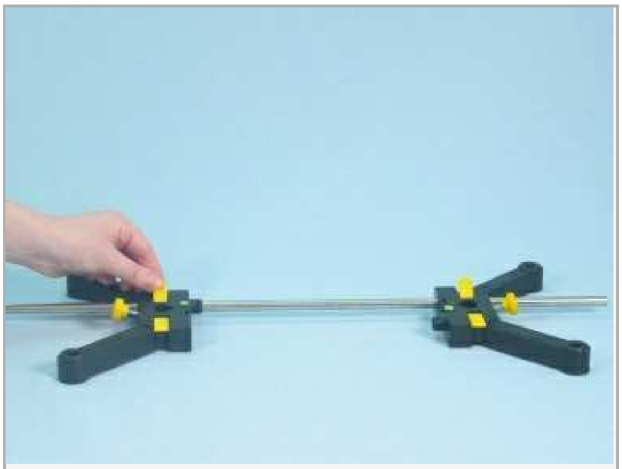


Fig. 2


Fig. 3

Set the distance between the two support base halves so that the sheet of paper easily passes between them without jamming. Stick the felt-tipped pen through the hole in the leaf spring attachment (Fig. 4). It should not be too loose, but still moveable. If necessary, wrap some paper or tape around it.

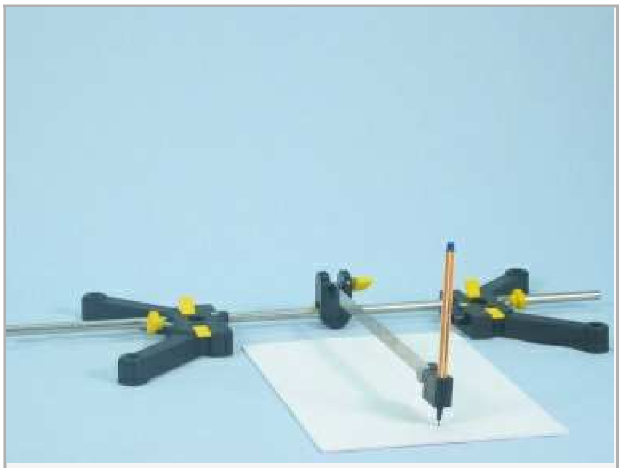


Fig. 4

Procedure

Practice

- Practice the recording procedure first!
- Attach the holding pin to the leaf spring attachment. (You can put slotted weights on the pin in order to increase the mass of the pendulum.)
- Pull the paper as uniformly as possible from the back to the front underneath the oscillating spring. Make sure that the plotted track is uniform.
- If necessary, correct the position of the leaf spring in the clamp.
- Simultaneously, determine the time t required to pull the paper completely past the pen.
- The evaluation is easier if you mark the position of the pen on the paper before initiating the oscillation.

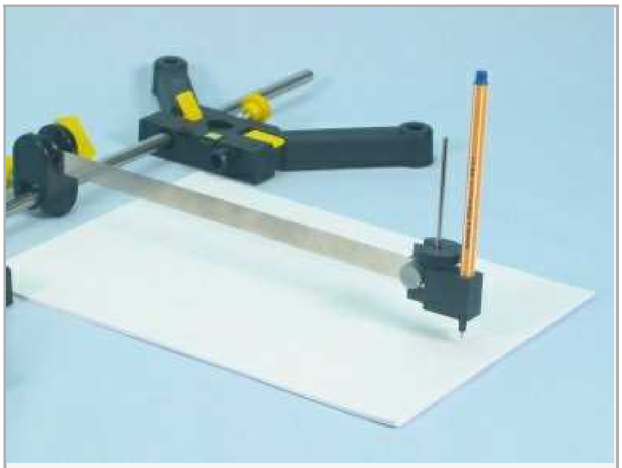


Fig. 5

Experiment

- Set the length of the leaf spring pendulum to l = 28 cm, and load the pendulum with an additional mass of 20 g (put slotted weight pieces on the holding pin).
- Set the pendulum in oscillation and record the oscillations as you have practiced. Simultaneously, determine the time t required to pull the paper completely past the pen.
- Repeat the recording twice.
- In each case, record the length l of the leaf spring, the additional mass m_a, total mass m and the elapsed time t in table 1 in the report.

- Repeat the experiment another three times, this time with an additional mass of 60 g. Again record l, m_a, m and t in table 1 in the report.

- Shorten the pendulum length to l = 14 cm, use a 20 g mass again, and repeat the experiment another three times. Again record l, m_a, m and t in table 1 in the report.

Report: Path-time recording

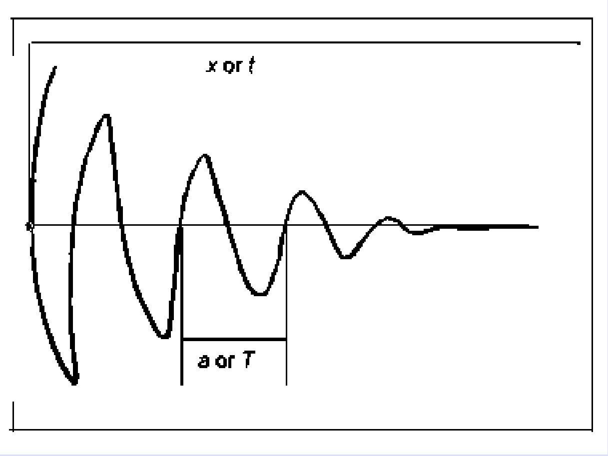
Result – Table 1

Enter measured values in the Table.

Mass of the leaf spring attachment (including holding pin): 27 g.

Determine the scaling of the respective time axes of your records: measure the distance *x* (see Fig. below) and record *x* and *t* in Table 1 on the Results page. Calculate the time t_1 (=scaling factor) for a distance of 1 cm.

Establish the oscillation period *T* from the recorded diagrams: determine the length *a* of one oscillation (see Fig. below) by averaging several recorded oscillations. Using *a* and the scaling factor t_1, calculate the oscillation period *T*. Record the values in table, and form the average value from the results of three sets of *T*-measurements.



m_a in g	*m* in g	*l* in cm	*t* in s	*x* in cm	t_1 in s	*a* in cm	*T* in s	*T* in s (average value)
0	0	0	0	0	0	0	0	0
			0	0	0	0	0	
			0	0	0	0	0	
0	0	0	0	0	0	0	0	0
			0	0	0	0	0	
			0	0	0	0	0	
0	0	0	0	0	0	0	0	0
			0	0	0	0	0	
			0	0	0	0	0	

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Evaluation – Question

Compare the values for the oscillation period as determined above with the values directly measured with a stop watch in the experiment "Oscillation of a leaf spring". Do they agree? What could be causes for disagreements?

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