Harmonic Oscillation

Physics | Acoustics | Wave Motion

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f513269739d0a0003ee3f1e

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Teacher information

Application

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harmonic oscillation

This experiment lays the foundation for the understanding of the harmonic oscillator. We encounter the harmonic oscillator everywhere in physics. In classical mechanics it is used to describe spring and thread pendulums, in electrodynamics it is used to describe electromagnetic oscillating circuits and even in quantum mechanics.

Students should become familiar with the terms "amplitude", "period duration" and "frequency" in connection with harmonic oscillations. These terms are essential for acoustics.

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Other teacher information (1/2)

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Prior knowledge

Before conducting the experiment, students should know that the term oscillation refers to a periodic process. They should also be able to characterise sounds by their volume and pitch.

Scientific principle

A harmonic oscillation is a periodic movement around a rest position in which the restoring force is proportional to the displacement from the rest position. It is characterized by amplitude and period duration or frequency. The students work out these parameters using the vibration examples of an oscillating ruler and a spring pendulum.

Other teacher information (2/2)

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Learning objective

A harmonic oscillation is characterized by the amplitude and the period duration or frequency. The amplitude describes the maximum deflection. The period duration indicates the time the oscillator requires to complete a period and the frequency describes how many oscillations take place per unit of time.

Tasks

Two examples of a vibration shall be considered in this experiment: That of a ruler on the edge of a table and that of a spring pendulum. Both oscillations are observed and then it is considered which quantities can be used to describe these oscillations.

The second part of the experiment (spring pendulum) is to be carried out in partner work.

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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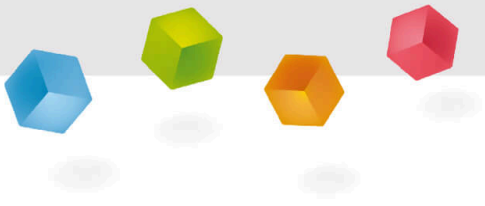

Student Information

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Motivation

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Ambulance

Sound waves are usually generated in places where a medium, e.g. air, is compressed and can then expand again. Sounds are caused by repetitive movements, which are called oscillations. Vibrations and take place all around us, radio and television programmes are transmitted by waves generated by vibrations, sound is nothing more than a wave and even in the atoms vibrations take place.

Tasks

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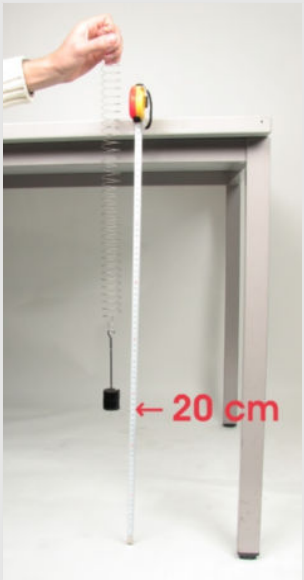

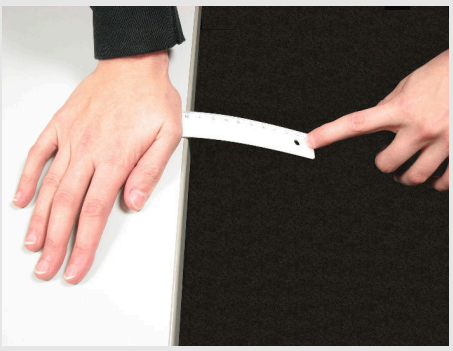

- Observe the oscillation of a ruler on a table edge.
- Let a weight swing up and down on a spring and consider which parameters can be used to describe this vibration.

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Equipment

Position	Material	Item No.	Quantity
1	Ruler, plastic, 200 mm	09937-01	1
2	Measuring tape, l = 2 m	09936-00	1
3	Helical spring, 3 N/m	02220-00	1
4	Weight holder, 10 g	02204-00	1
5	Slotted weight, black, 50 g	02206-01	2
6	Digital stopwatch, 24 h, 1/100 s and 1 s	24025-00	1

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Procedure (1/3)

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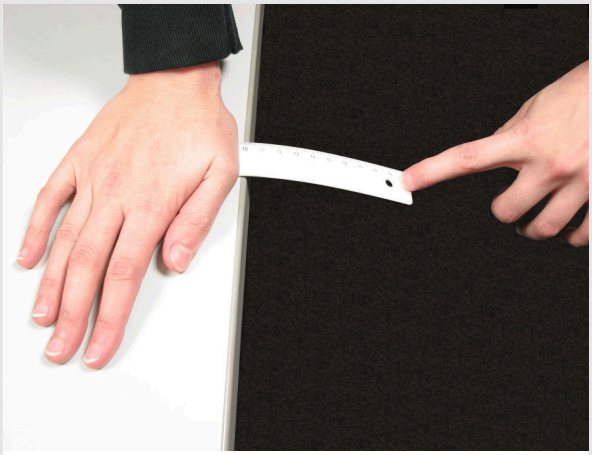

oscillation of a ruler

- Put the ruler on the table. Hold it with one hand. The hand should be as close as possible to the edge of the table, but not over the edge.
- Now press down the ruler at its free end so that it starts to swing when you let go.
- Repeat this process a few times. Also changes the oscillating length of the ruler.

Procedure (2/3)

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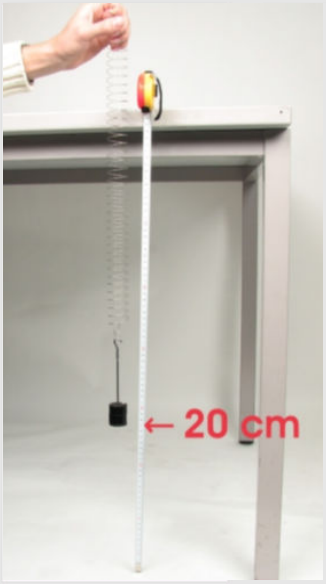

- Pull the tape measure so far out of the roll that it reaches from the table to the floor without kinking. Stick the tape to the edge of the table with a strip of adhesive tape. The scale should face you, the zero point of the scale should be exactly on the floor.
- Student 1: Hold the spring at one end and hang the weight on the other end. The spring stretches into a rest position.
- Student 1: Now hold the spring and weight in front of the tape measure so that the weight hangs 20 cm above the ground, i.e. at the "20 cm" mark on the tape measure.

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Procedure (3/3)

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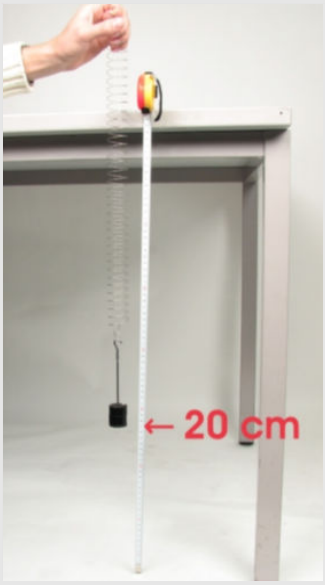

- Student 1: Keep your hand steady in the same place; Student 2: Pull the weight 20 cm down to the floor (0 cm) and release it.
- Observe the spring pendulum and repeat the process with exchanged rollers. Watch carefully how the position of the weight changes over time.
- Student 1: Hold the spring pendulum in the same position as before; Student 2: Take a stopwatch and pull the weight back 20 cm to the ground. When releasing the weight, press the stopwatch start button at the same time.
- Stops the time it takes the weight to complete 10 full vibration cycles. Notes the result in the protocol.

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Report

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Task 1

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How does the free end of the Linal move? (Mark all correct)

- [ ] It always moves from the rest position down and back to the rest position.
- [ ] It swings evenly up and down around the rest position.
- [ ] The highest and lowest points of the movement move closer and closer to the resting position over time.
- [ ] The highest and the lowest point of the movement does not change with time.

Check

Task 2

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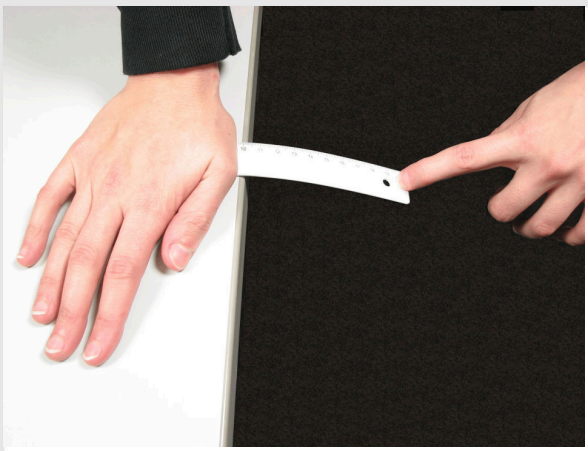
Drag the words to the right place

With the swinging ruler, the sound is produced directly at the _____. There the _____ is made to vibrate so that the _____ can move through the room as a wave. The further you move the ruler, the _____ the sound is. If you leave the ruler further over the table, the sound is _____.

deeper | louder | air | tone | ruler

Check



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Task 3

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	Pass 1	Flow 2	Pass 3	Pass 4	Pass 5
Time for 10 oscillations / s					

Rest position Weight in cm	Highest position Weight in cm

Task 4

PHYWE

Drag the words to the right place

The weight on the spring pendulum swings up and down just like the free end of the ruler. With such oscillations, the farthest displacement from the rest position is called amplitude. The amplitude of the spring pendulum is calculated: _____ - _____ = _____ .
The amplitude of both oscillations is determined by the _____ at the beginning. The _____ the amplitude of the ruler, the _____ the sound.

deflection
louder
resting position
Highest point
greater
Amplitude

Check

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Task 5

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An oscillation process can take place at different speeds. The period of oscillation or period duration is the time required by an oscillating object to pass through the oscillation (also called period). Calculate the period duration of the spring pendulum oscillation.

Period duration in s: duration

The reciprocal value of the period duration indicates the number of oscillation cycles per second. This quantity is called the frequency of an oscillation. Calculate the frequency of the spring pendulum oscillation.

Frequency in duration

Task 6

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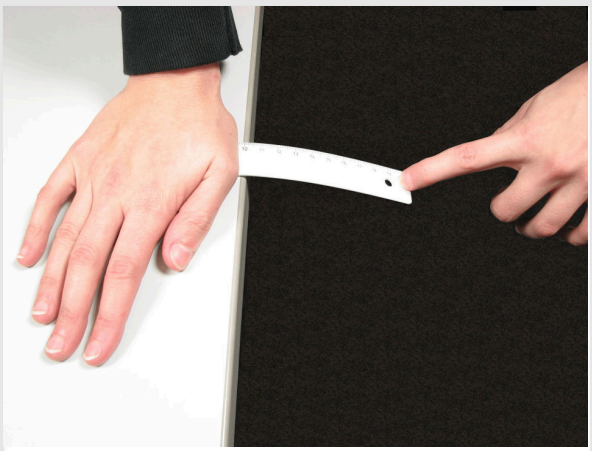
Fill the gaps

The longer the free end of the ruler, the [ ] the frequency. The shorter the free end, the [ ] the frequency. If the frequency of the ruler is greater, the sound produced is [ ]. If it is smaller, the sound produced is [ ].

Check



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Slide	Score / Total
Slide 14: Movement of the ruler	0/2
Slide 15: Sound through a ruler	0/5
Slide 17: Oscillation of a spring pendulum	0/6
Slide 19: Frequency of the ruler	0/4

Total amount 0 / 17

Solutions | Repeat | Exporting text

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