

## Coupled pendula with Cobra SMARTsenseexpert version

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### Principle

Two equal gravity pendula with a particular characteristic frequency are coupled by a "soft" spiral spring. The amplitudes of both pendula are recorded as a function of time for various vibrational modes and different coupling factors. The coupling factors are determined by different methods.

### Benefits

- Large and sturdy set-up suitable for demonstration and lab courses as well
- Live data-logging system to measure the oscillations of both pendula at once

### Tasks

1. To determine the spring constant of the coupling spring.
2. To determine and to adjust the characteristic frequencies of the uncoupled pendula.
3. To determine the coupling factors for various coupling-lengths using a) the apparatus constant, b) the angular frequencies for "inphase" and "in opposite phase" vibration, c) the angular frequencies of the beatmode.
4. To check the linear relation between the square of the coupling lengths and a) the particular frequencies of the beat mode, b) the square of the frequency for "inopposite phase" vibration.
5. To determine the pendulum's characteristic frequency from the vibrational modes with coupling and to compare this with the characteristic frequency of the uncoupled pendula.

### Learning objectives

- Spiral spring
- Gravity pendulum
- Spring constant
- Torsional vibration
- Torque
- Beat
- Angular velocity
- Angular acceleration

- Characteristic frequency

## Scope of delivery

Pendulum with recorder connection	02816-00	2
Helical spring, 3 N/m	02220-00	1
Rod with hook	02051-00	1
Weight holder, 10 g	02204-01	1
Slotted weight, silver bronze, 10 g	02205-03	5
Cobra SMARTsense Voltage - Sensor for measuring electrical voltage $\pm 30$ V (Bluetooth + USB)	12901-01	2
USB charger for Cobra SMARTsense and Cobra4	07938-99	1
measureLAB, multi-user license	14580-61	1
PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
Bench clamp expert	02011-00	2
Support rod, stainless steel, different lengths	02033-00	2
Right angle clamp expert with fulcrum screw	02054-00	4
Measuring tape, l = 2 m	09936-00	1
Connecting cord, 32 A, 500 mm, red	07363-01	2
Connecting cord, 32 A, 500 mm, blue	07363-04	2
Support rod, stainless steel, different lengths	02032-00	1