Mechanics

Oscillations

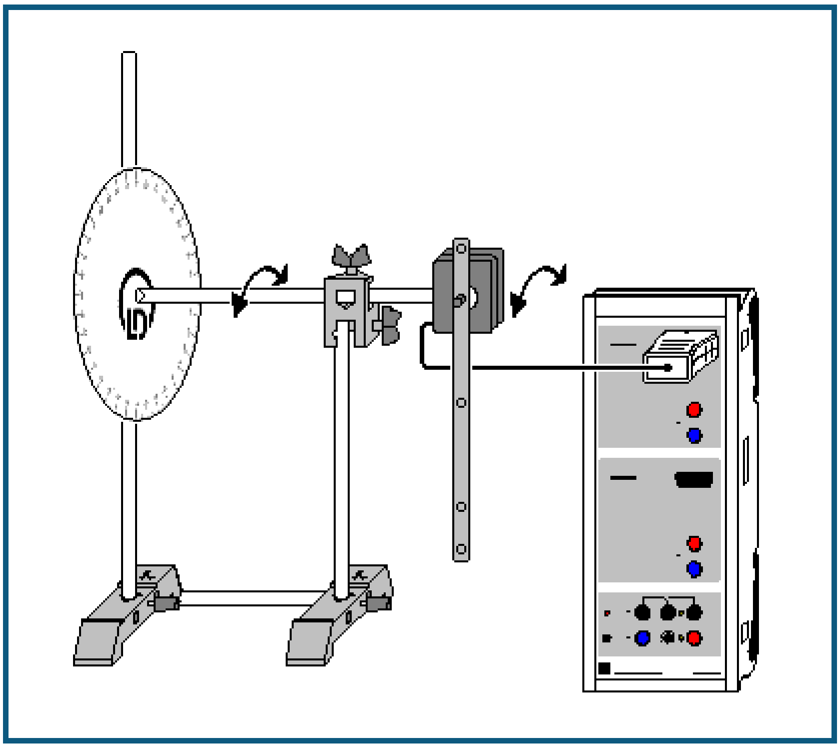
Simple and compound pendulum

Pendulum with changeable acceleration due to gravity (variable g-pendulum)

Description from CASSY Lab 2

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

Pendulum with changeable acceleration due to gravity (variable g-pendulum)



can also be carried out with Pocket-CASSY

Experiment description

With a variable g-pendulum (pendulum after Mach) only the component g·cos ϑ of the earth's gravitational acceleration affects the pendulum. Depending on the inclination ϑ, different oscillation periods result

$T = 2\pi\cdot\text{sqrt}(l_r/g/\cos\vartheta)$

with the reduced pendulum length l_r = J/ms.

In the experiment, the oscillation period is investigated depending on the angle of inclination. Alternatively, the acceleration due to gravity of a number of simulated celestial bodies can be determined. The reduced pendulum length l_r = 17.5 cm was calculated in the experiment Oscillations of a rod pendulum and confirmed experimentally. The effective part of the acceleration due to gravity is therefore $a = g\cdot\cos\vartheta = l_r\cdot 4\pi^2/T^2 = 6.91\ \text{m}/T^2$.

On the printable angle scale the settings for

Celestial body	ϑ	g·cos ϑ
Earth (reference location)	0°	9.81 m/s^2
Venus	25.3°	8.87 m/s^2
Mars	67.8°	3.71 m/s^2
Mercury	67.8°	3.70 m/s^2
Moon	80.5°	1.62 m/s^2
Pluto	86.6°	0.58 m/s^2

are already entered.

Equipment list

1	Sensor-CASSY	524 010 or 524 013
1	CASSY Lab 2	524 220
1	Rotary motion sensor S	524 082
1	Physical pendulum	346 20
1	Angle scale with the entered celestial bodies	print out
1	Leybold multiclamp	301 01
2	Stand rods, 25 cm, d = 10 mm	301 26

1	Stand rod, 50 cm, d = 10 mm	301 27
2	Stand bases MF	301 21
1	PC with Windows XP/Vista/7/8	

Experiment setup (see drawing)

The pendulum is screwed on the axle of the rotary motion sensor. The scale is pushed onto the stand rod of the rotary motion sensor. To do this cut the scale as indicated by means of a sharp knife.

Carrying out the experiment

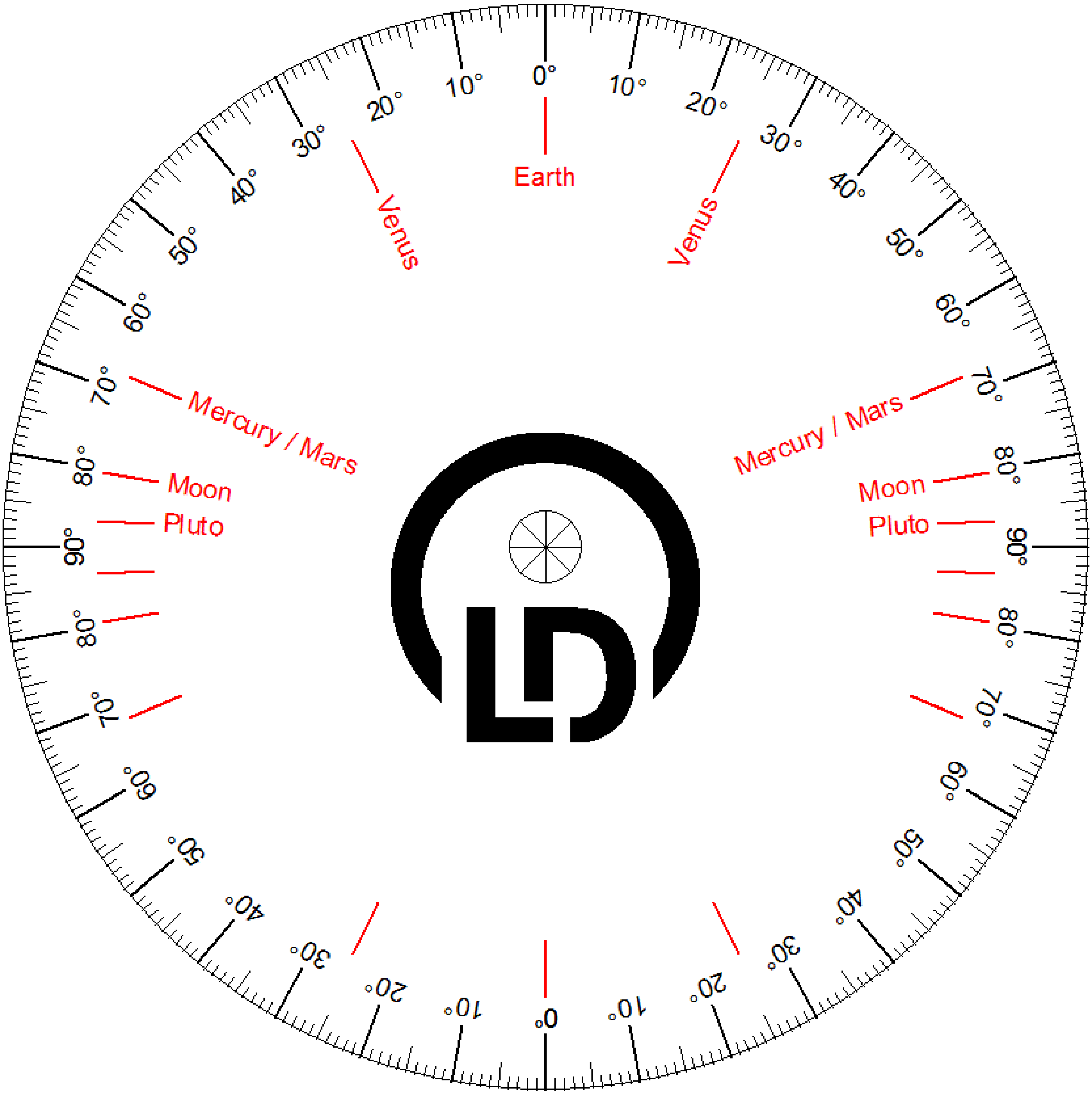
- Load settings
- Set up pendulum vertically (ϑ = 0°), align the experiment setup and deflect the pendulum by approximately 10°
- Once the displayed value for the oscillation period T_{A1} has settled to a constant value, start the measurement by pressing and enter the angle in column ϑ (click with the mouse onto the table cell)
- Increase the angle repeatedly by 10° and repeat measurement until ϑ = 80° is reached.

Evaluation

During the measurement, the effective part of the acceleration due to gravity $a = l_r \cdot 4\pi^2/T^2$ with l_r = 17.5 cm is entered into the diagram.

With a free fit the relationship $a = g \cdot \cos\vartheta$ can easily be confirmed.

Alternatively, a range of celestial bodies can be simulated and their acceleration due to gravity determined. To do this align the pendulum with the red markers on the angle scale.


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
Earth
Venus
Venus
Mercury / Mars
Mercury / Mars
Moon
Moon
Pluto
Pluto