

Motions  
Free fall

Determining the acceleration of gravity  
with a light barrier and electronic stop clock

## Objects of the experiment

1. Measuring the time of fall  $t$  of a body for different distances of fall  $s$
2. Calculating the acceleration of gravity  $g$

## Setup



- In order to reduce the magnetic adhesion of the ball, stick a strip of adhesive tape to the front side of the holding magnet.
- Adjust the screw of the holding magnet so that the ball just adheres to the magnet.

In order that the holding magnet and the light barrier are always aligned exactly one above the other, a plumb should be used.

- Determining the distances of fall:
- Suspend the ball from the holding magnet.
- Slide the light barrier up the stand rod until the ball interrupts the ray and the red LED at the light barrier lights up.
- Using the felt tip pen, mark this point at the stand rod as the zero (upper edge of the light barrier housing) .
- Measure distances of 0.2 m, 0.4 m, 0.6 m, 0.8 m, and 1.0 m from the zero, and mark them at the stand rod as well.

## Apparatus

1 Holding magnet.....	336 21
1 Steel ball, 16 mm .....	352 54
1 Fork-type light barrier .....	337 46
1 Electronic stop-clock P.....	313 033
1 Metal Rule, 1 m.....	311 02
1 Stand base, V-shape, large.....	300 01
1 Stand rod, 150 cm, 12 mm diam. ....	300 46
1 Stand rod, 25 cm, 12 mm diam. ....	300 41
1 Leybold multiclamp .....	301 01
2 Connecting leads, 32 A, 200 cm, black .....	501 38
1 Multi-core cable, 6-pole, 1.5 m .....	501 16
1 Black felt-tip pen, medium size, set of 5 .....	667 019ET5

## Carrying out the experiment

- Position the light barrier at a distance of 0.2 m from the holding magnet.
- Release the motion by pressing the START/STOP key of the stopclock.
- Read the time of fall from the stopclock when the ball has passed the light barrier.
- Reset the stopclock to zero by pressing the RESET key.
- Position the light barrier at distances of 0.4 m, 0.6 m, 0.8 m, and 1 m from the zero. Repeat the measurement for each distance.
- Calculate the acceleration of gravity  $g$  from the quotient  $\frac{2s}{t^2}$  .

## Measuring example

Distance $s$ in m	*Time $t$ in s	Acceleration of gravity $g$ in m/s <sup>2</sup>
0.2	0.20	10.00
0.4	0.29	9.52
0.6	0.35	9.83
0.8	0.41	9.52
1.0	0.46	9.43
		Mean value: 9.66

\*Time  $t$  : mean value of three measured values

## Evaluation

The mean value for the acceleration of gravity calculated from the measured values is:  $g = 9.66 \text{ m/s}^2$ .

The table value is:  $g = 9.81 \text{ m/s}^2$ .