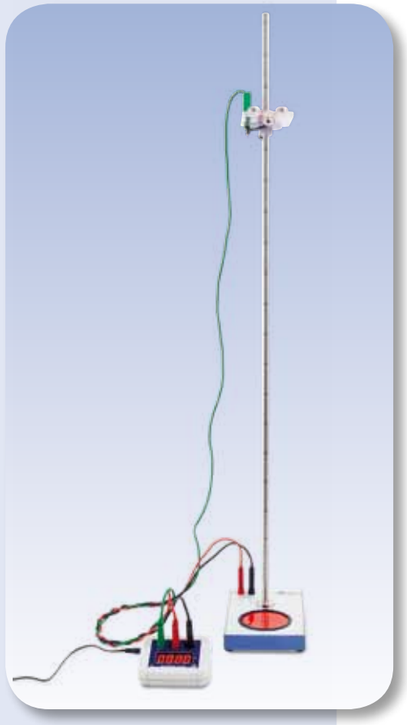
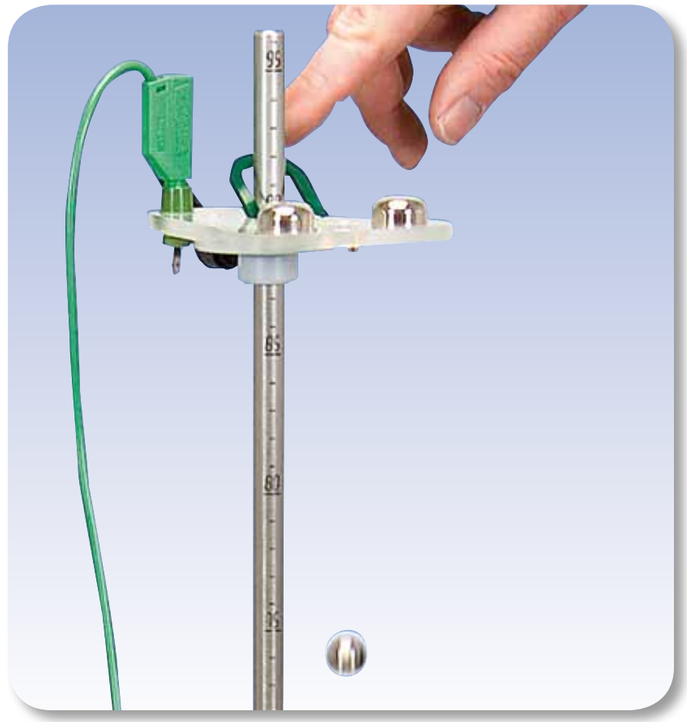
UE1030300 FREE FALL





EXPERIMENT PROCEDURE

- **Measure the time *t* that a ball takes to fall a distance *h* between a release mechanism and a target plate at the bottom.**
- **Draw points for a displacement/time graph for a uniformly accelerating motion.**
- **Verify that the distance fallen is proportional to the square of the time.**
- **Calculate the acceleration due to gravity *g*.**

OBJECTIVE

Determine the gravitational acceleration.

SUMMARY

In free fall the distance fallen *h* is proportional to the square of the time *t* taken to fall that distance. The coefficient of that proportionality can be used to calculate the gravitational acceleration *g*.

REQUIRED APPARATUS

Quantity	Description	Number	
1	Free-fall Apparatus	**1000738**	
1	Millisecond Counter (230 V, 50/60 Hz)	**1012833**	**or**
	Millisecond Counter (115 V, 50/60 Hz)	**1012832**	
1	Set of 3 Safety Experiment Leads	**1002848**	

BASIC PRINCIPLES

If a body falls to the ground in the Earth's gravitational field from a height *h*, it undergoes a constant acceleration *g*, as long as the speed of the fall is slow so that friction can be ignored. Such a falling motion is called free fall.

In this experiment a steel ball is suspended from a release mechanism. As soon as it is released into free fall, an electronic timer is started. After it has fallen a distance *h* the ball hits a target plate at the bottom which stops the time measurement at a time *t*.
Since the ball is not moving before it starts to fall at time $t_0 = 0$ its initial velocity is zero, i.e. $v_0 = 0$. Therefore the distance covered in time *t* is given as follows

(1) $$h = \frac{1}{2} \cdot g \cdot t^2$$

EVALUATION

First variant:
Fall times change in the ratio 2:1 if the height of the fall changes in the ratio 4:1. This confirms that the height is proportional to the square of the time.

Second variant:
Measurements for various heights of fall should be plotted on a displacement/time graph. The height *h* is not linearly proportional to the time *t*, as can be confirmed by attempting to match the curve to a line then to a parabola. To obtain a straight line, the height should be plotted against the square of the time. The straight-line relationship found in this way confirms equation (1). The gradient of such a line corresponds to the acceleration due to gravity.

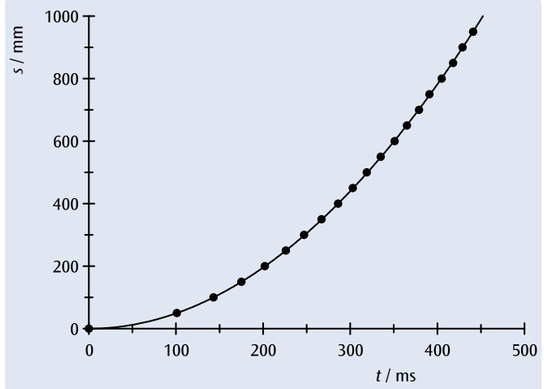


Fig . 1: Time-displacement diagram for free fall.

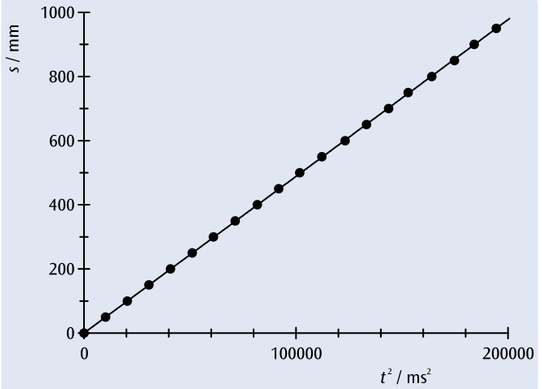


Fig. 2: Height plotted against the square of time