

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

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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

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

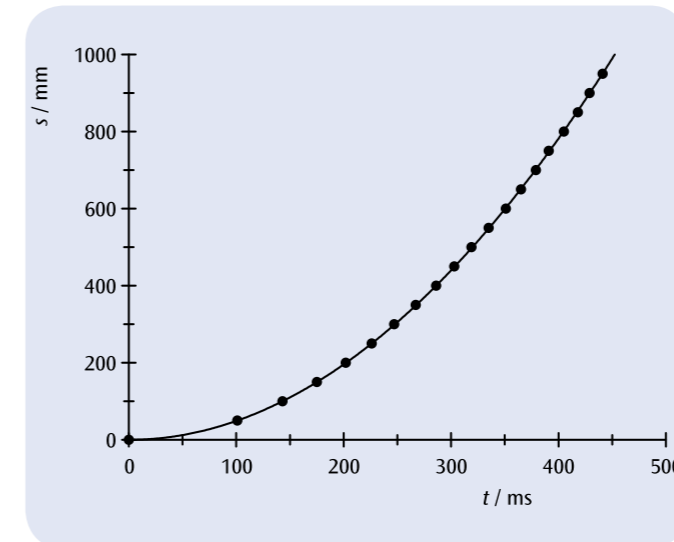


Fig. 1: Time-displacement diagram for free fall.

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.

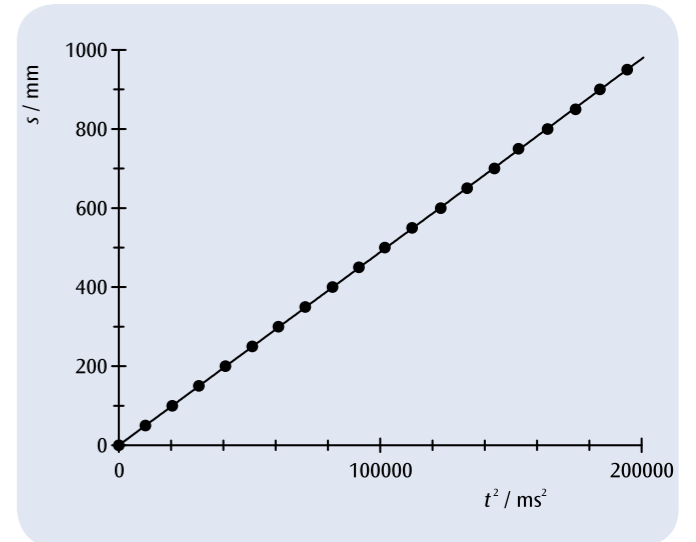


Fig. 2: Height plotted against the square of time