Related topics

Motion along a straight line due to constant acceleration, laws of falling bodies, gravitational acceleration.

Principle and task

A sphere falling freely covers certain distances. The time of fall is measured, and evaluated from diagrams. From this, the acceleration due to gravity can be determined.

Equipment

Falling sphere apparatus consisting of	02502.88	1
Release unit	02502.00	1
Impact switch	02503.00	1
Digital counter, 4 decades	13600.93	1
Support base -PASS-	02005.55	1
Right angle clamp -PASS-	02040.55	2
Plate holder	02062.00	1
Cursors, 1 pair	02201.00	1
Meter scale, demo, l = 1000 mm	03001.00	1
Support rod-PASS-, square, l = 1000 mm	02028.55	1
Connecting cord, 1000 mm, red	07363.01	2
Connecting cord, 1000 mm, blue	07363.04	2

Fig. 1: Test set up for free fall.

Problems

1. To determine the functional relationship between height of fall and time of fall ($s = s(t)$).
2. To determine the acceleration due to gravity.

Set-up and procedure

The set up is shown in Fig. 1. An electrically conducting sphere is gripped in the release mechanism which closes the start circuit.

The pan is adjusted, using the adjusting screw under the arrest switch, so that a downward movement of a few tenths of a millimetre closes the stop circuit. The pan is raised by hand after each test (initial position).

For the effective determination of the height of fall using the marking on the release mechanism, the radius of the sphere must be taken into account (diameter 3/4 inch, approx. 19 mm). The aerodynamic drag of the sphere can be disregarded.

Theory and evaluation

If a body of mass m is accelerated from the state of rest in a constant gravitational field (gravitational force $m\vec{g}$), it performs a linear movement. By applying the coordinate system so that the x axis indicates the direction of motion, and solving the corresponding one- dimensional equation of motion:

$$m \frac{d^2h(t)}{dt^2} = m \cdot g$$

We obtain, for the initial conditions

$$h\,(0) = 0$$

$$\frac{dh(0)}{dt} = 0$$

the coordinate h as a function of time,

$$h(t) = \frac{1}{2}\, gt^2 \qquad (1)$$

From the regression line of the data of Fig. 3, we get

$$g = 9.76\ \frac{m}{s^2}\ .$$

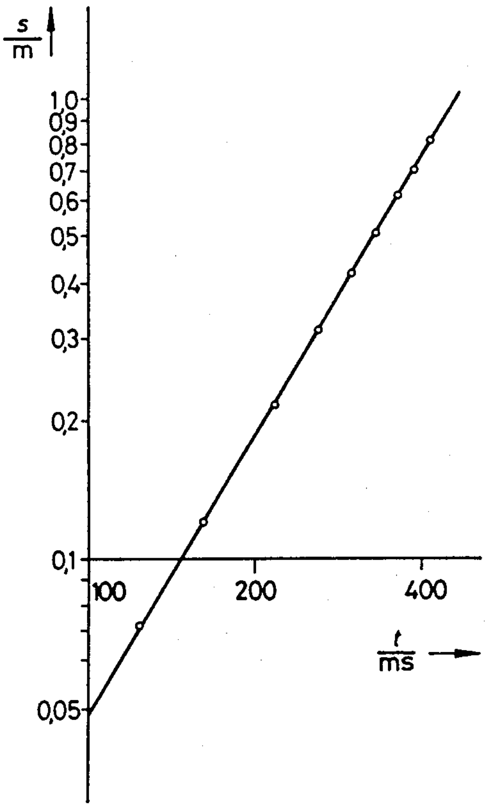

Fig. 2: Relationship between height of fall and time of fall.

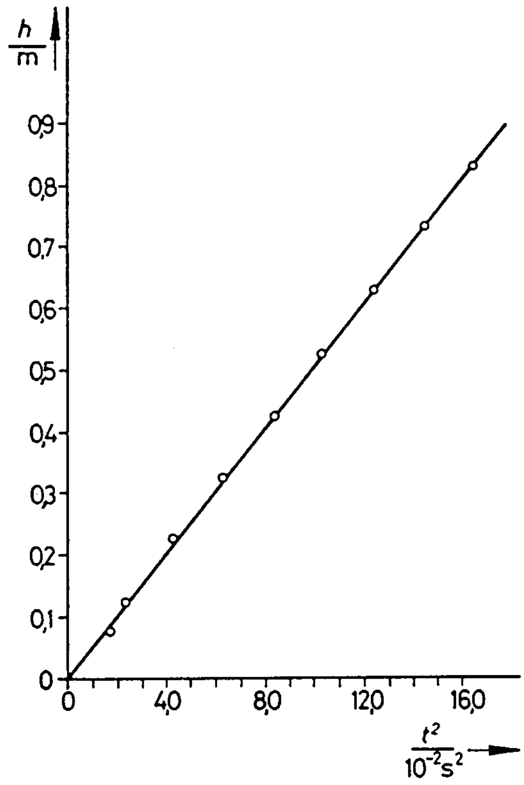

Fig. 3: Determination of the acceleration due to gravity.