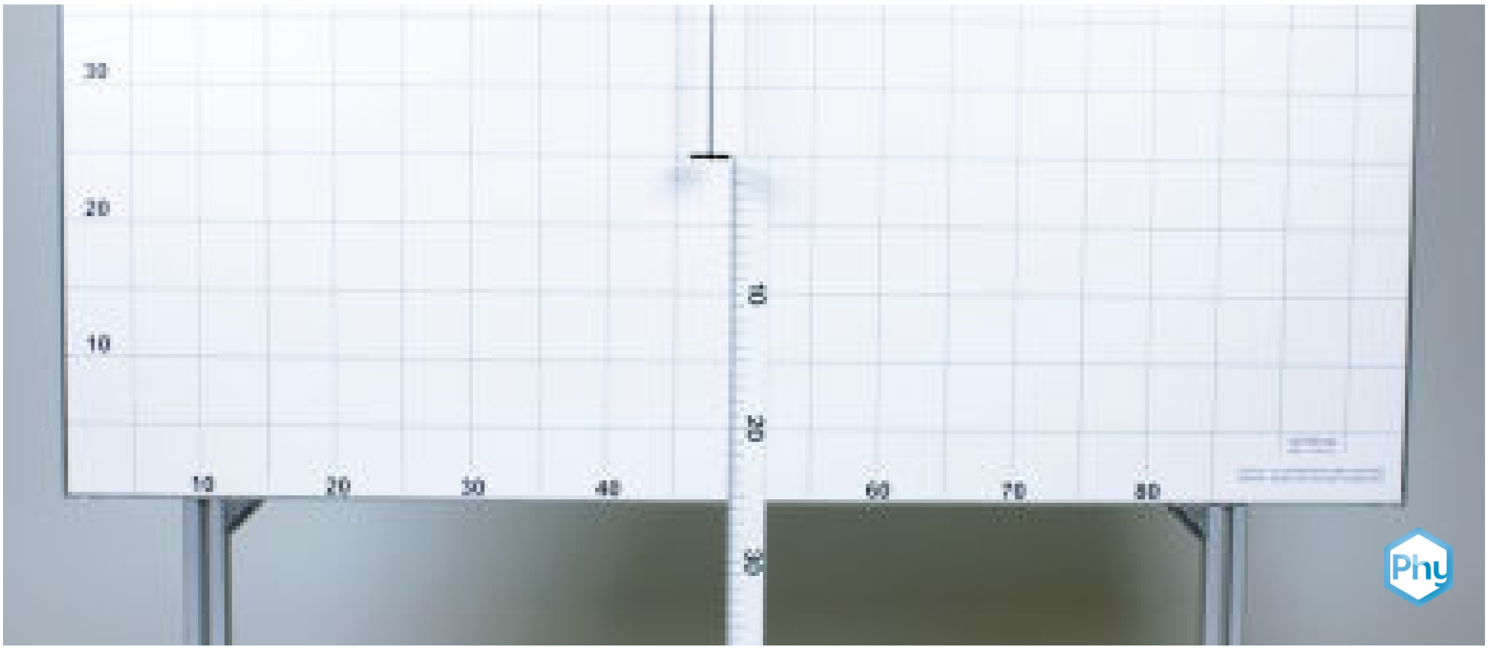
Mass and weight



Physics | Mechanics | Forces, work, power & energy

Difficulty level	Group size	Preparation time	Execution time
medium	-	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/64725968e1994e000281c7e2

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General information

Application

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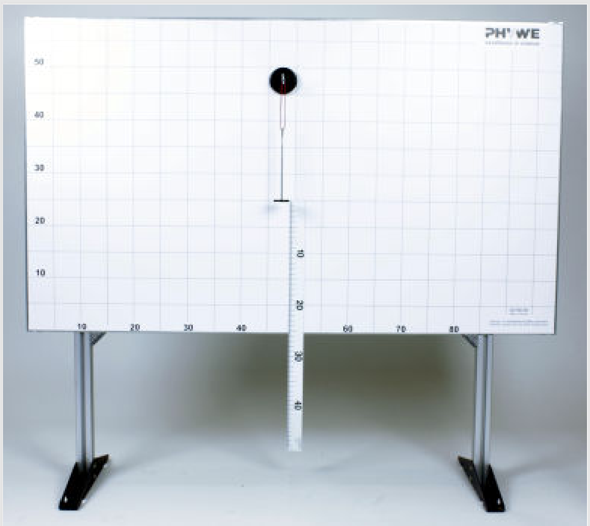

Figure 1: Experimental setup

The weight force of an object results from its mass m and the acceleration due to gravity g:

$$F = m \cdot g$$

This is a directed force that points towards the earth's centre of gravity. Put simply, the force always acts in the direction of the ground, regardless of where you are on the earth.

Gravitational acceleration is approximately $g = 9,81 m/s^2$.

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Other information (1/2)

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Prior knowledge

No previous knowledge required.

Principle

The weight force of a body is proportional to its mass.

Other information (2/2)

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Learning objective

With the help of a spring force meter, it is to be demonstrated that the weight force of a body is proportional to its mass.

Tasks

Measuring the weight of a mass using a spring gauge.

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Safety instructions

The general instructions for safe experimentation in science lessons apply to this experiment.

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Torsion dynamometer	03069-03	1
3	Weight holder, 10 g	02204-01	1
4	Slotted weight, silver bronze, 10 g	02205-03	2
5	Slotted weight, silver bronze, 10 g	02205-03	2
6	Slotted weight, silver bronze, 50 g	02206-03	1
7	Slotted weight, silver bronze, 50 g	02206-03	1
8	G-clamp	02014-01	2

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Set-up and Procedure

Set-up

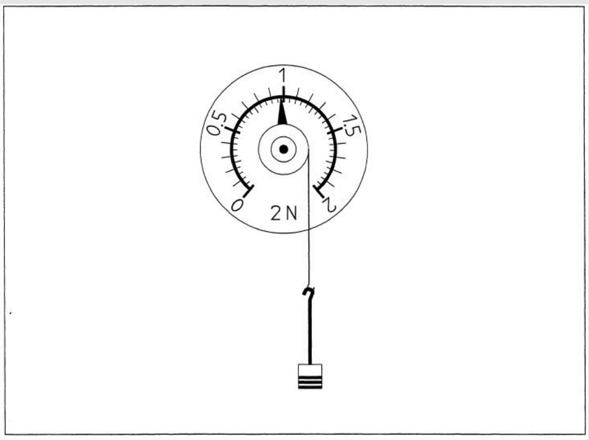

Figure 2

- Set up experiment according to Fig. 2
- Set the pointer of the force gauge to zero
- Equip weight plates with four slotted weights of 10 g each (with alternating colours) and attach to the dynamometer

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Procedure

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- Read and record the Weight force F_G
- Load the weight plates one after the other with slotted weights of 50 g each (with alternating colours), read off the respective weight force and record it.

Evaluation (1/4)

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Table 1 shows sample values for the test carried out:

m/g	F_G/N	m/kg	$\frac{F/m}{N/kg}$
50	0,49	0,05	9,8
100	0,97	0,10	9,7
150	1,45	0,15	9,7
200	1,95	0,20	9,8

Table 1

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Evaluation (2/4)

The graphical representation of the measured values (Fig. 2) results in a straight line through the zero point of the F_G-m coordinate system.

From this, it follows that a proportional relationship between the weight force F_G and the mass m in the experiment used body consits of:

$F_G \sim m$

This relationship is equivalent to F_G/m = constant, which can be confirmed by subsequent quotient formation.

(see Table 1, column 4). If, as in Table 1, the mass of the test specimens in kg is used for the quotient formation, then

The mean value is approximately:

$F_G/m = 9,8 N/kg$

Evaluation (3/4)

A body with a mass of 1 kg thus experiences a weight force of 9.8 N. Or: 1 N is the weight force experienced by a body with a mass of 102 g.

The value 9.8 N/kg corresponds to the gravitational acceleration g. If the result of the experiment is written in the form

$F_G = m \cdot g$

then one obtains a special form of Newton's basic law $F = m \cdot a$.

From this it can be concluded: The weight force $\vec{F_G}$ gives a freely falling body the acceleration $\vec{g}$ (acceleration due to gravity).

The acceleration due to gravity depends on the location. The following applies to Central Europe: $g = 9,81 m/s^2$.

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Evaluation (4/4)

These considerations can be taken up in the treatment of free fall in kinematics or in connection with the treatment of Newton's fundamental law. Then the unit Newton can also be introduced:

$1N = 1kg \cdot m/s^2$

In the initial treatment of the connection between weight force and mass, one will limit oneself to the above-mentioned illustrative version of the experimental result, i.e. that 1 N is the weight force experienced by a body with the mass 102 g (e.g. a 100 g bar of chocolate with packaging).

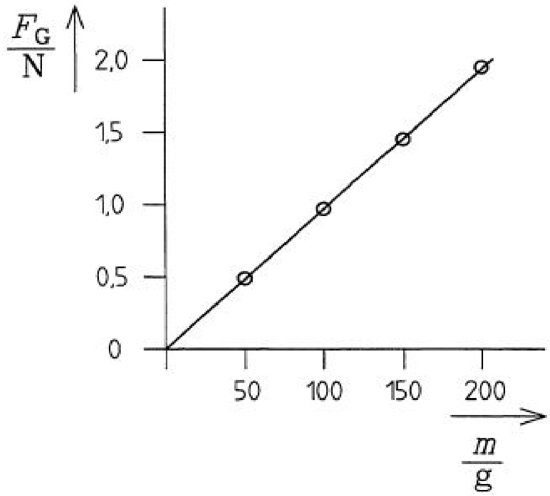

Figure 3

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