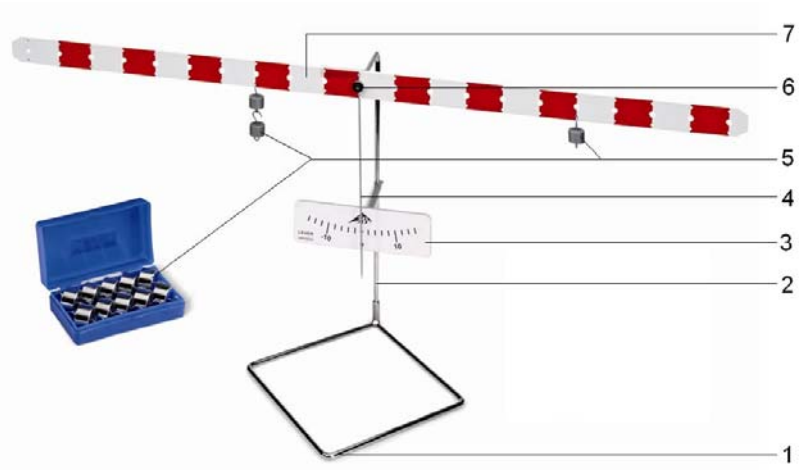
Lever 1008539

Instruction sheet

01/13 ALF



1 Stand base
2 Stand rod
3 Scale
4 Pointer
5 Weights
6 Holder with ball bearing and knurled nut
7 Lever arm

1. Description

Equipment set to demonstrate the law of the lever, used in experiments on equillibrium and beam-type model scales.

The equipment kit consists of a stand upon which a lever arm is mounted on a ball bearing. There are drilled holes in the middle of the arm running along the arm's axis. These are used to suspend weights from in order to shift the fulcrum's position. A red and white block scale permits a rapid reading of the lever arm's length. A scale with pointer attached to the stand permits precise display of the state of equilibrium.

2. Technical data

Length of lever:	1 m
Mass of lever:	0.458 kg
Number of holes:	21
Separation of holes:	50 mm
Set of weights:	10x 50 g

3. Operating principle

The lever belongs to the class of simple machines. The machine we are normally dealing with here is a straight or angled bar. The lever can pivot around an axis (fulcrum) and utilize forces operating at a distance from the fulcrum.

Each force results in a torque, which is all the greater in magnitude, the greater the force and the longer the force's line of action is to the rotation axis (length of the arm). A lever with its fulcrum at position O, upon which forces *F* and *G* are acting, is in equilibrium, if the left hand torque is equal to the right hand torque (law of levers: force multiplied by the force arm equals load multiplied by the load arm). The following holds true for the forces *F*, *G* and the lever arm lengths L_1, L_2:

$$G \cdot L_1 = F \cdot L_2$$

If the fulcrum of the lever is exactly between the application points of the two forces, this is called a two-arm lever (Fig. 2), if the forces are located on the same side this is termed a single-arm lever (Fig. 3).

4. Operation

4.1 Assembly of the apparatus

- Slide the scale holder with the scale itself to the middle of the stand rod and secure it in place with a screw.
- Set up the stand rod on the stand base and secure it in place with the screw.
- Attach the holder with the ball bearing to the stand rod and secure it in place with its screw.
- Attach the pointer to the lever arm.
- Attach the lever arm and pointer to the lever arm attachment using the knurled nut.
- Adjust the scale such that the end of the pointer is aligned with the bottom of the scale markings.
- Slide the balance weight along the arm to make sure the arm is balanced.

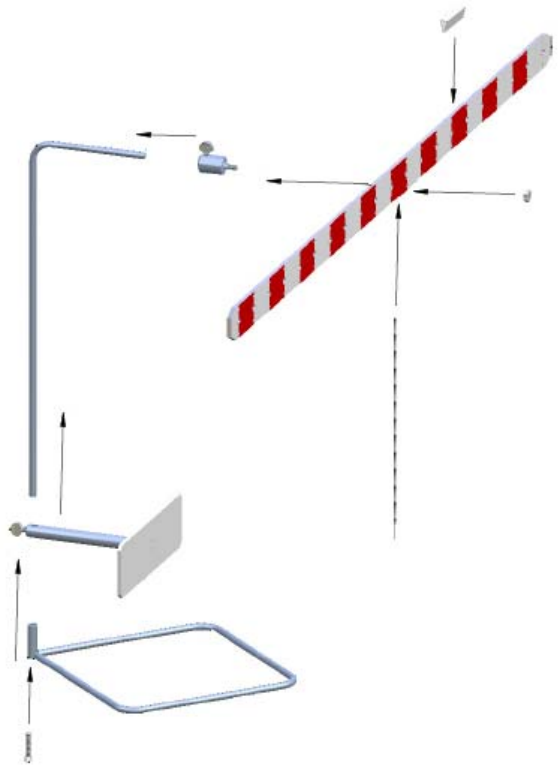


Fig. 1 Assembly of the lever

5. Sample experiments

5.1 Verify the law of levers using the two-arm lever

- Fasten the lever arm in the middle of the ball bearing.
- Hang 5 50 g weights (each approx. 2.5 N) on the left side of the lever arm in the third bore hole from the center.
- Hang 3 50 g weights (each approx. 1.5 N) on the right side of the lever arm in the fifth bore hole from the center.

The lever is in a state of equillibrium.

- Repeat the experiment using other weight combinations.

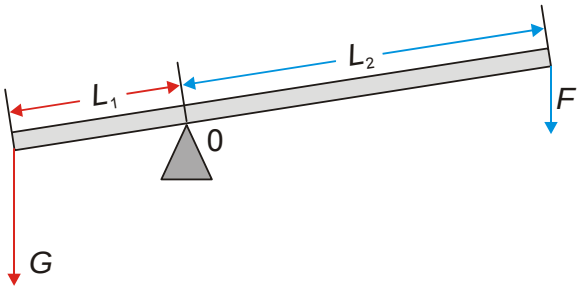


Fig. 2 Two-arm lever

5.2 Verify the law of levers using the single-arm lever

Additionally required:

One dynamometer 2 N, 5 N and 10 N each (e.g. 1003105/1003106/100317)

- Fasten the lever arm to the ball bearing in the last bore hole.
- Hang 5 50 g weights (each approx. 2.5 N) on the right side of the lever arm at the location of force *G*.
- Instead of force *F* deploy a dynamometer.
- Bring the lever into a state of equillibrium and then note down the force registered at the dynamometer.

In this experiment the weight of the lever arm must be taken into consideration (0.458 kg corresponds to 4.49 N).

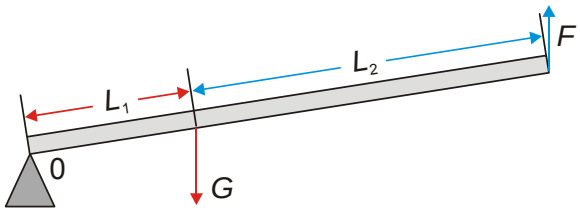


Fig. 3 Single-arm lever