Composition of forces having the same line of application (Item No.: P1252200)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 7-10
Topic: Mechanik
Subtopic: Kräfte, einfache Maschinen
Experiment: Zusammensetzung von Kräften mit gleicher Wirkungslinie

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	1 Student

Additional Requirements:

Experiment Variations:

Keywords:

Principle and equipment

Principle

Demonstrate how forces which have the same line of application and the same or opposite direction are composed.

Equipment

Position No.	Material	Order No.	Quantity
1	Demo Physics board with stand	02150-00	1
2	Torsion dynamometer	03069-03	2
3	Scale for demonstration board	02153-00	1
4	Pointers f. Demonst.Board, 4 pcs	02154-01	1
5	Weight holder for slotted weights	02204-00	1
6	Slotted weight, black, 10 g	02205-01	2
7	Slotted weight, silver bronze, 10 g	02205-02	2
8	Slotted weight, black, 50 g	02206-01	1
9	Slotted weight, silver bronze, 50 g	02206-02	2
10	Marker, black	46402-01	1

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Set-up and procedure

Set-up

Procedure

Observation and evaluation

Observation

Observation 1

1. F_G = 2 N
2. F_2 = 0.5 N
3. F_1 = 1.5 N

Observation 2

1. F_G = 2 N
2. F_2 = 1.5 N
3. F_1 = 3.5 N

Evaluation

Evaluation 1

A comparison of forces shows that an upward force resulting from the addition of $\overrightarrow{F_1}$ und $\overrightarrow{F_2}$ balances the weight $\overrightarrow{F_G}$. This force is termed the resultant force $\overrightarrow{F_R}$. Therefore, the following is true:

$$\overrightarrow{F_R} = \overrightarrow{F_1} + \overrightarrow{F_2} \ .$$

and in this special case F_R balances F_G:

$$F_R = F_1 + F_2 = F_G \ .$$

Forces on the same line of action which are oriented in the same direction can be combined by adding their values.

Evaluation 2

The comparison of the forces in this case results in the following:

$$F_R = F_1 - F_2 = F_G \ .$$

Forces on the same line of action which are oriented in opposite directions can be combined by subtracting one value from the other.

Remarks

Forces are vectorial quantities. If two forces act simultaneously on one point, then the following is true:

$$\overrightarrow{F_R} = \overrightarrow{F_1} + \overrightarrow{F_2}$$

The resultant force is determined graphically by superimposing the force vectors (arrows) on each other and in the experimentally determined cases one calculates their magnitude by adding or subtracting the magnitude of the components $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$.

As a result of the relationship $102 = 1N$, the given measured values have an inaccuracy of 2%. This degree of accuracy is however sufficiently exact for this experiment.

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