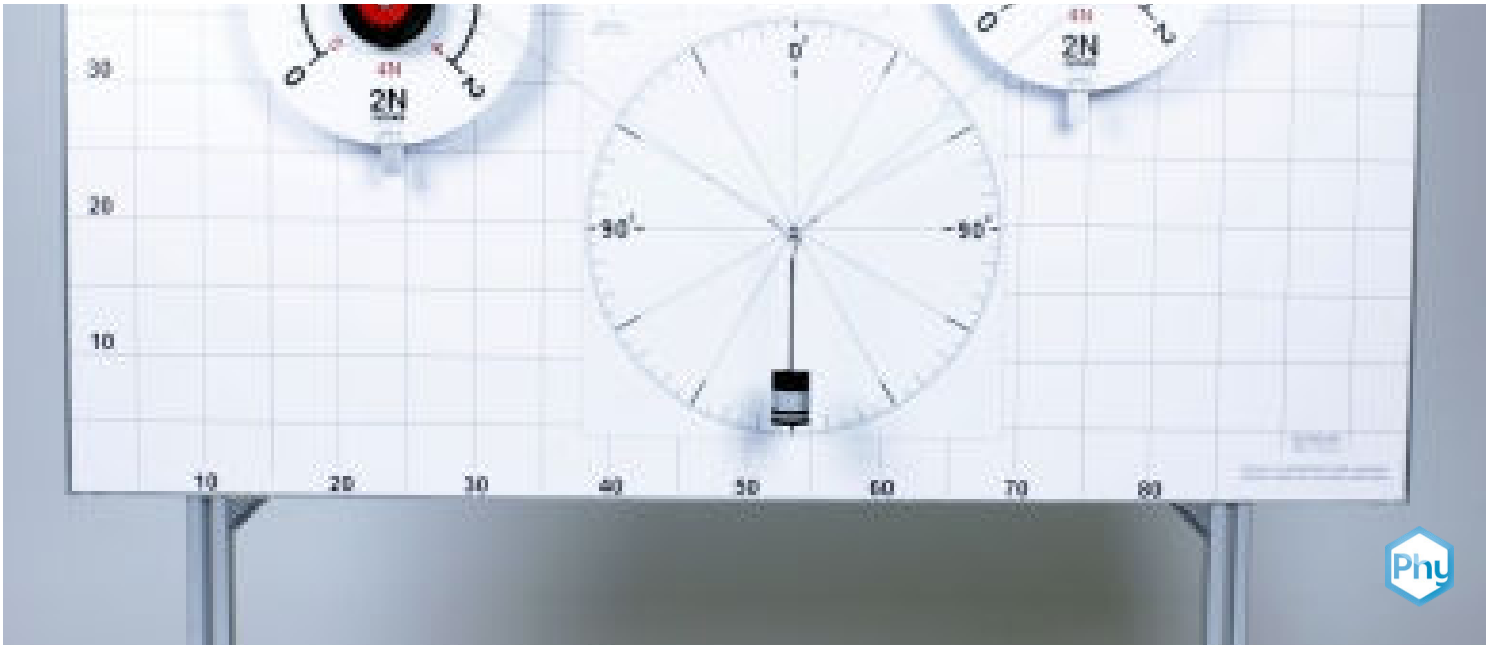
# Resolution of a force into two non-parallel forces




P1252400

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/6613abea022b2b0002625218

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# General information

## Application

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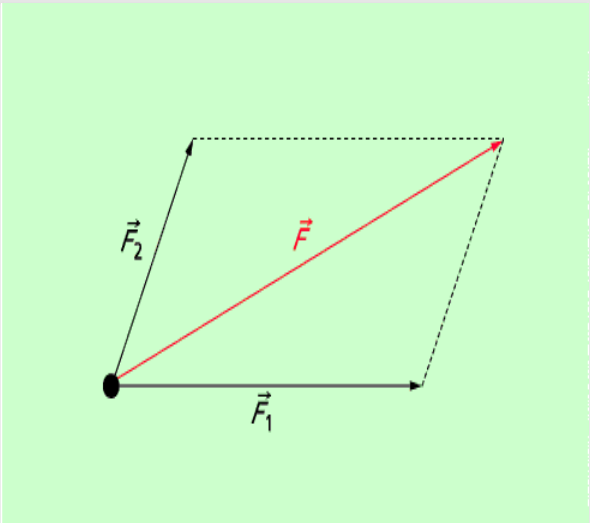


Fig. 1: Resolution of forces

The resolution of forces refers to the decomposition of a single force into at least two partial forces acting in different directions.

In this experiment, a force is divided into two partial forces whose lines of action intersect.

These forces can be determined by drawing or calculation.



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## Further information (1/2)

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**Prior knowledge**

No prior knowledge required.

**Principle**

The aim is to demonstrate that a force can be divided into two forces whose lines of action intersect.

## Further information (2/2)

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**Learning objective**

Through the experiment, the students are supposede to learn that a force can be broken down into partial forces or components if the direction of the components is known and how they can be calculated by the construction of a force parallelogram.

**Tasks**

The students are supposed to carry out observations and measurements in order to be able to determine both decomposed forces.



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# Safety instructions

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



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# Equipment

| Position | Equipment | Item no. | Quantity |
|---|---|---|---|
| 1 | PHYWE Demo Physics board with stand | 02150-00 | 1 |
| 2 | Torsion dynamometer | 03069-03 | 2 |
| 3 | Scale for demonstration board | 02153-00 | 1 |
| 4 | Weight holder 10g | 02204-01 | 1 |
| 5 | Slotted weight, silver-bronze, 10 g | 02205-03 | 1 |
| 6 | Slotted weight, silver-bronze, 10 g | 02205-03 | 1 |
| 7 | Slotted weight, silver-bronze, 50 g | 02206-03 | 1 |
| 8 | Slotted weight, silver-bronze, 50 g | 02206-03 | 1 |
| 9 | Optical disk, magnet held | 08270-09 | 1 |
| 10 | Fish line, l. 100m | 02090-00 | 1 |
| 11 | Screw clamp | 02014-00 | 2 |



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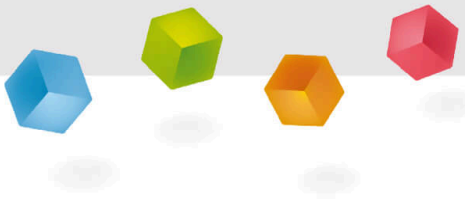

# Setup and procedure

## Set up (1/2)

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- Place the dynamometer on the demo board and adjust it.
- Make a small loop with the fish line and attach it to the weight holder.
- Attach the weight holder with slotted weights (2 x 10 g, 2 x 50 g) to the dynamometer.
- Measure and note the displayed force $\vec{F}$



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## Set up (2/2)

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- Put the second dynamometer on as well, adjust it and hook in its pull cord at the point of force application $\vec{F}$.
- Move both dynamometers so that the pull cords form an arbitrary angle with each other.
- Place the optical disc so that its centre is behind the point of force application (Fig. 2).

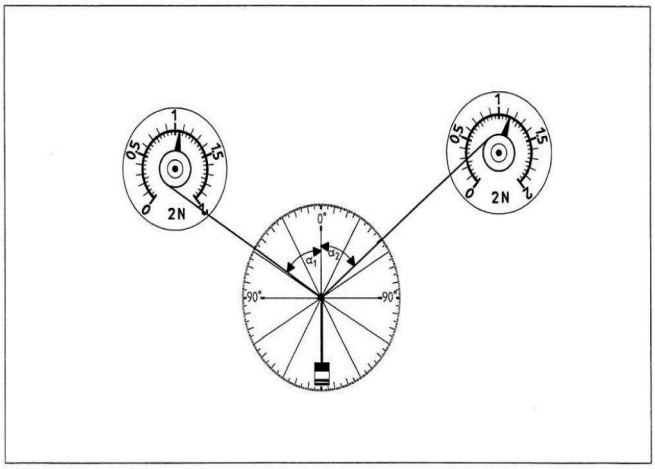


Fig.2: Force resolution with two dynamometers

## Procedure

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- Read the values displayed by the dynamometers for F1 and F2 and measure the angles α1 and α2, which are constructed by $\vec{F_1}$ and $\vec{F_2}$ and the perpendicular of the optical disc, and note the results in Table 1.
- Change the position of the dynamometers several times and determine the respective values F1 and F2 as well as the corresponding α1 and α2 (including the case α1 + α2 = 90°).
- Before each measurement, ensure that the point of force application is above the centre of the optical disc and note the measured values in Table 1.
- Remove both dynamometers using the optical disc and the scale and construct the force parallelogram for one of the cases examined using the dry-erase marker on the demo board (Fig. 2).

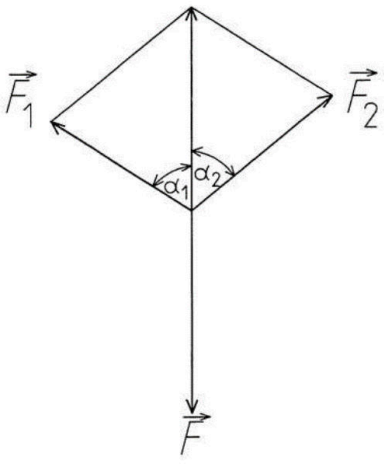


Fig. 3: Force parallelogram



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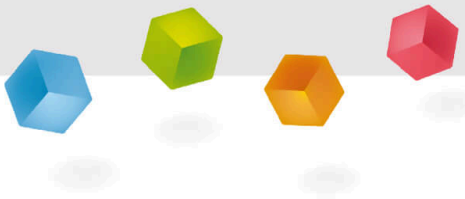

# Evaluation

## Evaluation (1/3)

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The sum of the amounts of $\vec{F_1}$ and $\vec{F_2}$ is always greater than the magnitude of the force to be decomposed $\vec{F}$ and the greater the angle α1 + α2 enclosed by them.

$\vec{F_1}$ and $\vec{F_2}$ in any case together produce the same effect as the force $\vec{F}$. They are referred to as components of $F$.

$F = 1{,}3N$

Tabelle 1 (Messbeispiel)

| $F_1/N$ | $F_2/N$ | $\alpha_1/1^\circ$ | $\alpha_2/1^\circ$ | $(F_1+F_2)/N$ | $(\alpha_1+\alpha_2)/1^\circ$ |
|---|---|---|---|---|---|
| 1,06 | 1,14 | 58 | 51 | 2,20 | 109 |
| 0,66 | 1,11 | 60 | 30 | 1,77 | 90 |
| 1,53 | 1,25 | 52 | 75 | 2,78 | 127 |
| 0,78 | 0,79 | 36 | 33 | 1,57 | 69 |



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## Evaluation (2/3)

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You can determine $\vec{F_1}$ and $\vec{F_2}$ by drawing their lines of action and the force $\vec{F}$ and thus construct a force parallelogram whose diagonal is $\vec{F}$. The components $\vec{F_1}$ and $\vec{F_2}$ then form the sides of the parallelogram.

A force can be divided into components whose lines of action intersect at the point of force application. The components can be determined by drawing or calculation.

In this experiment, the weight holdert with slotted weights is selected to specify a force that is broken down into components. A coil spring that is deflected by a certain distance is also suitable for specifying the force. In this case, the position of the optical disc, the centre of which marks the end of the extended spring, should not be changed.

## Evaluation (3/3)

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It is recommended that the students construct the force parallelogram for themselves simultaneously to the teacher drawing it on the demo board.

The special case α1 + α2 = 90° is provided so that the students can check the measurement results mathematically using an example even without knowledge of trigonometry.

Another task could be to check the remaining measurements on the drawing. It is not absolutely necessary to record an exact series of measurements for this experiment. You can also make do with a single measurement of F1, F2, α1 and α2 and quadruple the values to obtain the force parallelogram.

In this case qualitative proof should be provided that the components can include any angle and have different resulting amounts.



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## Task 1

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Fill in the blanks.

The sum of the amounts of $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ is always [ ] than the magnitude of the force to be decomposed $\vec{F}$ and the [ ] the angle [ ] enclosed by them.

Check

| Slide | Score / Total |
|---|---|
| Slide 15: Decomposition of forces | 0/3 |

**Total score** 0 / 3

Show solutions Repeat



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