# Forces on a pulley mounting (Item No.: P0999700)

## Curricular Relevance

**Area of Expertise:** Physik
**Education Level:** Klasse 7-10
**Topic:** Mechanik
**Subtopic:** Kräfte, einfache Maschinen
**Experiment:** Zerlegung der Kräfte auf einer geneigten Ebene

| Difficulty | Preparation Time | Execution Time | Recommended Group Size |
|---|---|---|---|
| Intermediate | 10 Minutes | 10 Minutes | 2 Students |

**Additional Requirements:**

- Scissors
- Protractor sheet, copy

**Experiment Variations:**

**Keywords:**

## Task and equipment

## Information for teachers

## Additional Information

The students should

1. With the aid of a pulley deflect a weight (force) and measure the resultant force $F_r$ acting on the mounting of the pulley.
2. Change the angle α between the weight (force) $F_g$ and the deflected force $F_1$ and once again determine the resultant force.

In a supplementary problem the students who are familiar with the trigonometric functions should calculate the resultant force $F_r$ using $F_1$, $F_g$ and the angle α.
The protractor sheet (circle with angular divisions) which is required for the evaluation is provided as a master which can be copied. The xerox copies should be given to the students before they begin the experiment.


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## Task and equipment

### Task

### What forces act on a deflection pulley?

With the aid of a pulley a weight (force) is deflected and the resultant force acting on the mounting of the pulley is measured. The angle between the weight (force) and the deflected force is changed and once again the resultant force is measured.

### Equipment

# Set-up and procedure

## Set-up

## Procedure

- Load the weight holder with 3 mass pieces ($m_{tot.}$ = 40 g) and align the 2 N spring balance so that it is exactly horizontal (Fig. 9).
- Be sure that the mass is suspended and that the line can move freely.
- For hanging the slotted weight up the weight holder, you should slip the slotted weight over the top of the weight holder (Fig. 10).

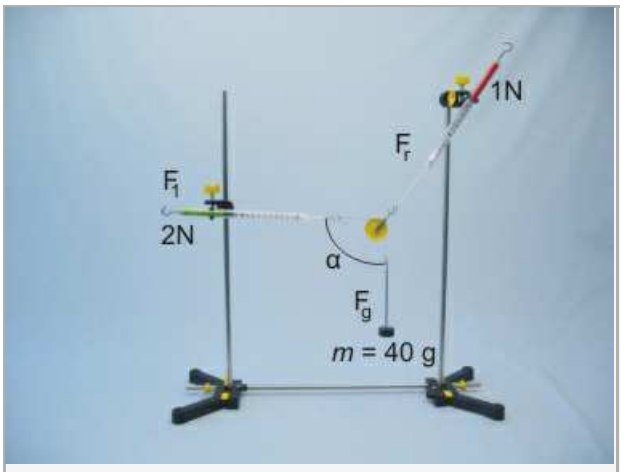

Fig. 9

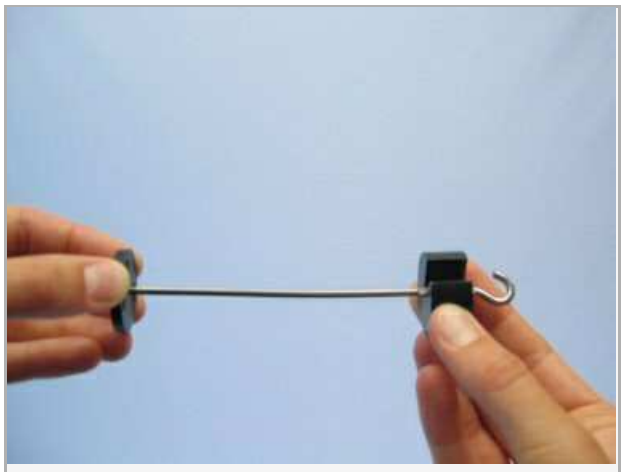
Fig. 10

- Read both spring balances and record the measured values for the deflected force $F_1$ and the resultant force $F_r$ on the pulley (α = 90°).
- Change the angle α between the weight (force) $F_g$ and $F_1$ by, first, moving the holder of the 2 N spring balance to the top of and, then, to the bottom of its support rod. Set the angles as nearly as possible to the values in Table 1 in the report.
- In each position hold the protractor sheet so that its center is at the intersection of the two force axes.
- For each position, i.e. every angle α, read the forces $F_r$ and $F_1$ and record the values in Table 1, too.

Fig. 11: Example for measuring α = 90°.

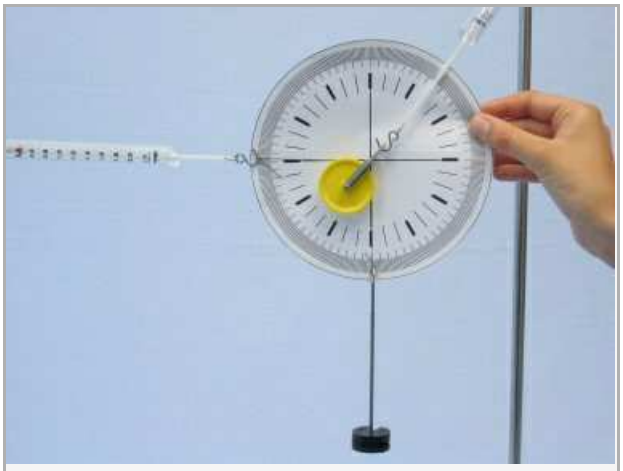
Fig. 11

Fig. 12: Overview of the experimental setup for α = 120°.

Fig. 12

Example for measuring α = 70° (Fig. 13 and Fig. 14).

Fig. 13

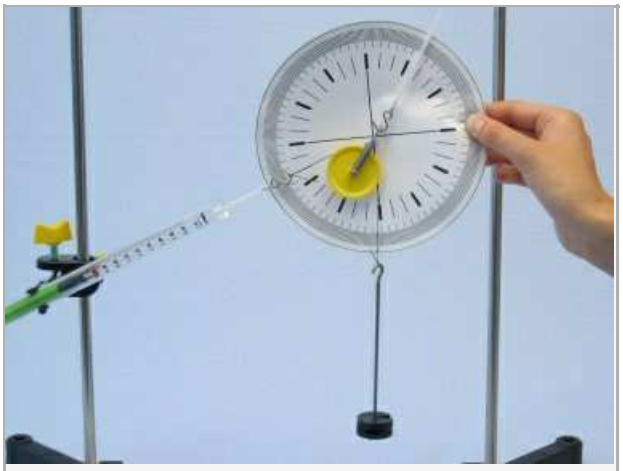

Fig. 14

Remove the 2 N spring balance from its holder and pull it downward, parallel to $F_g$ (α = 0°) (Fig. 15). Record these in Table 1.

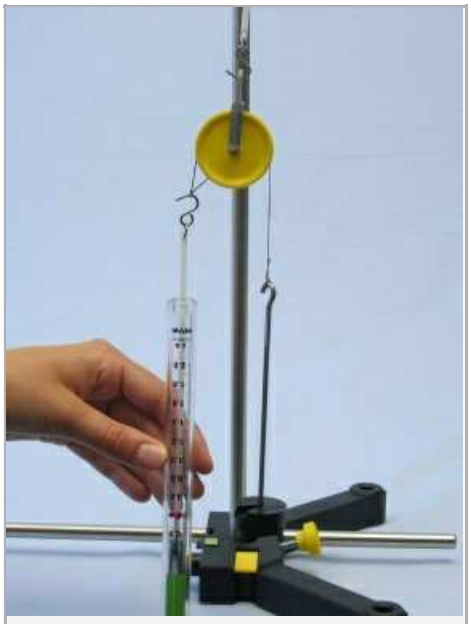

Fig. 15



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# Report: Forces on a pulley mounting

## Results – Table 1

Record all the measured values in Table 1.

| angle α in ° | $F_1$ in N | $F_r$ in N |
|---|---|---|
| 90 | 1 ±0 | 1 ±0 |
| 120 | 1 ±0 | 1 ±0 |
| 105 | 1 ±0 | 1 ±0 |
| 70 | 1 ±0 | 1 ±0 |
| 50 | 1 ±0 | 1 ±0 |
| 0 | 1 ±0 | 1 ±0 |

## Evaluation – Question 1

Calculate the weight (force) $F_g$ from the mass $m$ and record the value in the input box.

$F_g$ = ..... N

## Evaluation – Question 2

Compare the measured values for the forces $F_r$ and $F_g$. Are they equal? Which is larger?

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## Evaluation – Question 3

Do you have to consider the weight of the pulley?

## Evaluation – Question 4

How large is it? Measure it with a spring balance.

## Evaluation – Question 5

For which of the angles α is the force $F_r$ the largest?

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## Evaluation – Question 6

For which angle is it the smallest?

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## Evaluation – Question 7

How do you explain this?

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## Auswertung - Frage 8

Draw the force parallelograms for the angles 70° and 120° on a separate sheet of paper. Determine the resultant force $F_r$ from them and compare it with the measured results in the Table. Decide on a suitable scale before you begin drawing, e.g. 1 N corresponds to 10 cm.



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## Evaluation – Additional Task 1

Calculate $F_r$ for 3 angles α with the formula mentioned above using the two forces $F_1$ and $F_g$:

| α | 120° | 50° | 0° |
|---|---|---|---|
| $F_r$ in N | 1 ±0 | 1 ±0 | 1 ±0 |

## Evaluation – Additional Task 2

Compare these results with your measured values! What do you notice?

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## Evaluation – Additional Task 3

What does the force parallelogram look like for α = 90° when you consider the weight (force) of the pulley? Sketch this parallelogram on the scribble.



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